

IROAST

International Research Organization
for Advanced Science & Technology

Annual Report 2019

Kumamoto University

Annual Report 2019

International Research Organization for Advanced Science and Technology
Kumamoto University

Contents

Preface 1

IROAST Members 2

Operation and Management of IROAST 11

1. IROAST Steering Committee Activities 11
2. IROAST Research Support Programs 11
3. Statistics for IROAST Research Activities 12

Research Activities 15

1. IROAST Researchers 15
2. Distinguished Professors 35
3. Young Faculty Members for International Joint Research 51
4. Visiting Professors 63
5. Research Units 95
6. Researchers Supported by the IROAST International Joint Research Travel Support Program 157
7. Internship Researchers 173

IROAST Symposiums 211

IROAST Seminars 227

Agreement & Memorandum of Understanding 271

IROAST Researcher Publications 277

International Collaborative Publications from IROAST Visiting Professors and their Host Professors 284

External Funds 287

Publications Supported by the IROAST Publication Support Program 289

Regulations, Guidelines and Rules of IROAST 291

Preface



The International Research Organization for Advanced Science and Technology (IROAST), which opened in April of 2016, is one of the Centers of Excellence in Kumamoto University and promotes world class, cutting-edge research in science and technology. It features a standardized international research environment with several established global collaborations and utilizes a tenure track based personnel system.

We have been vigorously promoting our partnership with the International Collaborative Research Group for Science and Technology, which opened in Kumamoto University in 2013 and closed at the end of March 2018. All of the group members are still working as IROAST's adjunct researchers and are collaborating on international research projects with IROAST faculty and our visiting professors.

The aims of IROAST are the further promotion of international collaborations to establish international research networks in the following four advanced areas of science and technology: Nano Material Science, Green Energy, Environmental Science and Advanced Green Bio, in parallel with the development of young excellent researchers, promotion of ongoing cutting-edge research projects, and initiation of innovative interdisciplinary research projects.

To achieve these goals, we will promote the international partnership with overseas universities and institutions. The ultimate goal of IROAST is to be fully and globally recognized as a hub of world-class, cutting-edge research networks through the international brain circulations.

By the end of the fiscal year of 2019, the global outbreak of new coronavirus (COVID-19) has produced an enormous number of confirmed cases and deaths. We would like to give our sincere gratitude to all the healthcare professionals for their tremendous effort fighting against the virus in this pandemic. It will definitely take some time to conquer COVID-19, but we patiently continue to improve the situation and protect our family and all the others in society.



Dr. HIYAMA Takashi, Professor Emeritus
Distinguished Professor
Director of International Research Organization for
Advanced Science and Technology (IROAST)
Kumamoto University, JAPAN
E-mail: hiyama@cs.kumamoto-u.ac.jp
URL: http://www.cs.kumamoto-u.ac.jp/hiyama/

IROAST Members

Director / Vice-Director



Takashi Hiyama



Jun Otani

Distinguished Professors



Jorge Norberto Beltramini



Konstantinos Kontis



László Pusztai



Yufeng Zheng

Tenure-track Professor / Associate Professors / Assistant Professor



Mitsuhiro Aida



Takumi Higaki



Ruda Lee

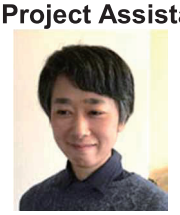


Atsushi Sainoki



Takashi Ishida

Project Assistant Professor/ Postdoctoral Researchers



Akiko Nakamasu



Minwoo Kim



Adam Karl Schwartzkopff

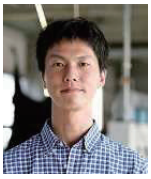


Mizuki Yamada

Young Faculty Members for International Joint Research



Takahiro Hosono
FAST



Kei Ishida
FAST



Makoto Kumon
FAST



Mizue Munekata
FAST



Yuta Nakashima
FAST



Masayuki Tanabe
FAST

Visiting Professors



U Rajendra Acharya
Ngee Ann Polytechnic
Singapore



José E. Andrade
California Institute of Technology
USA



Josep-Lluís Barona-Vilar
University of Valencia
Spain



Olivier Boutin
Aix Marseille University
France



Paul Bowen
The University of Birmingham
UK



Pierre Breul
University of Clermont Auvergne
France



Maria Jose Cocero
The University of Valladolid
Spain



Marc de Boissieu
SiMAP, CNRS, Université Grenoble Alpes
France



Patrice Delmas
The University of Auckland
New Zealand



Martin Dienwiebel
Karlsruhe Institute for Technology
Germany



Martino Di Serio
University of Naples Federico II
Italy



Derek Elsworth
The Pennsylvania State University
USA



Carolina Escobar
University of Castilla La Mancha
Spain



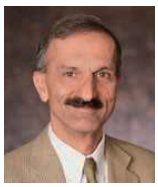
Amir A. Farajian
Wright State University
USA



Etsuko Fujita
Brookhaven National Laboratory
USA



Tomonari Furukawa
University of Virginia
USA



Hamid Ghandehari
University of Utah
USA



Olivier Hamant
INRA, RDP, ENS Lyon
France



Christian Hardtke
University of Lausanne
Switzerland



Jens Hartmann
Universität Hamburg
Germany



Yang Kim
Kosin University
Republic of Korea



Alexei Kuzmin
Institute of Solid State Physics, University of Latvia
Latvia



Ick Chan Kwon
Dana Farber Cancer Institute, Harvard Medical School
USA
and
Korea Institute of Science and Technology
Republic of Korea



Pavel Lejček
Academy of Sciences of the Czech Republic
and
University of Chemistry and Technology, Prague
Czech Republic



Viren Ivor Menezes
Indian Institute of Technology Bombay
India



Matthieu Micoulaut
Sorbonne University
France



Dmitri Aleks Molodov
RWTH Aachen University
Germany



Rahul Raveendran Nair
The University of Manchester
UK



Reiko Oda
CNRS, University of Bordeaux
France



Shie-Ming Peng
National Taiwan University
Taiwan



Ramesh S. Pillai
University of Geneva
Switzerland



Zoran Ren
University of Maribor
Slovenia



Christian Rentenberger
University of Vienna
Austria



Shirley Shen
Commonwealth Scientific and Industrial Research Organisation
Australia



Gioacchino Viggiani
Université Grenoble Alpes
France



Thomas Waitz
University of Vienna
Austria



Andrew Whittle
Massachusetts Institute of Technology
USA



Zhenghe Xu
Southern University of Science and Technology
China
and
University of Alberta
Canada



Firuz Zare
The University of Queensland
Australia

Visiting Associate Professors



Tomoyasu Mani
University of Connecticut
USA



Daniel P. Zitterbart
Woods Hole Oceanographic Institution
USA

Distinguished Professors (4)

Name	Period of Appointment	Affiliation
Jorge Norberto Beltramini	October 1, 2019- March 31, 2020	Adjunct Professor-Catalysis for Clean Energy Group Leader, Center for Tropical Crops & Bio-Commodities- Faculty of Science &Engineering, Queensland University of Technology (QUT), Australia
Konstantinos Kontis	November 1, 2018-	Professor, Head of the Aerospace Sciences Division, Sir Henry Mechan Chair of Engineering, School of Engineering, University of Glasgow, UK
László Pusztai	April 1, 2017-	Scientific Advisor, Wigner Research Centre for Physics, Hungarian Academy of Science, Hungary
Yufeng Zheng	May 1, 2017-	Professor, Department of Materials and Engineering, College of Engineering, Peking University, China

Tenure-Track Professor/Associate Professors/Assistant Professor (5)

Name	Period of Appointment	Former Affiliation
Mitsuhiro Aida Professor	July 1, 2017-	Postdoctoral Researcher Department of Applied Biological Science, Tokyo University of Science PhD: Kyoto University (1999)
Takumi Higaki Associate Professor	August 1, 2017-	Research Associate Professor Graduate School of Frontier Sciences, The University of Tokyo PhD: The University of Tokyo (2009)

Ruda Lee Associate Professor	January 1, 2017-	Postdoctoral Researcher Department of Dr.ug Discovery and Development, Instituto Italiano Di Technologia, Italy PhD: Korea University, Korea (2013)
Atsushi Sainoki Associate Professor	January 1, 2017-	Postdoctoral Researcher Mine Design Laboratory, McGill University, Canada PhD: McGill University, Canada (2014)
Takashi Ishida Assistant professor	June 1, 2016-	Postdoctoral Researcher Graduate School of Science and Technology, Kumamoto University PhD: Nara Institute of Science and Technology (2007)

Project Assistant Professor (1)

Name	Period of Appointment	Former Affiliation
Akiko Nakamasu Higaki Laboratory	November 1, 2019- (Postdoctoral Researcher December 1, 2017- October 30, 2019)	Research Assistant Professor Faculty of Medical Science, Kyushu University PhD: Ochanomizu University (2010)

Postdoctoral Researchers (3)

Name	Period of Appointment	Former Affiliation
Minwoo Kim Lee Laboratory	June 1, 2018- February 29, 2020	PhD: Yonsei University, Korea (2018)
Adam Karl Schwartzkopff Sainoki Laboratory	July 1, 2017-	Casual Lecturer/ Course Coordinator The University of Adelaide, Australia PhD: The University of Adelaide, Australia (2016)
Mizuki Yamada Aida Laboratory	October 1, 2019-	Researcher Institute of Vegetable and Floriculture Science, National Agriculture and Food

		Research Organization PhD: Niigata University (2014)

Young Faculty Members for International Joint Research (6)

Name	Period of Appointment	Partner University/Institution
Takahiro Hosono Associate Professor FAST	June 1, 2019- March 31, 2022	Department of Earth and Planetary Science, University of California, Berkeley, USA
Kei Ishida Assistant Professor FAST	June 1, 2019- March 31, 2022	McGill University, Canada University of California, Davis, USA
Makoto Kumon Associate Professor FAST	April 1, 2018- March 31, 2021	Virginia Polytechnic Institute and State University, USA University of Virginia, USA
Mizue Munekata Associate Professor FAST	April 1, 2019 March 31, 2022	German Aerospace Center, Germany Institute of Aerodynamics and Flow Technology, Germany
Yuta Nakashima Associate Professor FAST	December 1, 2019- March 31, 2022	The Children's Hospital of Philadelphia, USA University of Pennsylvania, USA
Masayuki Tanabe Assistant Professor FAST	June 1, 2019- March 31, 2021	Department of Biomedical Engineering and Radiology, Columbia University, USA School of Engineering, Ngee Ann Polytechnic, Singapore

Visiting Professors (39)

Name	Affiliation	Host Professor
U Rajendra Acharya	Senior faculty member Ngee Ann Polytechnic, Singapore	**Makiko Kobayashi** FAST
José E. Andrade	Professor California Institute of Technology, USA	**Jun Otani** FAST
Josep-Lluís Barona-Vilar	Professor University of Valencia, Spain	**Makoto Takafuji** FAST
Olivier Boutin	Professor Deputy Director M2P2, Director Master Chemical Engineering Aix Marseille University, France	**Mitsuru Sasaki** IPPS

Paul Bowen	Deputy Pro-Vice-Chancellor and Feeney Professor of Metallurgy The University of Birmingham, UK	**Kazuki Takashima** FAST
Pierre Breul	Professor University of Clermont Auvergne, France	**Jun Otani** FAST
Maria Jose Cocero	Professor The University of Valladolid, Spain	**Tetsuya Kida** FAST
Marc de Bossieu	Director SiMAP, CNRS, Université Grenoble Alpes, France	**Shinya Hosokawa** FAST
Patrice Delmas	Associate Professor The University of Auckland, New Zealand	**Toshifumi Mukunoki** FAST
Martin Dienwiebel	Professor Karlsruhe Institute for Technology, Germany	**Kazuki Takashima** FAST
Martino Di Serio	Professor University of Naples Federico II, Italy	**Shinya Hayami** FAST
Derek Elsworth	Professor The Pennsylvania State University, USA	**Atsushi Sainoki** IROAST
Calolina Escobar	Assistant Professor University of Castilla La Mancha, Spain	**Shinichiro Sawa** FAST
Amir A. Farajian	Associate Professor Wright State University, USA	**Hamid Hosano** IPPS
Etsuko Fujita	Senior Chemist Brookhaven National Laboratory, USA	**Yutaka Kuwahara** FAST
Tomonari Furukawa	Professor University of Virginia, USA	**Makoto Kumon** FAST
Hamid Ghandehari	Professor University of Utah, USA	**Hamid Hosano** IPPS
Olivier Hamant	Research Director INRA in the Plant Reproduction and Development Laboratory, ENS Lyon, France	**Shinichiro Sawa** FAST

Christian Hardtke	Professor University of Lausanne, Switzerland	**Shinichiro Sawa** FAST
Jens Hartmann	Professor Universität Hamburg, Germany	**Takahiro Hosono** FAST
Yang Kim	Professor Emeritus Kosin University, Republic of Korea	**Shinya Hayami** FAST
Alexei Kuzmin	Leading Researcher, Full Member of the Latvian Academy of Science Institute of Solid State Physics, University of Latvia, Latvia	**Laszlo Pusztai** IROAST
Ick Chan Kwon	Presidential Scholar Dana Farber Cancer Institute, Harvard Medical School, USA/ Principal Research Scientist Korea Institute of Science and Technology, Republic of Korea	**Takuro Niidome** FAST
Pavel Lejček	Professor Academy of Sciences of the Czech Republic/ University of Chemistry and Technology, Prague, Czech Republic	**Sadahiro Tsurekawa** FAST
Viren Ivor Menezes	Professor Indian Institute of Technology Bombay, India	**Hamid Hosano** IPPS
Matthieu Micoulaut	Professor Sorbonne University, France	**Shinya Hosokawa** FAST
Dmitri Aleks Molodov	Professor RWTH Aachen University, Germany	**Sadahiro Tsurekawa** FAST
Rahul Raveendran Nair	Professor The University of Manchester, UK	**Shinya Hayami** FAST
Reiko Oda	Senior Principal Investigator CNRS, University of Bordeaux, France	**Makoto Takafuji** FAST
Shie-Ming Peng	Distinguished Research Professor National Taiwan University, Taiwan	**Shinya Hayami** FAST

Ramesh S. Pillai	Professor University of Geneva, Switzerland	**Tokio Tani** FAST
Zoran Ren	Professor University of Maribor, Slovenia	**Kazuyuki Hokamoto** IPPS
Christian Rentenberger	Associate Professor University of Vienna, Austria	**Mitsuhiro Matsuda** FAST
Shirley Shen	Principal Research Scientist Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	**Kazuki Takashima** FAST
Gioacchino Viggiani	Professor Université Grenoble Alpes, France	**Jun Otani** FAST
Thomas Waitz	Associate Professor University of Vienna, Austria	**Mitsuhiro Matsuda** FAST
Andrew Whittle	Professor of Civil & Environmental Engineering Massachusetts Institute of Technology (MIT), USA	**Jun Otani** FAST
Zhenghe Xu	Professor Southern University of Science and Technology, China/ Professor University of Alberta, Canada	**Makoto Takafuji** FAST
Firus Zare	Professor The University of Queensland, Australia	**Hamid Hosano** IPPS

Visiting Associate Professors (2)

Name	Affiliation	Host Professor
Tomoyasu Mani	Assistant Professor University of Connecticut, USA	**Yutaka Kuwahara** FAST
Daniel P. Zitterbart	Assistant Professor Woods Hole Oceanographic Institution, USA	**Kei Toda** FAST

FAST: Faculty of Advanced Science and Technology, Kumamoto University
IPPS: Institute of Pulsed Power Science, Kumamoto University

Operation and Management of IROAST

1. IROAST Steering Committee Activities

We held our IROAST Steering Committee meetings 10 times in the academic year of 2019 to discuss and determine varieties of regulations and agenda items required for successful operation and management of IROAST. We have enacted 13 regulations and rules so far, and they are listed at the end of this Annual Report. The committee has approved the adoption of many researchers participating in the IROAST research support programs below.

2. IROAST Research Support Programs

We have several research support programs running in parallel to promote internationally collaborated research programs with an aim to configure international joint research networks and offer/gain benefit from the brain circulation around the world.

IROAST Young Faculty Members for International Joint Research

We select young excellent faculty members from the Faculty of Advanced Science and Technology, the Institute of Pulsed Power Science, the Magnesium Research Center and the Center for Water Cycle, Marine Environment and Disaster Management and invite them to IROAST for three years to give them opportunities to conduct international joint research at overseas universities and institutions for at least one year in total.

IROAST International Joint Research Travel Support

We select excellent faculty members from the Faculty of Advanced Science and Technology, the Institute of Pulsed Power Science, the Magnesium Research Center and the Center for Water Cycle, Marine Environment and Disaster Management and send them to overseas universities and institutions to conclude MOUs to promote their international joint research and/or to perform their joint research there.

IROAST Visiting Professor and Visiting Professor Candidate Invitation

We invite our Visiting Professors and candidates for Visiting Professors to IROAST to promote the joint research with their host researchers toward the configuration of international joint research networks and to open international seminars to attract young researchers including graduate students into the cutting-age research activities.

IROAST Research Award (for IROAST faculty members only)

We select and award excellent and powerful IROAST faculty members at the end of every academic year to appreciate their research activities.

IROAST Proofreading/Publication Support

We give financial support for proofreading/publication to IROAST-affiliated researchers to increase the number of publications from the Kumamoto University science and technology

fields.

IROAST Research Internship Program

We provide hands-on research opportunities for highly motivated undergraduate/graduate students and young postdoctoral researchers who have interests in advanced scientific research.

IROAST Symposiums

We invite keynote speakers from overseas and domestic universities to hold international symposiums two to three times a year.

IROAST Seminars

International researchers invited through the IROAST Visiting Professor and Visiting Professor Candidate Invitation program above give talks in the IROAST Seminars organized by their host professors.

3. Statistics for IROAST Research Activities

The following tables indicate several indices to evaluate our research activities.

◆ Indices for Self-evaluation of IROAST Research Activities

Indices for Self-Evaluation **(Numerical Target)**	2016	2017	2018	**2019**
Number of Papers **(30 papers per year)**	13	26	46	**44**
Rate of Internationally Collaborated Papers **(~80%~)**	84.6%	88.5%	80.0%	**81.9%**
Rate of Top 10% Papers **(~20%~)**	0%	15.4%	9.3%	**13.0%**
Field Weighted Citation Index **(>1.1)**	0.85	1.33	1.13	**1.71**
Number of Concluded MOU **(>20 for the first term)**	3	8	13	**16**
Number of Visiting Professors **(~40~)**	18	26	37	**40**
Number of Distinguished Professors **(4)**	0	2	3	**4**
Number of International Symposia including KU-KAIST Joint Symposium **(>1)**	1	1	5 (3+2)	**3 (2+1)**
Number of International Seminars including IROAST&IRCMS Joint Seminars **(~20~)**	8	20 (19+1)	23 (22+1)	**20 (18+2)**
Number of Invited Researchers **(~25~)**	9	25	28	**22**
Number of Researchers Visiting Overseas Universities and Institutions **(~20~)**	5	21	18	**15**
Number of Internship Students	–	–	3	**13**

Category of Researchers (2019)	2016 (2016.1.1～2016.12.31)	2017 (2017.1.1～2017.12.31)	2018 (2018.1.1～2018.12.31)	**2019 (2019.1.1～2019.12.31)**	**2020 (2020.1.1～2020.4.23)**
Tenure-track Researcher (5)	2	10	13	**18**	**16***
Distinguished Professor (4) (Papers with the affiliation of IROAST)	—	2	6	**6**	**3**
Postdoctoral Researcher (4)			(2**)	**(5**)**	**(4**)**
International Joint Researcher (6) (Papers with the affiliation of IROAST)	—	4	16	**1**	**4**
Collaborated with Visiting Professors or Papers with the affiliation of IROAST (40)	11	10	11	**19**	**7**
Total	13	26	46	**44**	**30**

* : including the papers in press

** : collaborated papers with the tenure-track researchers not included when counting the number of papers

◆ Summary of Research Fund

FY2019

Categories	Number of Grants	Amount (x 1000 Yen)
JSPS Grant-in-Aid	6	24,050
Commissioned Research	1	150
Private Research Grant	7	4,692
Total	14	28,890

FY2018

Categories	Number of Grants	Amount (x 1000 Yen)
JSPS Grant-in-Aid	6	22,000
Commissioned Research	1	6,862
Private Research Grant	3	8,110
Donated Grant	5	3,600
Total	14	40,572

FY2017

Categories	Number of Grants	Amount (x 1000 Yen)
JSPS Grant-in-Aid	3	6,340
Private Research Grant	2	8,150
Donated Grant	4	2,450
Total	9	16,940

FY2016

Categories	Number of Grants	Amount (x 1000 Yen)
JSPS Grant-in Aid	1	1,330
Commissioned Research	1	439
Donated Grant	2	1,200
Total	3	2,969

Research Activities

1. IROAST Researchers

No.	Name	Project Title
1-1	**Mitsuhiro Aida**	Plant developmental biology
1-2	**Takumi Higaki**	Quantitative bioimaging
1-3	**Ruda Lee**	Target specific and multi-functional drug delivery system
1-4	**Atsushi Sainoki**	Sustainable energy development
1-5	**Takashi Ishida**	Deciphering biological relevance of peptide hormone-mediated intercellular communications in plant by genome editing
1-6	**Akiko Nakamasu**	Theoretical modeling of plant structures
1-7	**Minwoo Kim**	Development of glycolchitosan liposomes and platelet-like gold nanostars
1-8	**Adam Karl Schwartzkopff**	Prediction of induced seismicity from fluid injection into faults
1-9	**Mizuki Yamada**	Analysis of auxin-related genes in shoot apical meristem formation

No. 1-1	Plant developmental biology		
Name	Mitsuhiro Aida		
Affiliation	IROAST Email: m-aida@kumamoto-u.ac.jp	Title	Professor
Research Field	Advanced Green Bio		

Research Achievements

Our research aim is to elucidate molecular and genetic mechanisms that regulates the activity of shoot meristem, a group of dividing cells that is responsible for production of plant aerial organs such as leaves, stems and floral organs, which are collectively called as shoot organs. In dicotyledonous plants, the shoot meristem is initially formed during embryogenesis in a boundary region between the two cotyledon primordia and after germination, it maintains a group of stem cells at its center and continuously provides new cells that give rise to shoot organs from its periphery.

We have been focusing on a set of transcription factor encoding genes called *CUC1*, *CUC2* and *CUC3*, which are expressed in the cotyledon boundary region and required for shoot meristem formation in *Arabidopsis thaliana*. With a collaboration with the Higaki lab in IROAST and Higashiyama lab in ITbM, Nagoya Univ, we have quantitatively analyzed 3D images of embryos and found that cells along the boundary have smaller size compared to those in cotyledon primordia and this size restriction required the activity of *CUC* genes. We also analyzed the connection of the *CUC* genes with plant hormone auxin. Genetic analyses as well as pharmacological tests using ovule culture system indicate that the *CUC* genes are required for multiple steps in the auxin pathway, such as biosynthesis, polar transport and signal transduction. Significance of the effects of the genes on the auxin pathway in boundary development and shoot meristem activity is currently under investigation.

By focusing on genes whose expression is regulated by the *CUC* genes, we uncovered a gene encoding secreted peptide required for leaf morphology. In a collaborative work with the Uchida/Torii lab in ITbM, Nagoya University and the Simon lab in Heinrich Heine University, we have shown that *CUC*-gene-dependent expression of the peptide is required for proper auxin response at the cotyledon tip and promotion of cotyledon growth. These results highlight the importance of cotyledon boundary as a signaling source for growth of shoot organs.

International Research Collaboration

The above work was carried out as a part of international research collaboration including research groups of Heinrich Heine University in Germany (Simon group), University of Cardiff in UK (Murray group), INRA ENS de Lyon in France (Hamant group) and CINVESTAV, LANGEBIO in Mexico (de Folter group). The work has been presented in the following international meetings:

1. Roles for CUP-SHAPED COTYLEDON genes in regulating the auxin pathway during embryonic shoot formation. International Symposium: Principles of pluripotent stem cells underlying plant vitality (May 10, 2019, Tohoku University, Sendai).
2. Organ boundary as a signaling source for embryonic shoot morphogenesis. Mechanisms of Plant Perception -from endogenous to exogenous- (September 20, 2019, Centre Général Guisan, Lausanne, Switzerland).

Prospect for further research collaboration

The following collaborative research will be continued in FY2020.

Analysis of transcription factor – target gene interactions during shoot meristem formation with Dr. S. Scofield in Cardiff University, UK.

Mechanisms of fruit development with Dr. S. de Folter in CINVESTAV, LANGEBIO, Mexico.

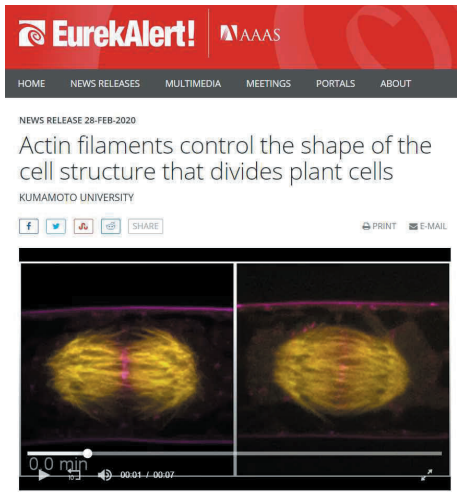
Role of mechanical signals in the regulation of gene expression with Dr. O. Hamant in INRA ENS de Lyon, France.

No. 1-2	Quantitative Bioimaging		
Name	Takumi Higaki		
Affiliation	IROAST Email: thigaki@kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Advanced Green Bio		

Recent advances in bioimaging equipment have enabled biological scientists to easily acquire large amounts of bioimage data within a short period of time. Following this influx of information, biologists are now engaging in bioimage informatics, an emerging area of bioinformatics. I am working on this interdisciplinary research area through development of bioimage analysis tools and its application to cell biological problems. As great opportunities in FY2019, I visited University of Zurich and University of Lausanne with Professors Mitsuhiro Aida (IROAST) and Shinichiro Sawa (FAST) in September. I gave oral presentations about quantitative cell biological studies focused on plant stomatal movement in the seminar organized by Prof. Kentaro Shimizu (University of Zurich) (September 16, 2019) and the international symposium "Mechanisms of plant perception - from the endogenous to the exogenous" held in General Guisan Center (Pully, Switzerland) (Organizer: Prof. Christian Hardtke (University of Lausanne)) (September 20, 2019) and discussed with cutting-edge plant scientists including IROAST Visiting Professor Dr. Christian Hardtke.



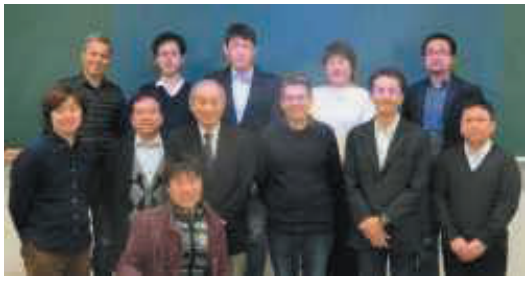
I am also working on microscopic image analysis of cytoskeleton, which tightly relates to various cell activities including cell division, expansion, and differentiation. In FY2019, I upgraded a high-versatility and high-throughput image analysis framework for quantification of multidimensional cytoskeletal organizations. Based on the microscopic image analysis techniques and high-resolution time-lapse confocal imaging, we published an original paper with my graduate student Mr. Keisho Maeda (Maeda et al. 2020 *Plant Cell Physiology*) (February 7, 2020). In this paper, we reported pharmacological disruption of actin filaments altered organization of phragmoplast microtubules, which make cell plate and separate plant cells, at early phase of cytokinesis in tobacco BY-2 cells. Our findings suggested that actin filaments regulate phragmoplast microtubules at the initial phase of plant cytokinesis. Under the kind support with our URA members, we also published a press release “Actin filaments control the shape of the cell structure that divides plant cells” including our movie data on EurekAlert! (February 28, 2020) (https://www.eurekalert.org/pub_releases/2020-02/ku-afc022820.php).



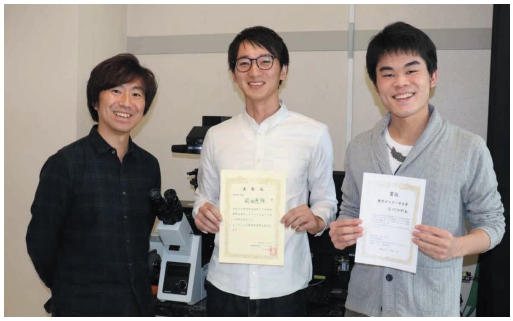
As collaborative projects, I worked on quantitative evaluation of cortical microtubule originations in leaf pavement cells, as collaboration with Prof. Takashi Hashimoto (NAIST), and published a paper (Wong et al. 2019 *Plant Physiology*). I also quantitatively evaluated artificial deposition of secondary cell wall on plant cotyledon pavement cells expressing a transcription factor VND7, as collaboration with Prof. Taku Demura (NAIST) and Dr. Misato Ohtani (The University of Tokyo), and published a paper (Hirai et al. 2020 *Plants*). Related to these projects, I organized a meeting focused on plant cytoskeleton, with an IROAST member Dr. Takashi Ishida, in Kumamoto University (November 2, 2019), and gave an oral presentation about quantitative image analysis on plant cell division. As invited speakers, we invited our university members Drs. Hidenobu Mizuno (IRCMS) and Koji Kikuchi (GSMS). It was great opportunity to make an appeal about not only IROAST but also our university's activity.



In addition, I gave an oral presentation on "3D reconstruction of *Arabidopsis* plant architectures to understand mechanical optimization in plants" at the 5th IROAST Symposium "International Symposium on Strategies on mechanical optimization in plants" (Co-sponsored by KAKEN Grant-in-Aid for Scientific Research on Innovative Areas "Elucidation of the strategies of mechanical optimization in plants toward the establishment of the bases for sustainable structure system") (Organizer: Prof. Shinichiro Sawa (FAST)) with my collaborator Dr. Itsuki Kunita (University of the Ryukyus) (December 5, 2020). In this symposium, an IROAST Visiting Professor Dr. Olivier Hamant (INRA, RDP, ENS Lyon) gave a special lecture. He became a formal research collaborator in my KANEN project, and we discussed potential applications of our techniques.



Related to these reserch activities, my graduate student Mr. Keisho Maeda won the "Excellent Oral Presentation Award" at the 13th annual meeting of the Cell Wall Researcher Network held in Okazaki, Aichi Prefecture (November 9, 2019). Also, my undergraduate students Mr. Kazuki Yoshimura and Mr. Ryusei Iseri won the "Excellent Poster Presentation Award" at the 1st Young Researcher Meeting of the KAKEN Project "Elucidation of the strategies of mechanical optimization in plants toward the establishment of the bases for sustainable structure system" held in Okazaki, Aichi Prefecture (November 10, 2019), and won the "Best Presentation Award" at presentation of graduation theses of the Biological Sciences Course of the Faculty of Science, Kumamoto University (Februrary 14, 2020), respectively.



No. 1-3	Target specific and Multi-functional drug delivery system		
Name	Ruda Lee		
Affiliation	IROAST Email: aeju-lee@kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Advanced Green Bio		

1. Research achievements

In FY2019, I focused on the development of stimuli-responsive nanostructure. I made collaboration with the chemistry department for a complicated chemical reaction. I designed redox-sensitive polymer, linker modified prodrug, and peptide modified polymer. All platforms confirmed by chemical conjugation analysis devices and formation nanoconstructs. Now, we are preparing *in vitro* and *in vivo* experiment. As well as, I established multi-drug resistance cell lines with Dr. Min Woo Kim. Inherent and acquired multidrug resistance (MDR) to chemotherapeutic drugs remains a major obstacle to ineffective cancer treatments. So, the MDR environment is key to cancer research to extend preclinic to the clinic. We set up 4 breast cancer cell lines, 3 lung cancer cell lines and 3 head and neck cancer cell lines. These cell lines will be used for collaborative research and JSPS grant research.

Dr. Min Woo Kim was contributed to 1) develop biomimetic nanomaterials and 2) exosome drug delivery carrier. He designed red blood cell/platelet membrane coated gold nanostar which can evade macrophages and enhance the cancer target efficacy. Additionally, the 808 nm laser irradiation induced thermal effects and controlled drug release. We published paper on “Frontiers in Bioengineering and Biotechnology”. The second his project was increased exosome extraction rate from the cancer cells. Recently, exosome is highlighted as a new drug delivery carrier. It is non-toxic cell-derived vesicles and has target ability itself, so exosome can deliver drug safely to the target area. Dr. Kim found that the cellular internalization mechanism of exosomes compares to liposomes. We are expecting to perform *in vivo* animal study with KBSI collaborators on September 2020. Mr. Sho Ueno (B4 student) was contributed to developing HER2 positive breast cancer target liposome. HER2 expressed breast cancer patients showed multi-drug resistance, so the chemotherapy results come out badly. He synthesis target peptide and scramble peptide for confirming target efficacy. HER2 positive and negative breast cancer cell lines were used for cellular internalization analysis. We succeeded in HER2 specific liposome delivery and have the plan to extend research for a dual molecule targeted drug delivery. He will work on this project for the Master project. Now, we are preparing manuscript for submitting international journal.

[Lee lab paper achievement]: First author (3), Corresponding author (3), Co-author (2)

1. Song Yeul Lee, **Ruda Lee**†, Eunha Kim, Sanghee Lee, Yong Il Park, "Near-infrared light-triggered photodynamic therapy and apoptosis using upconversion nanoparticles with dual photosensitizers," Frontiers in Bioengineering and Biotechnology, in press, 2020. (†co-first)
2. **Ruda Lee**, Yu Jin Choi, Myeong Seon Jeong, Yong Il Park, Keiichi Motoyama, Min Woo Kim, Seung-Hae Kwon, Jung Hoon Choi, "Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Nonsmall Cell Lung Cancer," Bioconjugate Chem., 31(3), 923-932, 2020.
3. Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, **Ruda Lee***, Yong Il Park, "Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions," Frontiers in Bioengineering and Biotechnology, 8, p133, 2020. (*co-corresponding)

4. Kwon SH, Wi T, Park YI, Kim MW, Lee G, Higaki T, Choi JH, **Lee R**, "Non-invasive early detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor," Bioconjug Chem., 31(3), 803-812, 2020.
5. Ayaka Harada, Hiroyasu Tsutsuki, Tianli Zhang, **Ruda Lee**, Kinnosuke Yahiro, Tomohiro Sawa, Takuro Niidome, "Preparation of biodegradable PLGA-nanoparticles used for pH-sensitive intracellular delivery of an anti-inflammatory bacterial toxin to macrophages," Chem. Pharm. Bull., 68(4), 363-368, 2020.
6. Sofiane Hamidi, Yukiko Nakaya, Hiroki Nagai, Cantas Alev, Takeya Kasukawa, Sapna Chhabra, **Ruda Lee**, Hitoshi Niwa, Aryeh Warmflash, Tatsuo Shibata, and Guojun Sheng, "Mesenchymal-Epithelial Transition Regulates Initiation of Pluripotency Exit before Gastrulation," Development, 147(3), dev184960, 2020.
7. Min Woo Kim, Takuro Niidome, **Ruda Lee**, "Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer," Marine Drugs, 17 (10), 581, 2019.
8. **Ruda Lee**, Sung-Jae Choi, Kyung Chul Moon, Jong Woong Park, Kwangmeyung Kim, Soo-Young Yoon and Inchan Youn, "Fluorogenic Probe for Detecting Active Matrix Metalloproteinase-3 (MMP-3) in Plasma and Peripheral Blood Neutrophils to Indicate the Severity of Rheumatoid Arthritis," ACS Biomater. Sci. Eng., 5, 6, 3039-3048, 2019.

2. International research collaboration

In FY2019, Prof. Niidome succeeded to get Korea-Japan bilateral grant. Japan's side task was the development of imaging sensors for detecting neutrophils. I and Prof. Key (Yonsei Univ.) closely collaborate together as the main researcher. Japan side developed Cathepsin G sensitive imaging sensor and set up a condition for conjugating on the microparticles.

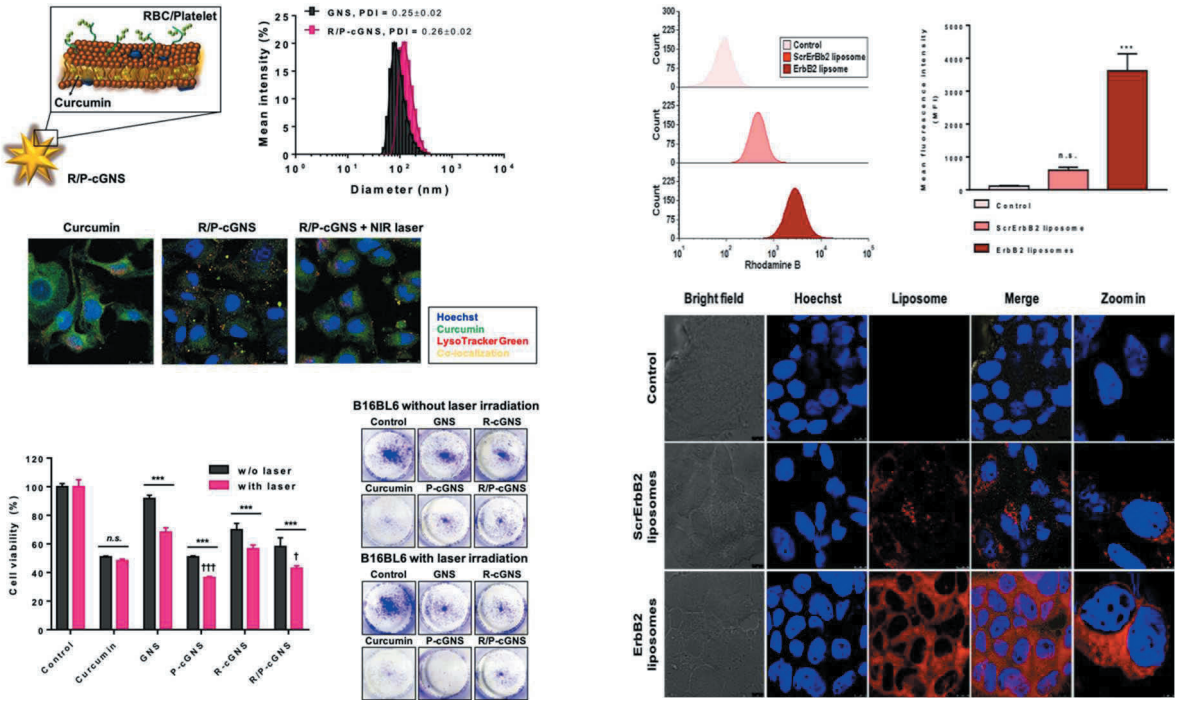
November 2019, I have visited Australia for discussing project grant. I provided HER1 and HER2 specific peptide to Dr. Helen Xu and she modified on the surface of upconversion nanoparticles. Now, we are looking for grant application and collaborative paper submission.

For Dr. Min Woo Kim’s research, we worked with the Korea Institute of Science and Technology (KIST). We worked on High-Intensity Focused Ultrasound (HIFU) mediated drug-controlled release system. In vivo characterization was finalized, and we’ve got promising results. In FY 2020, we are expecting to publish a collaborative research paper.

3. Prospect for further research collaboration

In FY2020, I have plan to JSPS bilateral grant with Japan (IROAST)-Korea (Chonnam National University, KBSI). We start to make a new strategy for detecting glioblastoma (brain tumor) by deep brain imaging and delivery of a target-specific drugs to reduce toxicity. This team consists of many early career researchers who get Ph.D. within 10 years and Professor. As well as, various field expertise will join the team (Biologist, Chemist, Physicist, Nano-scientist).

We start to get patients-derived samples and will apply on imaging sensor to diagnosis disease severity. One of my undergraduate students focused on Head and neck cancer specific peptide sequence. Three candidates were selected and will apply cell lines and human-derived samples. It can give information about the tumor margin and invasive lymph node for dissecting during the surgery. All of my researches final goal is clinical application for diagnosis, treatment and monitoring disease. So that, closely work with clinician is important. It will be a starting point and I will expand cancer research collaborators near future.



[Aslla symposium 2019, KIST]



[Role of Bio-imaging in Biomedical filed, KBSI, Korea]



[Japan-Korea Bilateral grant meeting, Kumamoto, Japan]



[Japan-Australia collaboration meeting, Sydney, Australia]



No. 1-4	Sustainable energy development		
Name	Atsushi Sainoki		
Affiliation	IROAST Email: atsushi_sainoki@kumamoto-u.ac.jp	Title	Associate Prof.
Research Field	Green Energy		

1. Research achievements

Journal and conference papers

During the fiscal year of 2019, six papers have been published in international journals, and seven papers have been submitted to international conferences. For three journal papers out of the six, I am the first and corresponding author. Regarding the conference papers, I presented two papers as the first author at YSRM, 2019, Okinawa and Rock Dynamic Summit, 2019, Okinawa.

List of journal papers published in 2019

1. SAINOKI, A.*, MAINA, D., SCHWARTZKOPFF, A., OBARA, Y., KARAKUS, M.
   Impact of the Intermediate Stress Component in a Plastic Potential Function on Rock Mass Stability around a Sequentially Excavated Large Underground Cavity
   International Journal of Rock Mechanics and Mining Science, 2020 (Accepted, IF=3.780)
2. SAINOKI, A.*, HIROHAMA, C., SCHWARTZKOPFF, A.
   Dynamic Modelling of Induced Seismicity by Using Seismic Efficiency Constraints and a New Scaling Law for Slip-weakening Distance
   Pure and Applied Geophysics, 2019 (Accepted, IF=1.466)
3. OBARA, Y., NAKAMURA, K., YOSHIOKA, S., SAINOKI, A., KASAI, A.
   Crack Front Geometry and Stress Intensity Factor of Semi-circular Bend Specimens with Straight Through and Chevron Notches
   Rock Mechanics and Rock Engineering, 1-16,2019 (IF=4.1)
4. KONG, P., JIANG, L., SHU, J., SAINOKI, A., WANG, Q.
   Effect of Fracture Heterogeneity on Rock Mass Stability in a Highly Heterogeneous Underground Roadway
   Rock Mechanics and Rock Engineering, 52,11,4547-4564,2019 (IF=4.1)
5. KODAMA, J. I., MITSUI, Y., HARA, S., FUKUDA, D., FUJII, Y., SAINOKI, A., KARAKUS, M.
   Time-dependence of Mechanical Behavior of Shikotsu Welded Tuff at Sub-zero Temperatures
   Cold Regions Science and Technology, 168,102868,2019 (IF=2.767)
6. SAINOKI, A.*, MITRI, H. S., CHINNASANE, D., SCHWARTZKOPFF, A. K.
   Quantitative Energy-Based Evaluation of the Intensity of Mining-Induced Seismic Activity in a Fractured Rock Mass
   Rock Mechanics and Rock Engineering, 52,11,4651-4667,2019 (IF=4.1)

List of conference papers published in 2019

1. SAINOKI, A., HIROHAMA, C.
   Methodology to Back-analyze the Slip-weakening Distance of Induced Seismicity, Considering Seismic Efficiency
   Rock Dynamics Summit, 219-224,2019
2. SCHWARTZKOPFF, A., SAINOKI, A.
   Numerical Study on Fluid Injection into Faults: the Importance of Considering Leak off into the Surrounding Rock Mass
   YSRM2019 & REIF2019,2019
3. SONO, T., OBARA, Y., TANIKURA, I., SAINOKI, A.
   Influence of Chipping Conditions on Damage of Concrete Using Pneumatic Breaker
   YSRM2019 & REIF2019,2019
4. HIROHAMA, C., SAINOKI, A.
   Estimation of the Kinetic Friction of Rock Discontinuities Undergoing Dynamic Failure during Seismic Events

YSRM2019 & REIF2019,2019

5. SAINOKI, A., SCHWARTZKOPFF, A., MITRI, H.
   Burst-prone Stress Conditions from Tectonics within a Fracture Network from a Fault Damage Zone
   YSRM2019 & REIF2019,2019
6. ARAI, T., MURAYAMA, H., SAINOKI, A., KODAMA, J.
   Estimation of the Normal Contact Stiffness between Concrete Lining and the surrounding Weal Rock Mass
   YSRM2019 & REIF2019,2019
7. SCHWARTZOPFF, A., SAINOKI, A.
   Coupled X-FEM Approach to Reproduce the Mechanics due to Direct Fluid Injection into a Natural In-situ Fault
   Rock Mechanics for Natural Resources and Infrastructure Development, 3058-3065,2019

Research grant

I have obtained Grant-in-Aid for Early-Career as well as JSPS postdoctoral fellowship. Additionally, research grants have been obtained through research collaboration with several private companies.

Award

I have obtained a paper award from Japanese Society for Rock Mechanics.

Invited lecture

I have been invited to International Workshop of Underground Oil & Gas Storage, 2019 and a domestic symposium for rock mechanics.

2. International research collaboration

In 2019, I concluded MOU with Prof. Ali Madiseh, University of British Colombia and received a student from UBC with the help of IROAST internship program. In addition, while collaborating with Prof. Derek Elsworth at Pennsylvania State University, one paper has been submitted to an international journal. In collaboration with Prof. Jiang at Shandong University of Science and Technology, one paper has been published in Rock Mechanics and Rock Engineering.



Research laboratory at UBC

3. Prospect for further research collaboration

I visited a deep underground mine called Mufulira mine in Zambia in September with Prof. Kodama at Hokkaido University and his graduate student. At the mine, we made a discussion toward research collaboration to understand the mechanism of rockbursts taking place at the

mine and to propose a method that mitigates the risk of dynamic hazard and realizes stable ore production. Hopefully, during the fiscal year of 2020, I can visit the mine again and make a deeper discussion regarding the research collaboration.



Deep underground mine, Zambia

No. 1-5	Deciphering biological relevance of peptide hormone-mediated intercellular communications in plant by genome editing		
Name	Takashi Ishida		
Affiliation	IROAST Email: ishida-takashi@kumamoto-u.ac.jp	Title	Assistant Professor
Research Field	Advanced Green Bio		

1. Research achievements

In the post-genomic era, phenotypic analysis of loss-of-function mutants has been routinely performed to clarify the biological significance of various genes. In this context, genome editing based on the CRISPR/Cas9 systems is a meaningful technique for the genetic analysis. In FY2017, I have reported a highly efficient genome editing pipeline and generation of a collection of loss-of-function mutants for the plant peptide hormones as a publicly available bioresource.

In this FY, I have reported the development of improved version of plant genome editing method (**IV**). Although currently the CRISPR/Cas9 system is widely used, one limitation of the system has been recognized. A protospacer-adjacent motif (PAM) immediately downstream of the target sequence needs to be taken into account in the design of target site, limiting the flexibility of the genome-editing system. To overcome this limitation several types of Cas9 nuclease variants have been engineered to improve the flexibility. Among the artificially designed Cas9 proteins, I selected two variants, SpCas9-VQR and SpCas9-EQR, and incorporated into the plant genome editing pipeline. Next, I evaluated the functionality and efficiency of the newly developed genome editing systems employing the Cas9 variants. Resulted in the practical demonstration, I succeeded to generate novel mutations for two genes, potentiating the usefulness and flexibility of CRISPR/SpCas9-mediated mutagenesis in plants.

Higher organisms have evolved sophisticated developmental regulation mechanisms. In the steady state, they routinely develop various tissues based on the genetically encoded body plan. However, biotic stimuli sometimes trigger formation of malformed organs. The gall formation induced by plant parasitic root-knot nematodes is representative of irregular organogenesis. I am trying to understand the molecular insights into the plant-microorganisms interactions.

In this FY, I have reported the analyses of gall formation process focusing on the dynamic change in characteristics of host plant cells. In the manuscript **I**, I have analyzed time-lapse RNAseq data and found that the activity of secondary cell wall biosynthesis is weakened in galls. In consistent with this, cell wall composition analysis showed the resemblance between galls and callus, representative cell mass that contain undifferentiated cells. These results were supported by the statistics analyses and the findings suggest that phytoparasitic nematodes modulate the developmental mechanisms of the host plant cells and convert it into undifferentiated state to modulate physiological processes and establish a feeding site. Furthermore, I have participate an international collaborative research group and published a manuscript **II** as a co-author. In the manuscript, I have discovered a key gene, ARF5, in the gall formation process and characterized the biological significance of the gene. ARF5 play indispensable roles for the regulation of vascular development in the normal growth condition and for the triggering the gall formation process in the infected condition. Colleagues also discovered similar genes that are important for both normal development and symptom formation. In conclusion, we proposed that the activation of plant developmental programs promoting transient-pluripotency/stemness leads to the formation of galls.

In addition, I am preparing a manuscript reporting the discovery of novel compounds that affect plant growth. This study has been carried out as interdisciplinary research project with a chemist and microbiologists. Further, I have started new international collaborative research focusing on the characterization of genes that are important for plant morphology.

Publications

・Authorship

I. Root-knot nematodes modulate cell walls during root-knot formation in *Arabidopsis* roots. **Ishida T**, Suzuki R, Nakagami S, Kuroha T, Sakamoto S, Nakata MT, Yokoyama R, Kimura S, Mitsuda N, Nishitani K, Sawa S, ***Journal of Plant Research***, in press, 2020. (Impact Factor: 2.082)

II. Root-knot nematodes induce gall formation by recruiting developmental pathways of post-embryonic organogenesis and regeneration to promote transient pluripotency. Olmo R, Cabrera J, Díaz-Manzano FE, Ruiz-Ferrer V, Barcala M, **Ishida T**, García A, Andrés MF, Ruiz-Lara S, Verdugo I, Pernas M, Fukaki H, del Pozo JC, Moreno-Risueno MA, Kyndt T, Gheysen G, Fenoll C, Sawa S, Escobar C, ***New Phytologist***, in press, 2020, doi: 10.1111/nph.16521 (Impact Factor: 7.430)

III. AT-hook transcription factors restrict petiole growth by antagonizing PIFs. Favero DS, Kawamura A, Shibata M, Takebayashi A, Jung JH, Suzuki T, Jaeger KE, **Ishida T**, Iwase A, Wigge PA, Neff MM, Sugimoto K, ***Current Biology***, in press, 2020, doi: 10.1016/j.cub.2020.02.017 (Impact Factor: 9.193)

IV. Developing heritable mutations in Arabidopsis thaliana using a modified CRISPR/Cas9 toolkit comprising PAM-altered Cas9 variants and gRNAs. Yamamoto A, **Ishida T** #, Yoshimura M, Kimura Y, Sawa S, ***Plant and Cell Physiology***, 60(10), 2255-2262, 2019. doi: 10.1093/pcp/pcz118 (Impact Factor: 3.929)

・Acknowledgement

V. Live cell imaging of meiosis in *Arabidopsis thaliana*. Prusicki MA, Keizer EM, van Rosmalen RP, Komaki S, Seifert F, Müller K, Wijnker E, Fleck C, Schnittger A, ***Elife***, 2019 May 20;8. pii: e42834. doi: 10.7554/eLife.42834. (Officially published version of **VII** in Annual report 2018)

Patents

WO/2018/147290 植物成長抑制剤、およびそれを用いた植物成長抑制方法
石川勇人, 谷時雄, 澤進一郎, **石田喬志**, 福島悠介, 稲垣準
WO/2018/147292 植物成長抑制剤、およびそれを用いた植物成長抑制方法
石川勇人, 谷時雄, 澤進一郎, **石田喬志**, 福島悠介, 稲垣準

Funding

JST A-STEP 細菌由来新規アルカロイドを先導物質とした植物成長抑制剤の開発
石川勇人, 谷時雄, 澤進一郎, 石田喬志

2. International research collaboration

The published projects listed in the section 1 were done as international collaboration.
Analysis of root-knot formation processes (**II**) was accomplished by a collaboration with research groups in Universidad de Castilla-La Mancha (Spain), INIA (Spain), ICA-CSIC (Spain), Universidad de Talca (Chile), Kobe University (Japan) and Ghent University (Belgium).
PIFs project (**III**) was performed with research groups in RIKEN CSRS (Japan), University of Cambridge (UK), Sungkyunkwan University (South Korea), Chubu University (Japan), IGZ (Germany), Washington State University (USA) and The University of Tokyo (Japan).

3. Prospect for further research collaboration

In FY2019, I have started some international collaboration on the genome editing in plants. Our pipeline for rapid generation of Arabidopsis mutant will provide us further collaborations. In addition, a research project following the publication **II** that is aiming to understand molecular insights into the nematode-induced root-knot formation is in progress as an international collaboration.

No. 1-6	Theoretical modeling of plant structures		
Name	Akiko Nakamasu		
Affiliation	IROAST Email: nakamasu@kumamoto-u.ac.jp	Title	Project assistant professor
Research Field	Advanced Green Bio		

1. Research achievements

In this year, I proceeded a research about plant morphogenesis with a general approach in mathematical and theoretical biology. Accordingly, I published a review paper with Associate Prof. Takumi Higaki (IROAST), as follows;
“Theoretical models for branch formation in plants” *Journal of Plant Research* 132(3), 325-333, 2019. I performed co-correspondence together with T. Higaki, in this review. The review was selected as an open access paper by the Botanical Society of Japan.

Then construction of a mathematical model for network formation of endoplasmic reticulum was attempted. A paper about this theme is now under construction.

In the 42nd Annuals meeting of the Molecular Biology Society of Japan (December 3-6th 2019), I organized a workshop titled “Hidden dimension of pattern formation” with Associate Prof. Masakatsu Watanabe (Osaka University) dealing with topics related to pattern formations. We attempted to gather interdisciplinary talks by experimental and theoretical biologists. More than 100 people joined to this workshop.

A research grant from Shimadzu Science Foundation, "Study on displaceable effects of spatial inhomogeneity on Turing pattern," (February 19, 2020-December 2021) was adopted. This is for a collaborative research with T. Higaki and Hirofumi Izuhara (Miyazaki University).

2. International research collaboration

I performed a collaborative research about an integrated mechanism for pigment-pattern formation in avian and fish with Masafumi Inaba (South California University) and M. Watanabe. The paper (re)submition of this theme is now prepareing, though finally it became my single author.

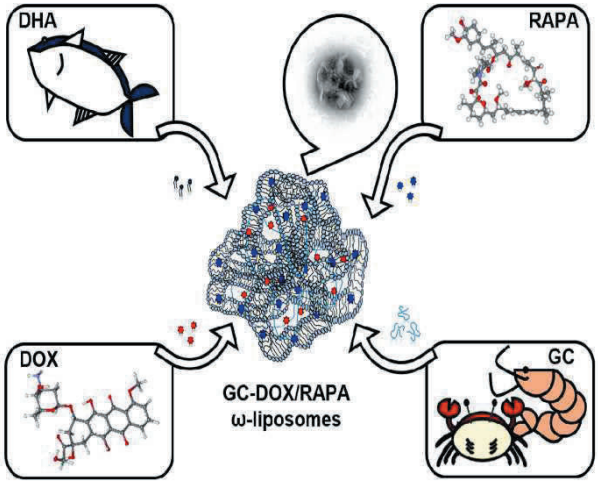
3. Prospect for further research collaboration

I’d like to collaborate with Dr. Irepan J. Reyes-Olalde (experimental plant biologist), who is a visiting researcher of Aida lab in IROAST, about pattern formation in carpel-margin meristems on a molecular level.
I was invited in a special session of AIMS conference on dynamical systems and differential equation (June 5-9th 2020) and contributed talk of a symposium of Pacifichem 2020 (December 15-20th 2020), though AIMS conference was postponed to next year (June 3-6th 2021).

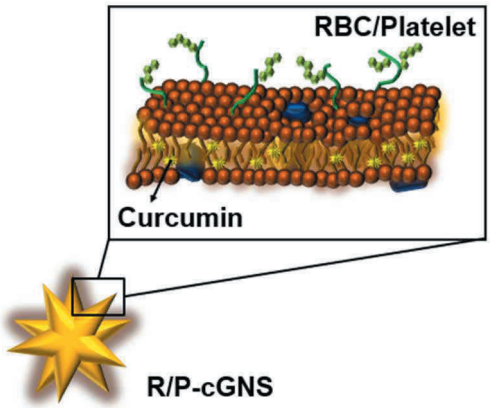
No. 1-7	Development of glycolchitosan liposomes and platelet-like gold nanostars		
Name	Minwoo Kim		
Affiliation	IROAST	Title	Postdoctoral Researcher
Research Field	Nanomaterial Science		

1. Research achievements

In this fiscal year, I have mainly focused on research dealt with several different nanoparticles. First, we designed glycol chitosan ω-liposomes with a mean diameter of less than 200 nm and a negative zeta potential, containing anti-cancer drugs (both doxorubicin and rapamycin) in a single nanoparticle. The liposomes exhibited a pH-sensitive drug release profile and we verified that the liposomes could effectively deliver the drugs into cancer cells. The combinatorial treatment with doxorubicin and rapamycin synergistically suppressed tumor growth in doxorubicin-resistant breast cancer cells, which were developed in our study by continuous exposure to DOX. These findings provide a viable example of using marine pharmaceuticals as a therapeutic and carrier that can control the release of cargo in acidic environments, including tumor microenvironments. The marine-derived drug delivery system consisting of chitosan and omega-3 fatty acids shows potential for the treatment of drug-resistant breast cancer.



In second research, I synthesized red blood cell and platelet membrane-coated gold nanostars containing curcumin (R/P-cGNS) and evaluated whether R/P-cGNS had improved anticancer efficacy. We also validated a controlled release profile under near-infrared irradiation for the ability to target melanoma cells and to have an immunomodulatory effect on macrophages. Red blood cell membrane coating provided self-antigens; therefore, it could evade clearance by macrophages, while platelet membrane coating provided targetability to cancer cells. Additionally, the nutraceutical curcumin provided anticancer and anti-inflammatory effects. In conclusion, the results presented in this study demonstrated that R/P-cGNS can deliver drugs to the target region and enhance anticancer effects while avoiding macrophage phagocytosis. We believe that R/P-cGNS can be a new design of the cell-based hybrid system for effective cancer therapy.



2. International research collaboration

I've attended 2019 KAIST-KU joint symposium organized by KAIST, one of the most famous research groups in Korea. I gave a talk entitled 'bio-inspired and bio-mimetic strategy: A platelet-like drug delivery system for cancer therapy' as a young researcher. It was a great chance to discuss about my current research, share knowledge with international researchers, and get inspiration for further collaboration with Korea. In addition, it was also a nice opportunity to consider about working with IRCMS not just only KAIST. This great opportunity has helped me to get ideas about advanced research and actually proceed with the research.



3. Prospect for further research collaboration

Although this fiscal year is the last year for me, I've made many progress during staying IROAST. In next research place, I am aiming to continue my research more focusing on clinical field. new lipid-based drug delivery systems such as ultrasound-responsive liposomes, red blood cell nanoparticles, and exosomes. Using various drug delivery systems developed in Japan, I could test whether they are actually clinically applicable or not. Moreover, I am expecting to continue a collaboration with Japan to get better performance in the future.

No. 1-8	Prediction of induced seismicity from fluid injection into faults		
Name	Adam Schwartzkopff		
Affiliation	IROAST Email: aschwartzkopff@kumamoto-u.ac.jp	Title	Postdoctoral research fellow
Research Field	Green Energy		

1. Research achievements

During this fiscal year, I have been using the developed cutting-edge numerical simulation program to generate results for publication. I have validated the code against an in-situ experiment using a parameter estimation software (PEST) to history match the data. This resulted in a closely aligned simulation to the in-situ experimental data. I also conducted a sensitivity analysis to determine the parameters that had the most influence on the solution and was compared with the calibrated parameters from the PEST result. In addition, I compared the calibrated solution using the developed code (with zero permeability into the rock mass) with the commercial software Universal Distinct Element Code (UDEC), which clearly illustrated the benefits of the developed code, as the result was matched closer to the in-situ data. The associated manuscript was submitted to Rock Mechanics and Rock Engineering and is currently under review.

Currently, I have been concentrating on replicating induced seismicity occurring due to fluid injection into a fault, using dynamic analysis. The analysis requires some fine-tuning, but the preliminary results are promising.

I have also been finalizing a manuscript to predict the hydraulic fracturing parameters (i.e. the breakdown pressure) using measured material properties of a tight sandstone (found in the Sichuan basin). In addition, I have been finalizing a manuscript submitted to Rock Mechanics and Rock Engineering journal that required revisions. This manuscript deals with the comparing numerical and analytical solutions for the breakdown pressure and the propagation surface from a pressurized circular crack (inclined to the external principal stress directions) to experimental results.

2. International research collaboration

I have been collaborating with The University of Adelaide (Assoc. Prof. Chaoshui Xu) and the Institute of Rock and Soil Mechanics, Chinese Academy of Sciences (Prof. Qi Li) for predicting the breakdown pressures of tight sandstone.

3. Prospect for further research collaboration

I was approached at the International Society of Rock Mechanics congress in September 2019 to potentially collaborate with CSIRO to validate the developed numerical simulation program using experiments conducted in Perth, Australia. I am currently looking for grants to apply for to conduct this work.

No. 1-9	Analysis of auxin-related genes in shoot apical meristem formation		
Name	Mizuki Yamada		
Affiliation	IROAST Email: myamada@kumamoto-u.ac.jp	Title	Postdoctoral Researcher
Research Field	Advanced Green Bio		

1. Research achievements

The shoot apical meristem (SAM) is a tissue formed during embryogenesis in the boundary region between cotyledon primordia and generates all shoot organs, such as leaves, stems and flowers. The *CUP-SHAPED COTYLEDON* (*CUC*) genes *CUC1*, *CUC2* and *CUC3* in Arabidopsis encode transcription factors that are necessary for SAM formation and cotyledon separation. Our research group has identified several genes related to the phytohormone auxin as candidate target genes of the CUC proteins. To elucidate the role of the *CUC* genes in detail, in FY 2019, I investigated the spaciotemporal expression patterns of those auxin-related genes in wild type and *cuc* mutant embryos. One of these genes was expressed widely in the boundary region, where the *CUC* genes act to promote SAM formation and cotyledon separation. By contrast, expression of the gene was confined to a smaller region in *cuc* mutants, suggesting a possibility that this auxin-related gene is involved in the *CUC* gene dependent developmental processes. I am further investigating genetic interactions of this gene with the *CUC* genes, and the results will be reported in FY 2020.

2. International research collaboration

NA

3. Prospect for further research collaboration

In FY 2020, I am also planning the transcriptome analysis of Arabidopsis embryo, focusing on SAM formation. This analysis will be carried out as a research collaboration with Dr. Minoru Kubo (Kumamoto University) and will identify new candidate genes involved in SAM formation.

2. Distinguished Professors

No.	Name	Project Title
2-1	**Jorge Norberto Beltramini**	Design of smart nano-catalysts for green chemistry and energy applications
2-2	**Kontis Konstantinos**	Enabling the application of pulsed power systems for green energy and environmental systems
2-3	**László Pusztai**	Nanoscale assemblies in hydrogen-bonded liquids and in amorphous materials
2-4	**Yufeng Zheng**	Development and management of biomaterials

No. 2-1	Design of smart nano-catalysts for green chemistry and energy applications		
Name	Jorge Norberto Beltramini		
Affiliation (home)	Centre for Tropical Crops & Biocommodities Queensland University of Technology (QUT) Email: jorge.beltramini@qut.edu.au	Title	Adjunct Professor
Research Field	Nanomaterial Science/ Green Energy/ Advanced Green BioCommodities		
Period of appointment	October 01, 2019-March 31, 2020 (25 working days)		
Host Professor	Shinya Hayami		
Affiliation	Department of Chemistry, Faculty of Advanced Science and Technology Email: hayami@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

Invited lectures:

Growing the bio-economy through catalysis: Advancements in the production of fuels and chemicals from biomass valorization, ISNSC11, Qing Yang, China, 12-16 October 2019.

Critical design of Heterogeneous Catalysts for Sustainable Production of Chemicals and Energy: Current Approach and Emerging Prospects, Chemistry Department, China East University, Shanghai, China, 21 October 2019.

Catalytic Biomass Conversion, a lecture part of a course on Perspective on Biomass Utilization, College of Cross-Cultural and Multidisciplinary Studies, Kumamoto University, 25 October 2019.

Nanocomposite Catalysts: Enabling Innovations for Sustainable Energy and Environmental Technologies, International Conference on Catalysis Science and Chemical Engineering (CatScience), Melbourne, Australia, 2-4 December 2019.

Research Projects:

Two projects where submitted during October-November 2019:

1. Catalytic Conversion of Carbohydrates as Green Raw Materials to CMF, FDCC and Key Platform Chemical Using Novel Metal Supported Structures as Catalysts, Kakenhi 2020, Kumamoto University.
2. SPARC – An international collaboration with Department of Applied Chemistry, Cochin University of Science and Technology, Cochin, India. Topic of research: Biomass conversion to key commodity chemicals.

At the same time I am embarked on promoting research and academic partnerships between the Chemistry Department, Graduate School of Science and Technology at Kumamoto University and the Centre for Tropical Crops and Biocommodities at Queensland University of Technology, Brisbane Australia, the Chemistry Department at IIT Indore, Indore, India and the Chemistry Department at East China University, Shanghai, China, with the aim to advance in research projects in the areas of nanomaterial science with emphasis on renewable energy that will allow

the exchange of young research scientists between the Institutions involved. It is the aim to have a working plan in place by mid-2020.

Scientific Publications:

T. Tana, Z. Zhang, **J. N. Beltramini**, H. Zhu, K. Ostrikov, J. Bartley and W. Doherty, Valorization of native sugarcane bagasse lignin to bio-aromatic esters/monomers via a one pot oxidation–hydrogenation process, Green Chemistry, 21, 861 -873, (2019), **(IF = 9.125)**

S. Mukundan, L. Atanda and **J. N. Beltramini**, Thermocatalytic cleavage of C-C and C-O bonds in model compounds and kraft lignin by $NiMoS_2$/C nanocatalysts, RSC Sustainable Energy & Fuels, 3, 1317 – 1328, (2019), **(IF = 3.987).**

M. Rashidi, **J.N. Beltramini** and D. Martin, the selective cleavage of lignin aliphatic C-O linkages by solvent-assisted fast pyrolysis (SAFP), Journal of inclusion Phenomena and Macrocylic Chemistry, 94, 297-307, doi.org/10.1007/s10847-019-00905-x, (2019), **(IF = 1.963).**

W.Wanwitoo, **J. N. Beltramini**, J. Bartley, N. Laosiripojana and W. Doherty, William, Effect of HCOOK/ethanol on Fe/HUSY, Ni/HUSY and Ni– Fe/HUSY catalysts on lignin depolymerisation to benzyl alcohols and bioaromatics, ACS Omega, 4(16):16980-16993, (2019), **(IF = 3.170).**

Y. Hirano, **J. N. Beltramini**, A. Mori, Y. Kim, M. Nakamura and S. Hayami, Microwave-improved catalytic conversion of glucose to 5-hydroxymethylfurfural using graphene oxide hybrid catalysts, submitted for publication to European Journal of Chemistry, (2019), **(IF = 5.160)**

L. Atanda, M. A. Wahab and **J. N. Beltramini,** Recent progress on catalysts development for CO_2 conversion into value-added chemicals by photo- and electro-reduction, Book Chapter contribution to Wiley Pub., to be published in March 2020.

Recently, I have been appointed Associate Editor to the Journal Frontiers in Chemical Reaction Engineering and also Editor Advisor to the Frontiers Journal publication series.

2. Overview and significance of the research collaboration and lectures to the students

At Chemistry Department at Kumamoto University, I designed new projects for Bachelor 4, Mater 1 and 2 students on applications of tailored nanocatalysts based on metal such as Ni, Pt, Fe and Co supported on carbon structures (graphene, carbon spheres, etc) to be applied for the conversion of biomass components as cellulose and lignin into commodity chemicals. As such students investigate the conversion of cellulose and carbohydrates into furanic compounds (5-HMF, FDCA, levulinic acid, etc.) to be used as key components in the production of fuels and plastics from biomass. Two publications are being finalized to be submitted in reputed international journals.

At the same time I participated on delivering of lectures and seminars to students at Chemistry Department and also from the College of Cross-Cultural and Multidisciplinary Studies on topics such as: catalytic biomass conversion, material design properties, catalyst characterization and testing.

I am planning for 2020 academic year to start a course for interested students on the important topic of Chemical conversion using renewable material: Their impact on climate change and economy.

3. Comments/suggestions for IROAST/Kumamoto University

IROAST is an excellent component of Kumamoto University that have a world-class approach to develop international cooperation, in particularly by inviting foreign experts to come to Kumamoto under the program of invited or distinguished Professors. As such, I have the opportunity to participate during 2017, 2018 and 2019 as visiting Professor and last October I have the privilege to be appointed as Distinguished Professor to work with the Chemistry Department with Professor Shinya Hayami. By participating on different activities organized by IROAST, I came to learn more about how also focus on train young tenure-track academic and scientists from Japan and the world to be the leaders of the future. IROAST focused on an integrated scientific approach involving the most diverse components of science and technology. During my participation on the 2019 review of activities a exchange of ideas were discussed on the way to IROAST expand its activities not only at Kumamoto University, but also being an integral part of worldwide scientific exchange.

4. Prospect for further research collaboration with Kumamoto University

With the Research Group of Professor Shinya Hayami, we are presently conducting a scientific and technical innovation research program for the development of new pathways of reactions using innovative nano-hybrid metal supported catalysts to produce fuels and key platform chemicals from waste agricultural and municipal biomass. It is important to remark, that these new reaction conditions are a major industrial challenge, for which we are obtaining excellent preliminary results that will make this process to be commercially competitive in the near future. To have a substantial progress knowledge in the design of these novel materials and their impact on reactions, we have also applied to the Kakenhi Grant Scheme for project financial support for 2020-2022. At the same time, we are starting to collaborate with international Institutions from Australia, China and India to expand our understanding in the field of nanomaterial design and applications. It is expected to start the exchange of students and researchers between Institutions that will greatly favor Kumamoto University research profile worldwide. As it is known, Professor Shinya Hayami research work and research facilities at Chemistry Department at Kumamoto University are well recognized internationally for his contribution on material science design and supra molecular chemistry, that will open further international collaboration between above mention International Institutions, that will for sure have greatly future impact on the Japanese economy and worldwide.

5. Impressions of Kumamoto University/Kumamoto

I am familiar with Kumamoto University since my first visit as Invited Speaker on a Nano and Supra Molecular Chemistry Conference in mid-2014. Since that time, I came regularly first as IROAST Visiting Professor, then during 2018-19 as JSPS Professor Fellow to conduct research on Metal Organic Frameworks for direct methane conversion oxidation with Professor Shinya Hayami at Chemistry Department. On all these times I had the chance to visit and interact with Professors, researchers and students on various Departments and Laboratories where we engaged on discussions and experimentations on common areas of research. I can say that I observed research being conducted at the top international level that leads to fruitful research and academic collaborations. In meeting, seminars and discussions with the different student levels (bachelor, masters, PhDs) I found on them the eager to success and learn, but I need to mention that the level of English communication should be constantly improved for a better understanding and to deliver an efficient outcome of research and learning. I fully enjoy the friendly atmosphere not only on Campus but in the Kumamoto city where people are very friendly and despite the language

differences are always ready to help in any situation. In summary, I enjoy my stay very much in Kumamoto and specially visiting the different Onsen during the Winter Season.

No. 2-2	Enabling the Application of Pulsed Power Systems for Green Energy and Environmental Systems		
Name	Konstantinos Kontis		
Affiliation (home)	Aerospace Sciences Division, School of Engineering, University of Glasgow, UK Email: Kostas.Kontis@glasgow.ac.uk	Title	Professor
Research Field	Green Energy/ Environmental Science		
Period of appointment	04/01/2019-03/31/2020 (22 working days)		
Host Professor	Hamid Hosano		
Affiliation	Institute of Pulsed Power Science Email: hosseini@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

a. Seminars:
a1) 3rd Dec: The 67th IROAST Seminar – IPPS Lecture & Seminar No. 50; Title: Going Interstellar; Research enablers were highlighted, focussed on future aerospace vehicles to be lighter and greener, and also to achieve optimal shape, performance, and system robustness throughout the flight envelope. Some thoughts were given to current blue-sky technologies that may have a dramatic effect upon future aerospace designs, and how Nature can be a source of inspiration. The lecture emphasised research or engineering issues for space travel and exploration, and other aerospace issues such as ensuring a diverse and robust engineering community. The target audience was students.

a2) 6th Dec: Professor Kontis gave a presentation during the meeting with the Dean of the School of Medicine: It provided an overview of University of Glasgow including key strengths, research generation with impact, innovation, international reach and internationalization strategy. The second part discussed the research potential within the four Colleges of the University with particular emphasis on MVLS activities. Target audience was members of staff.



b. Collaborative discussions:
b1) 24th Oct: Professor Kontis met Prof Hiyama, Mr Kumagai and other colleagues to discuss collaboration opportunities between Glasgow and Kumamoto Universities, renewing current MoU and possibly extending to a university wide MoU. As a result of this visit, the current MoU has been renewed.

b2) 29th Oct: Professor Kontis attended the 5th IRCMS&IROAST Joint Seminar. The results of the joint research collaboration group were reviewed and discussed.

b3) 6th Nov: Professor Konstantinos Kontis paid a courtesy visit to Vice President for International Affairs, Prof. Otani together with other colleagues. In the discussion with Prof. Otani, opinions on expanding the current academic exchanges between the two universities were exchanged beyond IROAST. As a result of this visit, a meeting with the Dean of Medicine was planned.

b4) 2nd Dec: Professor Kontis attended the 7th IROAST Faculty-Staff Meeting 2019, where we discussed the IROAST Research Award 2019, Annual Report 2019 and external funding opportunities. The meeting was chaired by Prof Hiyama. Prof Kontis had the opportunity to meet Prof Munekata after presenting her research interests.

b5) 3rd Dec: Professor Kontis met Prof Tani (Vice Dean, Faculty of Advanced Science and Technology) to discuss collaboration opportunities between Glasgow and Kumamoto Universities.

b6) 6th Dec: Professor Kontis met Prof Tomizawa (Dean of Medicine), Prof Wen-Jie Song (School of Medicine), Mrs Kimoto and other colleagues to discuss potential collaboration between the School of Medicine and MVLS (University of Glasgow). They exchanged opinions on how to start academic/student exchanges in the medical fields of both universities. Medicine is one of the strongest research fields in both universities, and it is expected to be a main pillar of the future university-level agreement.
http://iroast.kumamoto-u.ac.jp/news/prof-kontis-pays-a-courtesy-visit/



b7) 6th Dec: There was wrap-up session with Prof Hosano, Mr Kumagai and other colleagues for

KU international section, on the way forward and steps related to the KU—UoG collaboration.

b8) Professor Kontis had almost daily research discussions and exchange of ideas with Professor Hosano to strengthen research collaboration. Professor Kontis has identified the interaction via two projects involving his PhD students in Glasgow bringing together the collective expertise. In the first instance, meetings over skype with Prof Hosano are planned in 2020. The interaction will allow joint supervision, co-authored publications and further funding opportunities.

2. Overview and significance of the research collaboration and lecture to the students

The research collaboration discussions have enabled expansion of the current academic exchanges between the two universities in other areas of mutual interest such as medicine and have set the foundations of the renewal of the current MoU and the possibility of staff and student exchanges in the near future.

The lecture to the students enabled fruitful discussions about the potential of plasma systems and energy deposition in applications outside the traditional areas of IROAST, which opens up vast opportunities for multidisciplinary collaboration, knowledge transfer activities and impact generation.

3. Comments/suggestions for IROAST/Kumamoto University

IROAST/Kumamoto University has vast potential to make a difference regionally, nationally and internationally. Interdisciplinary and multidisciplinary approaches and, where relevant, use of stakeholder knowledge and gender dimension in research and innovation content are critical. IROAST has the opportunity to expand and open up their core expertise and create bridges with aerospace engineering, quantum technologies, nanofabrication etc.

4. Prospect for further research collaboration with Kumamoto University

As it has been discussed in item 3), there are vast opportunities for further research collaborations. The unique technologies of IROAST can be married with a range of engineering applications opening up multidisciplinary opportunities. The current stay has kick-started research activities. The following actions are planned with Professor Hosano subjected to call availability and mutual synergies: a) JSPS Kakenhi International collaboration; b) EPSRC research application on multi-phase flows; c) Joint research activities involving the researchers of both groups leading to co-authored publications in high impact factor journals, co-supervision of projects; d) Expansion of current MOU between Glasgow and Kumamoto U covering areas across the two universities.

5. Impressions of Kumamoto University/Kumamoto

I am really impressed by the passion and dedication of students and staff to expand the frontiers of science and engineering. The hospitality and friendliness of Kumamoto University and Kumamoto City are unforgettable and I am really grateful of the opportunity.

No. 2-3	Nanoscale assemblies in hydrogen-bonded liquids and in amorphous materials		
Name	PUSZTAI, László		
Affiliation (home)	Wigner Research Centre for Physics, Budapest, Hungary Email: pusztai.laszlo@wigner.mta.hu	Title	Scientific advisor
Research Field	Nanomaterial Science		
Period of appointment	Month 04, 2019-Month 03, 2020 (80 working days)		
Host Professor	HOSOKAWA, Shinya		
Affiliation	FAST, KU Email: shhosokawa@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

My primary research goal in general may be described in short as '**understanding disordered structures'.** Accordingly, my main activity (still, in general) is the investigation of the microscopic structure of liquids, amorphous materials and disordered crystals. We combine experimental data, such as total scattering structure factors (TSSF) from X-ray and neutron diffraction (XRD and ND, respectively) and EXAFS spectra, with computer modeling tools, such as Reverse Monte Carlo (RMC) and molecular dynamics (MD) simulations. As a result of such an approach, large sets (containing tens of thousands) of atomic coordinates ('particle configurations') in simulation boxes are provided that are consistent (within errors) with experimental data. These configurations are then subjected to various geometrical analyses, so that specific questions concerning the structure of a material may be answered. Below I describe some selected results from the year of 2019 that are specific to my stays at IROAST of KU: most of these works are all related to the search for hydrogen-bonded supramolecular assemblies in various molecular liquids.

(i) *Temperature dependent structure and dynamics of isopropanol-water (CH_3-CH(OH)-CH_3/H_2O) mixtures at low alcohol contents.* By making use of literature X-ray diffraction data, extensive molecular dynamics computer simulations have been conducted for isopropanol-water liquid mixtures in the water-rich side of the composition range, with 5, 10 and 20 mol % of the alcohol, at temperatures between room temperature and the experimental freezing point of the given mixture. All-atom type (OPLS) interatomic potentials have been assumed for ethanol, in combination with two kinds of rigid water models (SPC/E and TIP4P/2005). While the SPC/E water model provided fair agreement with measured data, using the TIP5P/2005 potential lead to near-quantitative reproduction of the experimental structure factors: this provided a strong basis for further structural analyses. Apart from partial radial distribution functions, various descriptors of hydrogen bonded assemblies, as well as of the hydrogen bonded network have been determined from the simulated particle configurations. A clear tendency was observed towards that an increasing proportion of water molecules participate in hydrogen bonding with exactly 2 donor- and 2 acceptor sites as temperature decreases. Further, we focused on characteristics related to hydrogen bonds (HB): cluster-, and in particular, ring formation, energy distributions, and lifetimes of HB-s have been scrutinized for the entire system, as well as for the water and isopropanol subsystems. It is demonstrated that, similarly to ethanol−water mixtures, the occurrence of 5-membered-hydrogen-bonded rings are significant, particularly at higher alcohol concentrations. Concerning HB energetics, an intriguing double maximum appears on the alcohol−alcohol HB energy distribution function. HB

lifetimes have been found significantly longer in the mixtures than they are in pure liquids.

Related publication: Pothoczki, Sz; **Pusztai, L**; Bakó, I; Molecular Dynamics Simulation Studies of the Temperature-Dependent Structure and Dynamics of Isopropanol−Water Liquid Mixtures at Low Alcohol Content; *J. Phys. Chem. B*; **123**, 7599−7610 (2019); DOI: 10.1021/acs.jpcb.9b05631.

(ii) Calculation of electronic structure related properties in water. A detailed analysis of the two- and three-body interaction energy components in water clusters, containing up to 30 water molecules, was performed at the M05-2X/6-311G** level of (the electronic structure) theory, using the "hierarchical" basis set superposition error (BSSE)-corrected energy decomposition scheme, VMFC(3), of Valiron and Mayer. It was shown showed that the average BSSE-corrected two- and three-body interaction energy terms are about 74 to 80 and 20 to 26%, respectively, of the total BSSE-corrected interaction energy for all investigated clusters. It was observed that the three-body interaction energy component is significantly negative/positive if there are two H-bonds and one attraction/repulsion interaction in the corresponding trimer, respectively. Our calculations also revealed that the deformation energy of water molecules is dependent on their H-bonded environment.

Moving from molecular clusters to bulk liquids, the effects of an asymmetric environment on the electronic properties of a water molecule in liquid water were analysed from ab initio molecular dynamics simulations of liquid water at 300 and 350 K with the BLYP-D3 functional. The following observations could be made: (1) The electronic density-of-states (DOS) and the net molecular charge are more affected by the asymmetry of the water molecule's H-bond surroundings than by the number of H-bonded neighbours. The reverse is true for the dipole moment. (2) For all three properties, a 3-coordinated water molecule is more perturbed by accepting two H-bonds and donating one than by donating two and accepting one. (3) This order is not maintained in the calculated X-ray emission spectrum (XES), which is less straightforward to interpret in terms of structure-property relationships than the DOS spectrum.

Related publications:
Bakó I; Mayer I; Hamza A; **Pusztai L**; Two- and three-body, and relaxation energy terms in water clusters: Application of the hierarchical BSSE corrected decomposition scheme; *Journal of Molecular Liquids*, **285**, 171-177 (2019). DOI: https://doi.org/10.1016/j.molliq.2019.04.088.

Bakó, I; Daru, J; Pothoczki, Sz; **Pusztai, L**; Hermansson, K; Effects of H-bond asymmetry on the electronic properties of liquid water – an AIMD analysis; *Journal of Molecular Liquids*, **293,** 111579 (2019). DOI: https://doi.org/10.1016/j.molliq.2019.111579.

(iii) Structure and related properties of tert-butanol-water liquid mixtures over the entire composition range. ***Hypothesis:*** Structural details, viscosity trends and dynamic phenomena in *t*-butanol/water solutions are closely related on the molecular scales across the entire composition range. Utilizing the experimental small- and wide-angle x-ray scattering (SWAXS) method, molecular dynamics (MD) simulations and the 'complemented-system approach', it is possible to comprehensively describe the structure-viscosity-dynamics relationship in such structurally versatile hydrogen-bonded molecular liquids, as well as in similar, self-assembling systems with pronounced molecular and supramolecular structures at the intra-, inter-, and supra-molecular scales. ***Experiments:*** The SWAXS and x–ray diffraction experiments and MD simulations were performed for aqueous *t*-butanol solutions at 25 °C. Literature viscosity and

self-diffusion data were also used. ***Findings:*** The interpretive power of the proposed scheme was demonstrated by the extensive and diverse results obtained for aqueous *t*–butanol solutions across the whole concentration range. Four composition ranges with qualitatively different structures and viscosity trends were revealed. The experimental and calculated zero-shear viscosities and molecular self-diffusion coefficients were successfully related to the corresponding structural details. The hydrogen bonds that were, along with hydrophobic effects, recognized as the most important driving force for the formation of *t*–butanol aggregates, show intriguing lifetime trends and thermodynamic properties of their formation.

Related publication: Cerar, J; Jamnik, A; Pethes, I; Temleitner, L; **Pusztai, L**; Tomšič, M; Structural, rheological and dynamic aspects of hydrogen-bonding molecular liquids: Aqueous solutions of hydrotropic *tert*-butyl alcohol; *J. Coll. Interf. Sci*., in press (2019); DOI: https://doi.org/10.1016/j.jcis.2019.10.094.

(iv) On the microscopic structure of the metallic glass $Pd_{40}Ni_{40}P_{20}$. The local structure of the $Pd_{40}Ni_{40}P_{20}$ bulk metallic glass was investigated by combining anomalous x-ray scattering at the Pd and Ni *K* absorption edges, X-ray diffraction, neutron diffraction, and reverse Monte Carlo modeling. From the structural models, partial structure factors and partial pair distribution functions, as well as three dimensional atomic configurations were obtained. In terms of details of the local structure, disagreement was found with an *ab initio* molecular dynamics simulations: the existence of the P-P nearest-neighbor configurations is clarified in the present experimental result. From Voronoi tessellation analyses, preference of recognisable icosahedral configurations is observed around the Ni atoms, whereas the local arrangements of atoms around Pd and P atoms are rather distorted.

Related publication: Hosokawa, S; Bérar, J-F; Boudet, N; Pilgrim, **Pusztai, L**; Hiroi, S; Maruyama, K; Kohara, S; Kato, H; Fischer, HE; Zeidler, A; Partial structure investigation of the traditional bulk metallic glass $Pd_{40}Ni_{40}P_{20}$; *Phys. Rev. B*; **100**, 054204 (2019); DOI: https://doi.org/10.1103/PhysRevB.100.054204.

Talks at meetings, seminars:
During my third year at IROAST, I have been invited to deliver talks at the following meetings:

(1) *International PDF workshop at SPring-8 (12-13 February, SPring-8 Facility, Hyogo, Japan)*
Title: „Reverse Monte Carlo modelling: Why? What? How?"

(2) *Pan Pacific International Symposium on Chalcogenide Functional Materials (10-11 November, Kumamoto University, Japan)*
Title: "Reverse Monte Carlo strategies for chalcogenide glasses"

In addition, I served as the main organizer and co-chairman of the 6th IROAST Symposium, titled '1st Pan-Pacific Reverse Monte Carlo Conference', held at Kumamoto University, on the 20th and 21st of February 2020. I delivered a talk there, as well.

2. Overview and significance of the research collaboration and lectures to the students

During my stays at IROAST, I've collaborated mostly with my host professor, Dr. Hosokawa, and his co-worker at the Department of Physics, Dr. Yoichi Nakajima, a young tenured-track

fellow.

Research proposals submitted:
(1) JSPS 'KAKENHI', type 'Challenging/Exploratory'; with Dr. Nakajima (under review).
(2) Beamtime applications to world class large scale facilities in Japan: SPring-8 synchrotron source (with Dr. Temleitner of the Wigner RCP, Hungary); and J-PARC pulsed neutron source (with Dr. Nakajima).

A joint publication with Prof. Hosokawa has appeared during FY2019.

The joint research work with Dr. Nakajima, on high pressure diffraction measurements of alcohol-water liquid mixtures, has been further extended: two more experiments have been completed, and another one is in the design stage. We very much hope that the first publications will be submitted during the present fiscal year.

A plan for the next fiscal has been formulated for offering a course for "Master's" students of FAST, KU (related to one Prof. Hosokawa's courses).

3. Comments/suggestions for IROAST/Kumamoto University

I have initiated the continuation of my presence at IROAST under the scheme that was started in FY 2017 – I think this clearly shows that in general, I am satisfied with my situation.

One point to mention perhaps, even though in practice, it does not influence much my daily life here: I think that after my third year finished at IROAST, I could be provided with the freedom that documents like my activity plan/report and budget plan I would be allowed to submit on my own – without bothering my (usually, extra busy) host professor.

4. Prospect for further research collaboration with Kumamoto University

The high pressure work, for which I obtain vital help and assistance from Dr. Nakajima, is expected to expand, by involving his students, as well – provided that we obtain a sufficient amount of (possibly, external) funding.

5. Impressions of Kumamoto University/Kumamoto

I can only repeat my words from my previous reports: life is convenient here for me, particularly as nowadays I'm staying in Kusunoki Kaikan. (If only a public washing/drying machine was available, somewhere in Kusunoki Kaikan, even if for a very limited time duration, like for 5 hours/week…)

No. 2-4	Development and management of biomaterials		
Name	Yufeng Zheng		
Affiliation (home)	Department of Materials Science and Engineering, College of Engineering, Peking University, China Email: yfzheng@pku.edu.cn yfzheng@kumamoto-u.ac.jp	Title	Professor
Research Field	Nanomaterial Science		
Period of appointment	04/01/2019-03/31/2020 (30 working days)		
Host Professor	Kazuki Takashima		
Affiliation	Department of Materials Science and Engineering, Faculty of Advanced Science and Technology Email: takashik@gpo.kumamoto-u.ac.jp	Title	Professor

1. Research achievements

I attended “The 7th International Symposium on Surfaces and Interfaces for Biomaterials” and gave a 60 minute plenary talk entitled “THE INTERFACE FORMATION AND EVOLUTION DURING THE IN VIVO DEGRADATION OF BIODEGRADABLE METALS”, from July 22-25, 2019, at Quebec City, Canada.



I attended Autumn Meeting of The Japan Institute of Metals and Materials, held at Tsukuba from Nov.24-26, 2019, and gave a 30 minute invited presentation entitled “Biodegradable Metals - definition, criteria, status and future”.



I attended 19th Asian BioCeramics Symposium (2019ABC) and 2019 International Symposium of Materials for Biomedical Application (2019 ISMBA), held at Taipei, from Dec.09-11, 2019, and gave an invited talk entitled “Recent advances on biodegradable metals for medical applications”.



In this financial year, I applied for Grants-in-Aid for Scientific Research -KAKENHI-(A), with the project title “機械的特性と生体内分解性に優れるZn-Li系新規生体金属材料の開発”, together with Prof. Kazuki Takashima, Jun Otani and Liqun Ruan as co-investigators.

In this financial year, I published 4 papers with the affiliation of IROAST:
Wei Yuan, Bo Li, Dafu Chen, Donghui Zhu, Yong Han, and **Yufeng Zheng**, “Formation Mechanism, Corrosion Behavior, and Cytocompatibility of Microarc Oxidation Coating on Absorbable High-Purity Zinc,” **ACS Biomaterials Science & Engineering,** 2019, 5, 2, 487-497

Hongtao Yang, Xinhua Qu, Wenjiao Lin, Dafu Chen, Donghui Zhu, Kerong Dai, and **Yufeng Zheng**, "Enhanced Osseointegration of Zn-Mg Composites by Tuning the Release of Zn Ions with Sacrificial Mg-Rich Anode Design," **ACS Biomaterials Science & Engineering**2019, 5, 2, 453-467

Guannan Li, Hongtao Yang, Yufeng Zheng, Xie-Hui Chen, Jian-An Yang, Donghui Zhu, Liqun Ruan, Kazuki Takashima, Challenges in the use of zinc and its alloys as biodegradable metals:Perspective from biomechanical compatibility, **Acta Biomaterialia** 97 (2019) 23-45

Hongtao Yang, Bo Jia, Zechuan Zhang, Xinhua Qu, Guannan Li, Wenjiao Lin, Donghui Zhu, Kerong Dai, Yufeng Zheng, Alloying design of biodegradable zinc as promising bone implants for load-bearing applications, **Nature Communications** 11 (2020) 401

2. Overview and significance of the research collaboration and lectures to the students
I conducted research collaboration with Prof. Takashima and Prof. Liqun Ruan by a joint experimental work on biodegradable zinc and its alloys, and we are going to conduct the mechanical testing on the corroded bulk samples at different timepoints after static immersion in simulated body fluid or with dynamic fatigue loading. The significance of this work is to reveal the degeneration of strength of biodegradable zinc under different corrosion environment.

3. Comments/suggestions for IROAST/Kumamoto University
Time goes fast. I wish that IROAST will get further support from the government and the university in the coming 5 years, and I am expecting to have the chance to continue my work at IROAST.

4. Prospect for further research collaboration with Kumamoto University
I will conduct research collaboration with Prof. Takashima, Prof. Jun Otani and Prof. Liqun Ruan under the framework of our proposal submitted for Grants-in-Aid for Scientific Research -KAKENHI-(A), no matter it gets approval or not.

5. Impressions of Kumamoto University/Kumamoto



I really enjoyed the peaceful and quite road on my way to work at IROAST.

3. Young Faculty Members for International Joint Research

No.	Name	Project Title
3-1	**Takahiro Hosono**	Coseismic hydro-environmental changes after the 2016 Kumamoto earthquake
3-2	**Kei Ishida**	Development of hybrid downscaling method of future climate projections
3-3	**Makoto Kumon**	Autonomous control of drones for environment monitoring
3-4	**Mizue Munekata**	Development and application of simultaneous measurement technique of pressure and temperature by luminescent paint using modulated excitation light
3-5	**Yuta Nakashima**	Bio-sensing and bio-imaging for cellular behavior
3-6	**Masayuki Tanabe**	Development of medial ultrasound functional sensor

No. 3-1	Coseismic hydro-environmental changes after the 2016 Kumamoto earthquake		
Name	Takahiro Hosono		
Affiliation	Faculty of Advanced Science and Technology Email: hosono@kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Environmental Science		
Period of Travel	-		
Host Researcher	Michael Manga		
Affiliation	Department of Earth and Planetary Science, University of California, Berkeley, USA	Title	Professor

1. Overview and significance of the international research collaboration

I made two major international research collaborations during 2019. One is the joint research with a research team from Department of Earth and Planetary Science, University of California, Berkeley, and the other is promoting Journal Special Issue editing in high impact international journal of our research field, Journal of Hydrology. Both collaboration research achieved very good results that will be explained in this report.

2. Research achievements and progress of the international joint research

1.1. Joint research with a research team from Department of Earth and Planetary Science, University of California, Berkeley

I and Profs. Michael Manga and Chi-Yuen Wang from University of California, Berkeley corroborate on publishing our co-authoring paper in international journal which describes hydrogeological changes during the 2016 Kumamoto earthquake. We communicate tightly via email and succeed our publication in high impact journal Water Resources Research. This publication was highlighted by Earth & Space Science News (EOS) Editors' Highlights with title 'Groundwater Drawn Downward After Kumamoto Quake'.
https://eos.org/editor-highlights/groundwater-drawn-downward-after-kumamoto-quake

Hosono, T., Yamada, C., Shibata, T., Tawara, Y., Wang, C.-Y., Manga, M., Rahman, A.T.M.S., Shimada, J., 2019. Coseismic groundwater drawdown along crustal ruptures during the 2016 Mw 7.0 Kumamoto earthquake. Water Resources Research, 55(7), 5891-5903.

Professor Chi-Yuen Wang visited Kumamoto on April 2019 to learn hydrogeological setting here and we discussed about future work. See photo bellow. Professor Michael Manga also visited Kumamoto on February 2020 to learn hydrogeological setting in Aso and we discussed about future work. We are submitting another manuscript to *Nature Communications*, which is in review now, and hopefully, the result will be reported in next year.



Snap photo with Professor Chi-Yuen Wang at Suizenji.

1.2. Special Issue in Journal of Hydrology

Journal Special Issue 'Coseismic hydro-environmental changes: Insights from recent earthquakes' was prepared for publication in the Journal of Hydrology, one of the major high impact international journals in our academic field. Very active interaction is necessary with many international co-workers to achieve this goal. Consequently, the Special Issue was published on line (see below link) and will complete official publication in May 2020. I published one Editorial article and 8 original research articles. Final complete results will be reported in next year.

https://www.sciencedirect.com/journal/journal-of-hydrology/special-issue/10B734S3PNW

Hosono, T., Masaki, Y. (2020) Post-seismic hydrochemical changes in regional groundwater flow systems in response to the 2016 Mw 7.0 Kumamoto earthquake. Journal of Hydrology, 580,124340.

Hosono, T., Saltalippi, C., Jean, J.-S. (2020) Coseismic hydro-environmental changes: insights from recent earthquakes. Journal of Hydrology, 585, 124799.

Ide, K., Hosono, T., Kagabu, M., Fukamizu, K., Tokunaga, T., Shimada, J. (2020) Changes of groundwater flow systems after the 2016 Mw 7.0 Kumamoto earthquake deduced by stable isotopic and CFC-12 compositions of natural springs. Journal of Hydrology, 583, 124551.

Kagabu, M., Ide, K., Hosono, T., Nakagawa, K., Shimada, J. (2020) Describing coseismic groundwater level rise using tank model in volcanic aquifers, Kumamoto, southern Japan. Journal of Hydrology, 582, 124464.

Kawabata, K., Sato, T., Takahashi, H.A., Tsunomori, F., Hosono, T., Takahashi, M., Kitamura, Y. (2020) Changes in groundwater radon concentrations caused by the 2016 Kumamoto earthquake. Journal of Hydrology, 584, 124712.

Miyakoshi, A., Taniguchi, M., Ide, K., Kagabu, M., Hosono, T., Shimada, J. (2020) Identification of changes in subsurface temperature and groundwater flow after the 2016 Kumamoto earthquake using long-term well temperature–depth profiles. Journal of Hydrology, 582, 124530.

Morimura, S., Zeng, X., Noboru, N., Hosono, T. (2020) Changes to the microbial communities within groundwater in response to a large crustal earthquake in Kumamoto, southern Japan. Journal of Hydrology, 581,124341.

Nakagawa, K., Yu, Z.-Q., Berndtsson, R., Hosono, T. (2020) Temporal characteristics of groundwater chemistry affected by the 2016 Kumamoto earthquake using self-organizing maps. Journal of Hydrology, 582, 124519.

Tawara, Y., Hosono, T., Fukuoka, Y., Yoshida, T., Shimada, J. (2020) Quantitative assessment of the changes in regional water flow systems caused by the 2016 Kumamoto Earthquake

using numerical modeling. Journal of Hydrology, 583, 124559.

1.3. Others

I succeed getting research foundation from JSPS which allows me to enhance international research collaboration including travel abroad. I will use this support for traveling in next 3 years to: University of California, Berkeley, USA, University of Canterbury, New Zealand, University of Rome, Italy, and University of Iceland, Iceland, with a partial support from IROAST program.

T. Hosono, principle investigator, JSPS Fostering Joint International Research (A), 2020-2023, 19KK0291

3. Prospect for further research collaboration with the visited university/institution

Prospection for further research was already mentioned above. I had a plan visiting University of Rome, Italy on June and University of California, Berkeley, USA on August 2020. However, currently this plan became suspended due to corona virus issue.

4. Comments/suggestions for IROAST (programs).

Thank you providing me good opportunities working within IROAST program. This is beneficial program for young researchers promoting ones' international research activity from both financial and phycological point of view.

No. 3-2	Development of Hybrid Downscaling Method of Future Climate Projections		
Name	Kei Ishida		
Affiliation	Faculty of Advanced Science and Technology Email: keiishida@kumamoto-u.ac.jp	Title	Assistant Professor
Research Field	Environmental Science		
Period of Travel	July 8, 2019 - July 18, 2019		
Host Researcher	Van-Thanh-Van Nguyen		
Affiliation	McGill University	Title	Professor
Period of Travel	August 5, 2019 – August 19, 2019		
Host Researcher	Ali Ercan		
Affiliation	University of California, Davis	Title	Assistant Research Professor

1. Overview and significance of the international research collaboration

Climate change is a large concern in many countries in the world now. To investigate impacts of climate change, future climate projections are used. Future climate projections are basically simulated results by means of general circulation models based on future climate scenarios. However, the resolutions of future climate projections are generally too coarse for regional-scale analysis. Therefore, downscaling technique is frequently utilized to obtain the projections at a finer resolution. There are mainly two types of downscaling techniques: Dynamical downscaling and statistical downscaling. Both of them have pros and cons. Therefore, hybrid downscaling technique, which is combined approach of dynamical and statistical downscaling, is sometimes utilized. In this international joint research, we will develop a new hybrid downscaling technique to improve estimations of climate change impacts at regional-scale.

2. Research achievements and progress of the international joint research

I visited McGill University in Montreal, Canada between July 8, 2019 and July 18, 2019 to meet Professor Van-Thanh-Van Nguyen. We had various discussions during my visit. First, we discussed issues of dynamical downscaling. Before my visit, I conducted dynamical downscaling over the Kyushu region in Japan by means of a three-dimensional regional atmospheric model. We found out difficulties of dynamical downscaling to obtain precipitation at watershed-scale for some purposes. In addition, we had discussions on how to improve precipitation estimation at watershed-scale by means of hybrid downscaling. We are now writing a journal paper on the issues of dynamical downscaling. Hopefully we can write it up, and submit it to an international journal in 2020.

I also visited University of California, Davis, the United States between August 5 , 2019 and August 19, 2019 to meet Dr. Ali Ercan and Dr. Tongbi Tu. We are now developeing hybrid downscaling method by combining dynamical downscaling with machine learning downscaling. Before my visit to California, I run a regional atmospheric model over the Kuma River watershed to obtain precipitation at sub-watershed scale. Then, we set up the methodology to downscale precipitation by means of machine learning approaches. We also conducted hybrid downscaling, a combination of dynamical and machine learning downscaling. Dr. Ercan and Dr. Tu are now working on writing a journal paper based on the hybrid downscaling results.

3. Prospect for further research collaboration with the visited university/institution

It may be difficult for me to visit the collaborators this year because of coronavirus. Therefore, we will set up an online meeting system among us to have further discussions on our collaborative research. Then, we will first write up journal papers based on our current results. After that, we will process the collaborative researches to develop and improve hybrid downscaling techniques.

No. 3-3	Autonomous Control of Drones for Environment Monitoring		
Name	Makoto Kumon		
Affiliation	Email: kumon@gpo.kumamoto-u.ac.jp	Title	Assoc. Prof.
Research Field	Advanced Green Bio.		
Period of Travel	Jun. 1-Nov.1, 2019, Nov. 18, 2019-Jan. 30, 2020, Mar. 4-Mar. 31, 2020		
Host Researcher	Tomonari Furukawa		
Affiliation	Virginia Polytechnic Institute and State University University of Virginia	Title	Professor

1. Overview and significance of the international research collaboration

The applicant has stayed at Virginia Tech. and University of Virginia under the supervision by Prof. Tomonari Furukawa to conduct a research on autonomous drone systems from June, 2019 until the end of the fiscal year. He worked on theoretical approaches for autonomous drone search, and also joined a team of robotic competition team to realize a real autonomous robot system.

2. Research achievements and progress of the international joint research

Drones have been widely utilized in these days under control by human operators. As autonomy for such drone systems will significantly extend their effectiveness, especially when working in a large fields or emergency sites where human cannot get close to, *e.g.* large-scale farms, forests and disaster/fire sites. Search is one of fundamental functions for such drones to detect and localize the target of interest, and the applicant has been on the project of autonomous search by drones in theoretical and experimental aspects in Virginia Tech and University of Virginia under the supervision of Prof. Tomonari Furukawa.

A) Theoretical analysis of state estimation in probabilistic robotics

1) Sound Source Active Localization based on Recursive Bayesian Estimation

It is one of sample applications of drone search to utilize a drone with a microphone array to detect and localize sound sources on the ground. The applicant has been working in drone-audition for these several years, and he has been collaborating with Prof. Furukawa to utilize Recursive Bayesian Estimation based localization. During the visit, the applicant formalized the control-policy decision method based on probabilistic inference utilizing RBE proposed by Prof. Furukawa (presented at IEEE/RSJ IROS 2019). The work pointed out that the multimodal belief distribution is inevitable under the existence of multiple targets in the search field, and, therefore, conventional approaches assuming unimodal distribution such as Kalman filter are not sufficient. Numerical simulations showed that the grid-based RBE that can handle any distributions showed flexible inference to guide a drone to search two sources. Experimental results using a real drone and its extensions have been also published (IEEE Robotics and Automation Letter 2020, IEEE International Symposium on System Integration 2020).

2) Grid-based Variational Bayesian Estimation

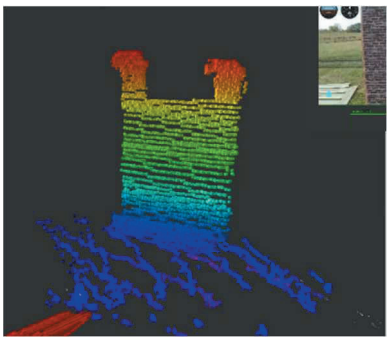
RBE is a filter to estimate the current belief from the obtained observations relying on the models of dynamics and observation. In order to relax *a priori* knowledge for those models, the applicant introduced the variational Bayesian inference to RBE so that the parameters of the models can be also estimated from the sensory information. Preliminary numerical

simulations showed the effectiveness of the approach, and evaluation with real application is planned for the next step. As this approach is an offline estimation, the computational cost increased by taking the parameters into account is not considered as critical, but it is also necessary to develop more computationally efficient techniques, which is another future work.

3) Parametric Bayesian Search with Negative-Observations
One of the effective approach to reduce the computational cost as pointed out in the previous section is to shift from grid-based method that is a nonparametric representation to a parametric method such as Gaussian mixture model. As Prof. Furukawa's group has already working a probabilistic search utilizing GMM like belief representation, the applicant joined the stream by considering the case of "negative observation" that is the information when the sensor reports the target is not in the field-of-view. Prof. Furukawa has already proposed grid-based RBE method to utilize that information for Search-and-Rescue scenario, and this study is going to extend its philosophy to more high dimensional general problems by reducing the search space to a limit number of Gaussian functions (see figure). As of the end of 2019 fiscal year, the basic theory has been formulated, and it is going to be tested by numerical parametric studies first, and then, it is planned to applied to real robotic applications in 2020.

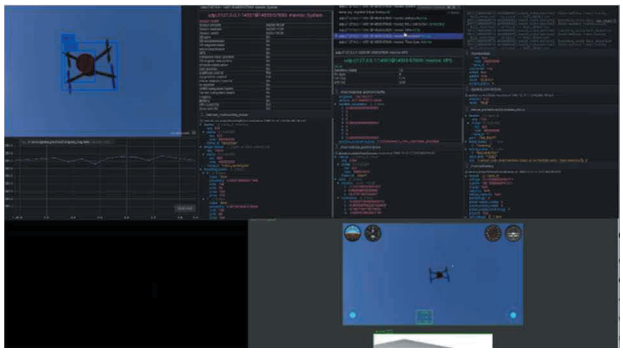
B) Experimental evaluation
As Virginia Tech and University of Virginia have their own special facilities for drone projects, drone cage and air field, the applicant joined a team to develop a real autonomous drone systems. The project targeted to demonstrate the abilities of the system at the international robotic competition, Mohamed Bin Zaid International Robotic Competition (MBZIRC), that was held in Abu Dhabi, UAE, in February of 2020 (figure). The applicant mainly joined the following components.





1) Perception and Control
In order to realize accurate and reliable observation, it is necessary to control the drone properly. One of the key features is to guide and hover the drone, and the applicant integrated a stable real-time kinematics (RTK) to the flight controller for accurate flight control. Thanks to this accurate localization, a simple laser scanner was able to be utilized to recognize an object in the field (figure). Besides, the stable flight supported to fly close to obstacles with avoiding them.

2) Human-machine interface design
As real operations for robots include human-machine interaction, sensory information from the robot to the ground control station is necessary. Especially, video feed is useful to monitor the state of the robot and the environment, which usually generates huge traffic. The team established a video compression system and the tailored communication configuration that worked even when multiple video streams were transmitted.



3. Prospect for further research collaboration with the visited university/institution
Theoretic works are still at the premature stage, and collaborative works of them will be

continued. MBZIRC project that the applicant joined has various outputs including working robot systems, and some of them are going to be utilized for successive projects. It is expected that the applicant may be able to have collaboration along with those projects.

4. Comments/suggestions for IROAST (programs).
The applicant greatly appreciates the IROAST program allowing him to have this precious opportunity conducting research in US. He is eager to encourage other researchers will join the program in the future.

5. List of journal papers
1) M. Wakabayashi, H. G. Okuno and M.Kumon, "Multiple Sound Source Position Estimation by Drone Audition Based on Data Association Between Sound Source Localization and Identification," IEEE Robotics and Automation Letters, Vol. 5, No. 2, pp. 782-789 (doi: //doi.org/10.1109/LRA.2020.2965417) Jan. 2020
2) Mizuho Wakabayashi, Kai Washizaka, Kotaro Hoshiba, Kazuhiro Nakadai, Hiroshi G. Okuno and Makoto Kumon, "Design and Implementation of Real-Time Visualization of Sound Source Positions by Drone Audition, " Proceedings of Int. Symposium on System Integration (SII2020), Honolulu, pp. 814-819, Jan. 2020
3) Yuto Kokusho and Makoto Kumon, "Sound Source Tracking by Incorporating Target Motion Estimated by Visual Trackers, " Proceedings of Int. Symposium on System Integration (SII2020), Honolulu, pp. 652-657, Jan. 2020
4) Kenshiro Yamada, Makoto Kumon and Tomonari Furukawa, "Belief-Driven Control Policy of a Drone with Microphones for Multiple Sound Source Search," 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Macau, China, Nov. 2019, pp. 5326-5332. doi: 10.1109/IROS40897.2019.8968119

No. 3-4	Development and Application of Simultaneous Measurement Technique of Pressure and Temperature by Luminescent Paint Using Modulated Excitation Light		
Name	Mizue Munekata		
Affiliation	Faculty of Advanced Science and Technology Email: munekata@kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Green Energy/ Environmental Science		
Period of Travel	November 2, 2019-November 10, 2019		
Host Researcher	Christian Klein		
Affiliation	German Aerospace Center Institute of Aerodynamics and Flow Technology	Title	Team Leader TSP/PSP

Pressure Sensitive Paint (PSP) measurement technique is based on the dependence of the intensity or decay time of its luminescence on pressure, brought about by oxygen quenching. PSP is usually exited by light at an appropriate wavelength (e.g. UV-Light) and its pressure dependent luminescence intensity or lifetime is detected by a camera system (CCD or CMOS). In the method based on the luminescent lifetime, two basic types of measurement exist: The first type is the time-domain lifetime method, which is mostly used in various PSP applications. For this method a pulsed light is used to excite the paint and the pressure dependent time constant is determined from decay curve of luminescence intensity. The second type is the frequency-domain fluorescence lifetime imaging (FLIM) where modulated light is used to excite the paint and the PSP luminescence is simultaneously detected to calculate pressure dependent phase shift or amplitude. Only few applications were reported using this method.

Recently, a new CMOS image sensor has been developed by CSEM and PCO for frequency-domain FLIM system and equipped in the pco.flim camera for fluorescence lifetime imaging in microscopy. In this study, the frequency-domain lifetime PSP technique (FLIM-PSP) is investigated using a larger model for industrial applications.

The FLIM-PSP technique with the pco.flim camera was investigated in calibration tests and a low-speed wind tunnel test and then we tested on the DLR-F17 wind tunnel model in the transonic wind tunnel of DLR. Further analysis of the results obtained with the DLR-F17 model in the transonic wind tunnel at various angles of attack, with focus on the vortex breakdown process(es) and on common peer-reviewed publication in the next future.

As one of new challenges, we have investigated simultaneous measurement of temperature and pressure with FLIM-PSP technique because of obtaining plural variables in this technique.

We would like to thank the IROAST to support our collaboration research at DLR in Germany.

No. 3-5	Bio-sensing and bio-imaging for cellular behavior		
Name	Yuta Nakashima		
Affiliation	Faculty of Advanced Science and Technology Email: yuta-n@mech.kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Advanced Green Bio		
Period of Travel	-		
Host Researcher	Dr. Douglas A. Coulter Dr. Hajime Takano		
Affiliation	The Children's Hospital of Philadelphia & University of Pennsylvania（UPENN）	Title	Professor Assistant Professor

This project objective is to develop the palm-size medical devices to apply to detection of disease and post-surgical management based by cellular kinetics. The development of the desired medical devices is need to fundamental technique shown below.

* Microfabrication technique for fabricating cell size and palm-size structure.
* Cell handling technique
* Sensing technique for cell produced signals such as protein, exosome, RNA, etc. on the devices.
* Imaging technique for detecting the morphology, movement, behavior, etc. on the devices.

In my laboratory, microfabrication technique and cell handling technique are already possessed. Host researchers has a lot of knowledges about in vitro and in vivo sensing/detection/imaging techniques for cell and tissue evaluation. We will promote joint research to achieve the objective medical devices by integrating our technologies.

In this season, we introduced the research equipment for real-time cultured cell observation system under the inverted microscope. This introduced system consists of a microscope mountable cell culture incubator and a super luminosity white LED light source. Thus, behavior and response of cultured cells using fabricated devices which has a cell culture chamber and some detection area can be observed in real-time and long time. This system can evaluate the tissue formation process, the dynamics of inducing cell differentiation, and the mechanism of function expression in vivo. Also, it can be applied to next-generation medical technologies such as regenerative medicine, transplantation medicine, and drug discovery. The introduction of this facility has a very effective and significance in the promotion of international joint research in the future, and the results obtained by the introduction can contribute to further deepening of research.

On the other hand, I had planned the discussion at host researcher laboratory in this March. However, I could not be achieved this plan by influence of COVID-19. In the next season, I will go to USA, and plan to start the collaborative research in host researcher laboratory at USA.

No. 3-6	Development of Medial Ultrasound Functional Sensor		
Name	Masayuki Tanabe		
Affiliation	Faculty of Advanced Science and Technology Email: mtanabe@cs.kumamoto-u.ac.jp	Title	Assistant professor
Research Field	Nanomaterial Science/ Advanced Green Bio		
Period of Travel	June 02, 2019-June 23, 2019 February 26, 2020-March 15, 2020		
Host Researcher	Elisa E. Konofagou		
Affiliation	Department of Biomedical Engineering and Radiology, Columbia University	Title	Robert and Margaret Hariri Professor
Period of Travel	September 19, 2019-September 21, 2019		
Host Researcher	Rajendra Udyavara Acharya		
Affiliation	School of Engineering, Ngee Ann Polytechnic	Title	Senior Faculty Member

I started a collaborative research on high-quality ultrasound visualization of high-speed imaging of the heart with Columbia University. I am also working with Ngee Ann Polytechnic and National Heart Centre Singapore in Singapore to develop an ultrasound device for the monitoring of cardiac disease. The results of ECG's Deep Learning analysis have been published in a paper and one patent has been filed in the US. The development of ultrasonic sensors and control circuits is progressing steadily. In September 2019, the collaboration was presented to the media in Singapore, with articles published and televised by Channel News Asia, Biospectrum, NNA and others.
I am grateful for IROAST's support in allowing me to stay at an overseas research institute. I would especially like to thank the staff for being flexible with the situation and giving me a friendly consultation. Unfortunately, because of COVID-19, I was not able to make a long stay at Columbia University. But I plan to continue the online collaboration steadily in the future.

Published paper:
Oh ShuLih, V. Jahmunaha,Tan RuSan, Edward J. Ciaccio, Toshitaka Yamakawa, Masayuki Tanabe, Makiko Kobayashi, Oliver Fauste, U. Rajendra Acharyaa, “Comprehensive electrocardiographic diagnosis based on deep learning” Artificial Intelligence in Medicine, Volume 103, March 2020, 101789, https://doi.org/10.1016/j.artmed.2019.101789

4. Visiting Professors

No.	Name	Project Title
4-1	**U Rajendra Acharya** HP: Makiko Kobayashi	Data mining techniques in Medical Informatics
4-2	**Josep-Lluis Barona-Vilar** HP: Makoto Takafuji	International collaboration research for design and application of organic/inorganic hybrid gel
4-3	**Olivier Boutin** HP: Mitsuru Sasaki	Development of Environmentally-benign molecular transformation techniques using sub/supercritical fluids and pulsed discharge atmosphere
4-4	**Maria Jose Cocero** HP: Tetsuya Kida Armando T. Quitain	Biomass to Green Energy Conversion Technologies
4-5	**Patrice Delmas** HP: Toshifumi Mukunoki	Image processing and analysis on Geotechnical and Geoenvironmental Engineering
4-6	**Etsuko Fujita** HP: Yutaka Kuwahara	Development of catalytic systems for CO_2 reduction by supramolecular systems
4-7	**Tomonari Furukawa** HP: Makoto Kumon	Autonomous Control of Drones for Environment Monitoring
4-8	**Hamid Ghandehari** HP: Hamid Hosano	Biomaterials for Localized Delivery: Design and Safety Considerations
4-9	**Olivier Hamant** HP: Shinichiro Sawa	Plant Cell and Developmental Biology
4-10	**Jens Hartmann** HP: Takahiro Hosono	Water quality in the Aso Caldera and Kirishima area
4-11	**Alexei Kuzmin** HP: László Pusztai	X-ray absorption methods for understanding disordered structures
4-12	**Tomoyasu Mani** HP: Yutaka Kuwahara	Utilization of Photons and Spins in Functional Materials

4-13	**Matthieu Micoulaut** HP: Shinya Hosokawa	Theory-Experiment Collaboration on Non-Crystalline Functional Materials
4-14	**Ramesh Shanmughom Pillai** HP: Tokio Tani	Studies on roles of nuage in piRNA biogenesis and functions
4-15	**Shirley Shen** HP: Kazuki Takashima	3D printing of Advanced Materials
4-16	**Daniel P. Zitterbart** HP: Kei Toda	Understanding the role of oceanic chemoattractants in marine animal navigation

HP: Host Professor

No. 4-1	Data mining techniques in Medical Informatics		
Name	Dr U Rajendra Acharya		
Affiliation	Email:aru@np.edu.sg	Title	Visiting Professor
Research Field	Nanomaterial Science/ Green Energy/ Environmental Science/ Advanced Green Bio/ Other (Artificial Intelligence)		
Period of Visit	September 2, 2019 to September 5, 2019		
Host Professor	Prof. Makiko Kobayashi		
Affiliation	Email: kobayashi@cs.kumamoto-u.ac.jp	Title	Assoc. Prof.

1. Research achievements:
Ans: (a) Discussed the project entitled “Automated wireless ultrasound patch”. We are likley to file a provisional patent on this topic.

(b) Submitting a paper “Comprehensive electrocardiographic diagnosis based on deep learning”

(c) Gave a talk on “AI in Healthcare”

2. Overview and significance of the research collaboration with Kumamoto University
Ans: Cardiovascular disease (CVD) is the leading cause of death worldwide, and coronary artery disease (CAD) is a major contributor. Early-stage CAD can progress if undiagnosed and left untreated, leading to myocardial infarction (MI) that may induce irreversible heart muscle damage, resulting in heart chamber remodeling and eventual congestive heart failure (CHF). Electrocardiography (ECG) can detect established MI and may also be helpful for early diagnosis of CAD. For the latter especially, the ECG perturbations can be subtle and potentially misclassified on manual interpretation and/or traditional algorithms found in ECG machines. For automated diagnostic systems (ADS), deep learning techniques are favored over conventional machine learning techniques, due to the automatic feature extraction and selection processes involved. This paper highlights various deep learning algorithms exploited for the classification of ECG signals into CAD, MI and CHF conditions. The Convolutional Neural Network (CNN), followed by combined CNN and Long Short-Term Memory (LSTM) models, appear to be the most useful architectures for classification. A 16-layer LSTM model was developed in our study and validated using 10-fold cross validation. A classification accuracy of 98.5% was achieved. Our proposed model has the potential to be a useful diagnostic tool in hospitals for the classification of abnormal ECG signals.

3. Comments or suggestions for IROAST/Kumamoto University
Ans: Better for the students to speak and write in English.

4. Prospect for further research collaboration with Kumamoto University
Ans: I shall continue to collaborate and write papers with Prof. Toshitaka Yamakawa, Prof. Masayuki Tanabe, and Prof. Makiko Kobayashi in the coming days.

5. Impressions of Kumamoto University/Kumamoto
Ans: Very good University and Professors are knowledgeable. Students are well behaved.

No. 4-2	International collaboration research for design and application of organic/inorganic hybrid gel		
Name	Josep-Lluis Barona-Vilar		
Affiliation	Instituto de Historia de la Medicina y de la Ciencia López Piñero (IHMC), Universidad de Valencia, Spain Email: Jose.Luis.Barona@uv.es	Title	Professor
Research Field	Nanomaterial Science		
Period of Visit	November 14, 2017-November 24, 2019		
Host Professor	Makoto Takafuji		
Affiliation	Faculty of Advanced Science and Technology Email: takafuji@kumamoto-u.ac.jp	Title	Professor

1. Research achievements.

I was in frequent touch with the Prof. Ihara and with Prof. Makoto Takafuji research group during my stage at Kumamoto University in November 2019. Prof. Ihara visited Valencia, where he visited our research Institute and laboratories, and we updated plans for the future. In November 2019 I visited Kumamoto University. During the period of my visit several aspects of the evolution of science and technology in modern and contemporary times have been discussed. One part of the visit was devoted to give intensive lecture-seminars to post-graduate students from different technological and scientific fields. Seven sessions were devoted to science and technology in the Antiquity, Middle Ages, Early modern colonial times, the Enlightenment and contemporary science. The role of science and technology in present times was also put into debate. Besides, I introduced the foundations of modern science and the history of science and medicine tradition in Spain and I gave a seminar lecture on “Technoscience: Risks & Opportunities of a Social Revolution” for graduate students, doctoral researchers and IROAST staff.

2. Overview and significance of the research collaboration with Kumamoto University.

The collaboration with Kumamoto University has contributed, on the one hand a humanistic, social and philosophical approach to present science and technology. In addition, it has started an interest on the several contributions of Japan to history of science and technology in the past. An example to this is the early development of research on physiology of nutrition in interwar years and the creation of the Imperial State Institute of Nutrition in Tokyo. I am preparing a book on the international impact of this institute in the first half of the 20th century.

Similarly, the research projects developed by the Takafuji Lab could find fruitful partnership in Valencia. In my opinion, the bilateral contribution can be reinforced in the future.

3. Comments or suggestions for IROAST/Kumamoto University.

Nowadays scientific and technological research (technoscience) is closely linked to social and economic development.

Therefore, a sociological and historical approach to the main issues and problems faced by the present world can contribute to enrich and clarify the debates. As a complement of laboratory expertise, social sciences and history would give the researcher a more intelligent and thoughtful

person. Master and PhD students should learn about social studies of science and technology. My intensive course on “The Origins of Modern Science and Technology” runs in this direction and it would be very fruitful for Kumamoto University to consolidate such wide humanistic approach to science and technology.

4. Prospect for further research collaboration with Kumamoto University

In addition to other possible collaborations in technical and scientific research, several collaborations could be started, such as the interchange of research experiences and research programs, master and PhD students, as well as the introduction of credits in humanities (history and philosophy of science and technology), history of health and medical sciences, and social studies of science.

For the next year 2020 I would be very pleased to teach the intensive course on “The Origins of Modern Science and Technology” for the Global Joint Education Center for Science and Technology, and eventually a second course on “Ethics and experimental research”, just in case this option could be interesting for the Kumamoto University.

5. Impressions of Kumamoto University/Kumamoto

Both Kumamoto University and IROAST are doing an excellent work and a hard effort to boost the internationalization of Kumamoto research groups. IROAST research projects, groups and topics have impact and good links with the international community and follow a well organized policy to achieve international impact. But also, internationalization means nowadays being fluent in foreign languages, with particular emphasis in English as *lingua franca* for the international science and technology community. Undergraduate and postgraduate students would make a step forward if a part of their courses were taught in English as well, and foreign students would have an easy way for academic integration in Kumamoto. Since the foundation of IROAST in 2016, Kumamoto University is working step by step into this direction as I had the occasion to realize at the March Kickoff symposium. Establishing a wide and solid network of research groups and programs is essential to be present at the international sphere.







No. 4-3	Development of Environmentally-benign molecular transformation techniques using sub/supercritical fluids and pulsed discharge atmosphere		
Name	Olivier Boutin		
Affiliation	Aix-Marseilles University, France Email: olivier.boutin@univ-amu.fr	Title	Professor
Research Field	Green Energy		
Period of Visit	January 23, 2020 – January 30, 2020		
Host Professor	Mitsuru Sasaki		
Affiliation	Institute of Pulsed Power Science Email: msasaki@kumamoto-u.ac.jp	Title	Assoc. Prof.

1. Research achievements

I stay one week at Kumamoto University. During the stay, we successfully discussed with Assoc. Prof. Sasaki about collaborative researches including student exchanges. One student came last year from Aix Marseille University to Kumamoto University for a three months internship. This year, two students will come from April to July. They are all very enthusiastic about their stay at Kumamoto and work at Kumamoto University. Two students from Kumamoto University came to my lab in 2019-2020, and another one is foreseen next autumn.

Students

F=France, J=Japan

2018: two students; FtoJ, 4 months: Yaca Dom, Di Wu

2019: two students; FtoJ, 4 months: Aurélien El Bonni; JtoF, three months: Hiroaki Takada

2020: three students; JtoF, two weeks: Hiras Manalu; FtoJ, four months: Philippe Sevim, Morid Ayoub

We would like to go on exchanges, from 1 to 2 in each direction each year.

2. Overview and significance of the research collaboration with Kumamoto University

During the stay, I present a scientific seminar on the use of Wet air oxidation process for different applications in the field of waste and waste-water treatments. The objectives were to present basics in properties of water at high pressure and temperature as well as specific applications, mainly in autarkic sites. I also give 6 hours of lessons to students to explain the functioning of municipal waste-water treatment plant.

Besides, we agree that the students we exchange between each university go on working on the same kind of research project during their training period. By this way, we expect in a very short time to be able to submit joint publications between Kumamoto and Aix Marseille University in international reviewed publications.

3. Comments to or suggestions for IROAST/Kumamoto University

The financial support and invitation from IROAST University was very much appreciated. It is the third time I come to Kumamoto University, and everything is well organized. I have to say that the collaboration between Dr Sasaki and myself began thanks to the fact Kumamoto and Aix en Provence are sister cities.

4. Prospect for further research collaboration with Kumamoto University

We will go on exchange students as well as propose projects to find financial supports. During this stay, we spent a day with Dr Sasaki to discussion deeply about the different research subject we can deal with our two research groups for further collaboration.

We have also discussed about a proposal for Units if young researcher (IROAST). Three topics can be proposed:
1- Oxidation process for wastewater treatment (including WAO …).
2- Biomass treatment: liquefaction, solid waste for adsorption.
3- Advanced extraction processes: shock waves, ultrasounds, supercritical CO2, subcritical water.
Four Universities would be involved:
1- Kumamoto University (Institute of Pulsed Power Science): M Sasaki, Hosano.
2- Aix Marseille University (Mechanics, Modelling and Green Processes): O. Boutin, JH. Ferrasse, E. Badens.
3- Alberta University (Agricultural, Food & Nutritional Science): A. Saldana
4- Valladolid University (High Pressure Research Group): MJ Cocero.
5- Indonesia??
We have to find a name (for instance Processes for biomass and waste treatment).

We have also identified two ways for applying for financial support :
1- JSPS Bilateral seminars: financial support for Japanese team, to see if other possibilities proposed in France.
2- Sakura project: for two years, financial support for Japanese and French teams, the researcher in Japan must have less than 46 years old.

5. Impressions of Kumamoto University/Kumamoto
Kumamoto university is very well organised and it is always a great pleasure to come. For Kumamoto city, and also for overall Japan, I have a very good impression, it is very easy to travel and visit.

No. 4-4	Biomass to Green Energy Conversion Technologies		
Name	Maria Jose COCERO		
Affiliation	High Pressure Research Group/Department of Chemical Engineering and Environmental Technology, Valladolid University (Spain) Email: mjcocero@iq.uva.es	Title	Professor
Research Field	Green Energy/ Advanced Green Bio		
Period of Visit	November 19-26, 2019		
Host Professor	Prof. Tetsuya KIDA/Prof. Armando T. QUITAIN		
Affiliation	Faculty of Advanced Science and Technology/College of Cross-Cultural and Multidisciplinary Studies Email: tetsuya@kumamoto-u.ac.jp/ quitain@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

During my stay at Kumamoto University as an IROAST Visiting Professor, I followed up on the research collaboration carried out by Dr. Armando T. Quitain, during his stay in my laboratory in Valladolid University (Spain) as IROAST International Collaborative Researcher and now as JSPS Scientist for Joint International Research. The following research-related and academic activities were carried out during my stay:

①Research collaboration on biomass utilization using microwave and supercritical fluid technologies

②Consultation with PhD and MS students, exchange students from ASEAN universities, and about 5 Japanese graduate students, currently working on biomass-related researches in the laboratory.

③Discuss about joint publication related to the abovementioned research collaboration topic

④Giving a seminar entitled “Lignin Biorefinery: Processes and Products”.

⑤Joined in the Global Team Teaching subject on “Perspectives on Biomass Utilization”, offered at the College of Cross-Cultural and Multidisciplinary Studies.

2. Overview and significance of the research collaboration with Kumamoto University

The research collaboration on the use of green technologies (supercritical fluid and microwave) for biomass utilization with Kumamoto University started more than a decade ago with Prof. Motonobu Goto, and was renewed by Dr. Armando T. Quitain when he visited as an IROAST Young Researcher in 2017 for half a year. This collaboration will significantly broaden the perspective of the participating students to the science and technology of this promising environmental topic.

My consultation and discussion with the students significantly helped the students’ capability and thinking about research. My expertise of the research topic will definitely guide the students to more promising research direction in the future. This gives an opportunity for them to have a discussion with prominent and leading scientists in this field, thereby improving their research capability and thinking. .

3. Comments or suggestions for IROAST/Kumamoto University

IROAST is doing a good job in globalizing cutting-edge research of Kumamoto University.

4. Prospect for further research collaboration with Kumamoto University

I will continue the research collaboration with Kumamoto University by continuously accepting students to my laboratory, and also by sending our students to Kumamoto University. Valladolid University has applied for an Erasmus Mobility Grant with Kumamoto University to further support the students and staffs mobility between the two institutions, and will consider applying for the program again. One alumnus from Kumamoto University, Dr. Elaine G. Mission, who was a doctoral student under Prof. Tetsuya Kida and Prof. Armando Quitain and who consulted me about her project last year, has been accepted for Marie-Curie Individual Fellowship Program, and will do research in my laboratory for 2 years starting May 2020.

With subsequent visits in the future, it is expected that a new set of students will benefit from it, and more research papers will be jointly published from this extended collaboration.

5. Impressions of Kumamoto University/Kumamoto

In my opinion, the consolidation of student mobility programs will be a strength of Kumamoto University. It could made a big difference to the students of Kumamoto University compared to those from other universities in Japan.

No. 4-5	Image processing and analysis on Geotechnical and Geoenvironmental Engineering		
Name	Patrice Delmas		
Affiliation	The University of Auckland Email: p.delmas@auckland.ac.nz	Title	Associate Professor
Research Field	Environmental Science/Image processing		
Period of Visit	January 6, 2019-December 19, 2019		
Host Professor	Toshifumi Mukunoki		
Affiliation	Faculty of Advanced Science and Technology Email: mukunoki@kumamoto-u.ac.jp	Title	Professor

1. Seminar Overview

The workshop investigated the potential of machine learning and most specifically deep learning techniques to the understanding of soils characteristics and behavior from various scales and horizons (above -aerial, and inside -CT-scan). The attendees provided several perspectives of deep learning techniques applications to a range of problems and images notably:

Opening address by Dr. Toshifumi Mukunoki

i) In marine, forestry and farming environment from aerial perspective
ii) for CT-scan image segmentation of brain images; in a multi-scale sensing and image analysis point of view; by Dr. Patrice Delmas
iii) 3D morphological and textural analysis of voxels datasets
iv) Micro-Macro scale issue and its modeling by Dr. Alfonso Gastelum Strozzi
v) Deep learning + Computer Vision in the context of New Zealand environment
vi) Multi-Scale UAV Mapping of surface topographies by Dr. Trevor Gee

Each lecture had 1 hour with Q&A.

2. Seminar Outcomes and Future Plan (e.g. about contribution to the development of young researchers and the initiation of international collaborative research aiming for the publication of international collaborative papers, etc.)

The young students received strong impression about the researches regarding basics of deep learning. Nowadays, AI is very popular so many people are using without deep understanding. For general users, it is OK because AI technology is very convenient. However, Dr. Delmas left a strong message to students if you did not understand what you were doing, you should not use it as your research tool if there are applications which may impact in human's life or well-being. But, indeed application of deep learning is very useful so try to understand machine learning first and then, study about deep learning. After the seminar, some technician and PhD candidates contacted them and discussed their own research how to use image analysis with deep learning to their own research. Dr. Delmas will come back to Kumamoto this summer as adjunctive professor to give a series lecture about Deep learning and Image analysis. This plan however may be placed on hold due to the current COVID-19 virus pandemic.

Dr. Gee is a specialist of Deep learning to Image analysis so now Dr. Mukunoki, Dr. Delmas and Dr. Gee have started collaborative research with respect to monitoring large area with respect to natural disaster like flood and landslides. As Deep learning uses large capacity of calculation, Dr.

Strozzi and his research Lab will contribute knowledge of CUDA (massively parallel processing architecture) for our project.

3. Others


Associate Prof. Mukunoki


Dr. Alfonso Gastelum Strozzi


Dr. Trevor Gee


Associate Prof. Patrice Delmas


Group Photo after seminar

4. Prospect for further research collaboration with Kumamoto University

In 2018, thanks to my IROAST position and financial support, I started to introduce new image processing methods to Professor Mukunoki's group with an aim to develop new research avenues. In 2019, my collaboration with Professor Mukunoki expended to joint funding applications to JSPS (Visiting fellowship and research funding application). An MBIE-New-Zealand Research Programme funding application (amount: $JPY 850,000,000) was submitted in March 2020 to strengthen our research collaboration in Image Processing theoretical and applied development for geotechnical and CT-scan imaging solutions. Currently both myself and Professor Mukunoki are part of a European Union Marie-Curie research staff exchanges funding proposal due soon involving colleagues in Europe and South America. As part of a collaboration initiated during the EU RISE PROTINUS project (2014-2018), A three-way collaboration between KU-UNAM (Mexico city)-UoA (Auckland) was struck with Dr Alfonso Gastelum Strozzi (Research Scientist, UNAM Mexico) and Professor Mukunoki meeting in Auckland (during the IVCNZ 2018 Conference I organized in Auckland) and again in Kumamoto for the IROAST workshop in December 2019. Ongoing discussions around research in physical modelling combined with Image Processing and Artificial Intelligence for geotechnical and CT-scan imaging solutions are currently taking place. To support the above research work, Professor Mukunoki supported a JSPS application to bring Associate Professor Delmas for several months at Kumamoto University over the summer 20202. The application received a B grade and was not successful. The JSPS fellowship will be revised and resubmitted in August 2020 for an intended stay during the summer 2021 working on novel hybrid Image Processing and Artificial Intelligence methods for the betterment of CT-scan imaging and analysis pipeline for geo-technical applications.

5. Impressions of Kumamoto University/Kumamoto

Kumamoto University is a very welcoming place with great facilities for lodging visiting researchers and for undertaking quality research. The group of post-graduate students I have been interacting with in the Faculty of Advanced Science and Technology is extremely motivated to learn and progress their skills in Image processing. I and my fellow research colleague Dr Trevor Gee engaged on several students' projects to support applied engineering solutions. The focus in 2019 was to combine the use of CT-scan facilities with new Image Processing algorithms. A prime focus of my stays as was the interaction with Professor Otani and Associate

Professor Mukunoki and their teams. I am looking forward to my following visits and of quality research outputs. I would love an on-campus facility with European quality coffee and Japanese quality desserts associated with the excellent existing catering facilities. I have a strong connection with Kumamoto city since experiencing the 16.04.16 earthquake event. I am always looking forward to coming back and experiencing the relaxed and welcoming atmosphere in Kumamoto and surrounding areas.

No. 4-6	Development of catalytic systems for CO_2 reduction by supramolecular systems		
Name	Etsuko Fujita		
Affiliation	Chemistry Division, Brookhaven National Laboratory, USA Email: fujita@bnl.gov	Title	Senior Chemist
Research Field	Green Energy		
Period of Visit	December 10-13, 2019		
Host Professor	Yutaka Kuwahara		
Affiliation	Faculty of Advanced Science and Technology Email: kuwahara@kumamoto-u.ac.jp	Title	Assistant Professor

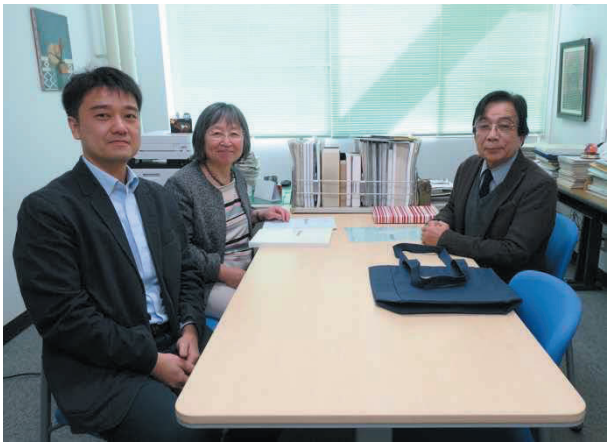
Despite a late arrival at the Kumamoto airport after the long trip from New York on December 10, I was cheerfully greeted and promptly taken to the Kumamoto Hotel Castle by Prof. Yutaka Kuwahara to have a good night's sleep.

The next day, Prof. Manabu Sugimoto, who stayed at BNL for one year as a visiting professor many years ago, treated me to a delicious Japanese lunch together with Prof. Kuwahara. We enjoyed scientific discussions including new directions, funding situations, and recent life at or near Kumamoto University and BNL. Then Prof. Kuwahara took me on an excursion to cruise the waterway of canals of Yanagawa. We were treated by an oarsman's talk on the city's long history, famous poems of Hakushu Kitahara, and occasional songs. The warm weather on that day was an additional gift for me to enjoy such an excursion on the narrow canals with the beautiful surroundings. And, of course, I enjoyed an "unagi no seiromushi" dinner at a restaurant in Yanagawa. It was a fantastic day for enjoying and learning about Japanese culture and history.

On Dec. 12, I presented a talk entitled "Our Investigations of CO_2 Reduction: Past and Present" at an IROAST sponsored seminar. I was very pleased to see many international visiting scholars and students at my seminar. After my talk, I was delighted by discussions of how to solve serious problems associated with an increased atmospheric CO_2 level and global warning as a chemist. I could only tell them that the use of solar energy to convert CO_2 to liquid fuels such as methanol, butanol and hydrocarbons is the best way, however, this is quite a challenging task, and that we need more innovative young researchers in this filed.

I also enjoyed taking with Prof. Hiyama, Director of the IROAST, and was very impressed by the continuing achievements in the pursuit of international collaborative research via IROAST and by the keen dedication of Prof. Hiyama and other faculty members hosting and educating international visitors at Kumamoto University.

After discussion of our ongoing research with Prof. Kuwahara, I left Kumamoto on Dec. 13. We hope our collaboration continues, even with an unfortunate cancelation of Prof. Kuwahara's visit to BNL in March, 2020 due to the COVID-19 pandemic.



No. 4-7	Autonomous Control of Drones for Environment Monitoring		
Name	Tomonari Furukawa		
Affiliation	Department of Mechanical and Aerospace Engineering, University of Virginia Email: tomonari@virginia.edu	Title	Professor
Research Field	Advanced Green Bio		
Period of Visit	Nov. 3, 2019 – Nov. 14, 2019		
Host Professor	Makoto Kumon		
Affiliation	FAST Email: kumon@gpo.kumamoto-u.ac.jp	Title	A. Professor

1. Research achievements

Activities with this visit include participation in IEEE/RSJ IROS Conference. The host professor presented a paper was co-authored by me, and the host professor attended a briefing of MBZIRC robotics competition where I have my University of Virginia team in. The joint participation allowed me and the host professor to see and discuss various research issues. I also gave a seminar to faculty and students at Kumamoto University and had a meeting with a student of the host professor. We could exchange various information to extend our collaboration in the future.

2. Overview and significance of the research collaboration with Kumamoto University

The host professor and I have been collaborating over ten years. The host professor has been working with me at University of Virginia under the IROAST program since June 2019. This is a collaboration that has been continuing consistently with success. It was important that I also visit Kumamoto University to communicate with faculty and students at Kumamoto University.

3. Comments or suggestions for IROAST/Kumamoto University

I thank IROAST and Kumamoto University to support our research collaboration.

4. Prospect for further research collaboration with Kumamoto University

The host professor will stay at University of Virginia until June 2019. We plan to write several papers jointly during his stay, and I also plan to apply for JSPS fellowship to plan a longer-term stay at Kumamoto University.

5. Impressions of Kumamoto University/Kumamoto

I grew up in Kumamoto, and my father worked at Kumamoto University. Kumamoto and Kumamoto University are special to me. As one of the few Japanese robotics professors who work at a top-rank US university, I try to leverage my experience and contribute to Kumamoto and Kumamoto University.

No. 4-8	Biomaterials for Localized Delivery: Design and Safety Considerations		
Name	Hamid Ghandehari		
Affiliation	Utah Center for Nanomedicine, Department of Pharmaceutics and Pharmaceutical Chemistry and Bioengineering Email: hamid.ghandehari@pharm.utah.edu	Title	Professor, Director
Research Field	Nanomaterial Science / Advanced Green Bio		
Period of Visit	December 17, 2019 - December 20, 2019		
Host Professor	Hamid Hosano		
Affiliation	Institute of Pulsed Power Science Email: hamid@kumamoto-u.ac.jp	Title	Professor

1. Research achievements:
Details of findings in the Ghandehari laboratory regarding nano-biomaterials for localized delivery and their design and safety considerations were presented to the audience. Highlights of some of the ongoing projects on polymeric drug delivery were presented.

2. Overview and significance of the research collaboration with Kumamoto University
Potential of collaborative projects at the interface of nanoparticle and polymeric drug delivery research in the Ghandehari lab with ultrasound and pulsed power technologies in the Hosano lab were discussed.

3. Comments or suggestions for IROAST/Kumamoto University
The IROAST initiative can significantly enhance international collaboration.

4. Prospect for further research collaboration with Kumamoto University
Such collaborative projects can potentially open new avenues for externally triggered drug delivery leading to improved safety and reduced toxicity of bioactive agents for specific disease treatment.

5. Impressions of Kumamoto University/Kumamoto
Colleagues were very hospitable. Kumamoto University is a leading international institution in several areas of research.

No. 4-9	Plant Cell and Developmental Biology		
Name	Olivier Hamant		
Affiliation	Email: olivier.hamant@ens-lyon.fr	Title	Dr
Research Field	Advanced Green Bio		
Period of Visit	December 3, 2019 – December 7, 2019		
Host Professor	Shinichiro Sawa		
Affiliation	Kumamoto University Email: sawa@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

- attended a symposium on plant biomechanics, organized by Prof. Sawa
- discussed various scientific projects with attendees and students
- shared material with Prof. Sawa as part of a collaborative project on stem integrity
- initiated a research project with Prof. Aida on meristem boundary and cell identity

2. Overview and significance of the research collaboration with Kumamoto University

- As a collaborator of a Kakenhi-funded project on plant biomechanics, I had the pleasure to share our results during my visit to Kumamoto university
- Together with Prof Aida, we already published a joint work on the role of mechanical forces in the expression of homeobox genes in plants (Landrein et al., 2015 eLife). The collaboration with Kumamoto university is another incentive to continue this effort.
- The collaboration with Kumamoto university is also a great way to share technical expertise. For instance, Prof Sawa has visited our lab at ENS Lyon, notably to get more hands on knowledge on atomic force microscopy and its application to study the mechanics of living plants.
- Given our mutual interests, I suspect our joint efforts will consolidate the position of the Japanese consortium on plant biomechanics, and thus the role of Kumamoto university on this emerging topic.

3. Comments or suggestions for IROAST/Kumamoto University

- I was impressed by the ambition to promote interdisciplinary interactions at IROAST, mixing engineering and biology, with many very promising developments (as shown at the plant biomechanics symposium)
- During my visit, I noticed that there is a great interaction between colleagues, a strong sense of work ethics, and an overall very friendly atmosphere on campus. These are all key ingredients for a successful university environment.
- A first suggestion, rather specific to the plant biomechanics group, would be to include one or two computational modelers in the mix, to help formalize and test hypotheses *in silico.*

- A second suggestion, if funds allow, would be to further strengthen the plant biomechanics and development group with more recruitment of staff on site in the future. This field is going to grow, and this is an opportunity to anticipate this trajectory, while standing out at the international level.
- Last, it might be useful to have meetings with some of the other visiting professors around a specific topic (not necessarily in Kumamoto actually), since IROAST also provides a common link. For instance, it would be easy to organize such an event with Christian Hardtke (He is also a visiting professor in IROAST) in Lyon or Lausanne, possibly jointly with the Lyon plant biomechanics conference in August 2021.

4. Prospect for further research collaboration with Kumamoto University

- I'm happy to continue to help the plant biomechanics and development consortium, with more interactions, and collaborations in the future. This may take the form of exchanges around know-how on mechanical tools, as well as sharing our results in different settings.
- In 2021, our institute will organize the next International Plant Biomechanics triennial conference. Our Japanese colleagues are of course very welcome, and I'm quite excited to hear about their latest results, while showing how advanced this new group already is in the field.
- Given our common interest, there will be opportunity for joint funding applications, including HFSP grants.

5. Impressions of Kumamoto University/Kumamoto

- The Kumamoto university shows a strong ambition, and the strategy to extend the international network, notably through IROAST, makes sense to me. At least, as part of the plant biomechanics and development consortium, there are clear positive outcomes.
- Thank to my host, I had a chance to visit the neighborhood, and enjoy the many attractive features of the city and its surrounding. Kumamoto is a great place to study, and a very nice environment for research, while offering spectacular scenery and enjoyable way of life.
- My visit to the university was extremely well organized, and I would like to take this opportunity to thank my host and his colleagues for their time and many fruitful discussions.

No. 4-10	Water quality in the Aso Caldera and Kirishima area		
Name	Jens Hartmann		
Affiliation	Email: jens.hartmann@uni-hamburg.de	Title	Professor
Research Field	Environmental Science		
Period of Visit	April 9th －16th, 2019		
Host Professor	Takahiro Hosono		
Affiliation	Email: hosono@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

Discussing a new publication about the joint research on water from the Aso-caldera using a new hydrothermal tracer.
Discussing future cooperation on a global water quality database, considering a long-term plan and strategy building on the previous GLORICH database.
Discussing a sampling tour for waters from the median tectonic line after the stay in Kumamoto (a tectonic line linking visually Aso caldera and Fuji san).

2. Overview and significance of the research collaboration with Kumamoto University

The study of controls on the water quality in tectonically active areas like Japan is of relevance as several under-researched processes control the water quality and the mobilization of matter and transport to the ocean. This includes seismotectonic processes causing deep water upwelling into the shallow groundwater and hydrothermal processes affecting the water quality directly at a local level. To be able to understand the regional controls on these fluxes, a research area like the Aso caldera or Kirishima represent unique opportunities due the given infrastructure with the cooperation partner in Kumamoto.
Specifically, the laboratory at Kumamoto University is of relevance as it is close to these highly active areas and samples can be handled directly in the laboratory at Kumamoto University.
The laboratory of Prof. Hosono is perfectly equipped for the joint work. We have conducted surveys for the past five years due this infrastructure and have now a set of samples and data, which allows us to analyses in depth the diverse processes controlling the water quality, also using novel isotope approaches, which were not combined in the way as it is now down.
The understanding that volcanic systems act also as a filter for deep carbon due weathering reactions, capturing CO2 before it enters the atmosphere is only emerging now, and we have here the opportunity to work at the frontier in this field. The research plan has a multi-year long vision.

3. Comments or suggestions for IROAST/Kumamoto University

I would like to thank IROAST and Kumamoto University for hospitality. The guest house is a very good infrastructure for visiting scientists, because of the calm area, not so loud as in the city and close distance to the laboratory in the morning. I am very happy.

4. Prospect for further research collaboration with Kumamoto University

In the next years we plan to analyse the multiple isotope systems for the named systems, to learn how fast the waters in the different compartments of the systems can change (kinetics of water evolution).
This is possible due to the decade long surveys by Kumamoto University achieving a unique data

set for water residence time and the new isotope data in combination. The interpretation and writing publications based on these data is the plan for the next visits, and we will continue as we have material for several years of research now.
We plan to work together on a global water quality database, which is a decade project.

5. Impressions of Kumamoto University/Kumamoto
Very good. Very friendly administration. I really like the Guest House. It is close to the laboratory, so not much time is wasted with travelling. I also thank for the opportunity to be able to use a room and store the equipment for our research.

No. 4-11	X-ray absorption methods for understanding disordered structures		
Name	KUZMIN Alexei		
Affiliation	Email: a.kuzmin@cfi.lu.lv	Title	Head of the Laboratory, Leading Researcher, Full Member of the Latvian Academy of Sciences
Research Field	Nanomaterial Science		
Period of Visit	February 17, 2020-February 24, 2020		
Host Professor	PUSZTAI László		
Affiliation	Email: lpusztai@u-kumamoto.ac.jp	Title	Distinguished professor

1. Research achievements

During the recent visit at IROAST, I have delivered an invited talk at the 6th IROAST Symposium/1st PanPacific Reverse Monte Carlo Conference (Kumamoto University, 20 and 21 February; the talk was on the 20th).

Also, we have conducted discussion with Prof. Pusztai concerning a possible submission in the near future.

During FY 2019, I have submitted a publication in which I also showed IROAST. The details of this paper are:
A. Kuzmin, J. Timoshenko, A. Kalinko, I. Jonane, A. Anspoks,
Treatment of disorder effects in X-ray absorption spectra beyond the conventional approach,
Rad. Phys. Chem. (2019), doi: 10.1016/j.radphyschem.2018.12.032. [Review]

2. Overview and significance of the research collaboration with Kumamoto University

The XAS methodologies, in combination with advanced (classical and quantum) computer simulation methods, are central to the research activities of, for instance, Profs. Hosokawa, Shimojo (Department of Physics, KU), and Akai (Institute of Pulsed Power Science, KU). Also, there are many issues that are of common interest with IROAST Distinguished Professor Pusztai, such as the local structure around ions in aqueous electrolyte solutions (relevant to 'Nano Material Science', as well as perhaps to 'Environmental Science').

With Prof. Pusztai, we work on the – unfortunately, non-trivial – problems of the interpretation of the EXAFS signal from larger alkali ions (Cs+, Rb+) in aqueous solutions.

3. Comments or suggestions for IROAST/Kumamoto University

I am grateful to the IROAST center for the invitation and financial support. The IROAST activities will undoubtedly enhance the visibility of the Kumamoto University and promote

international collaboration.

4. Prospect for further research collaboration with Kumamoto University

As we have discussed with L. Pusztai, I would be willing to visit IROAST also in FY 2020. I would be ready to deliver an ‘IROAST Seminar’, naturally.

5. Impressions of Kumamoto University/Kumamoto

It was my first visit to Kumamoto University and to Japan. I have appreciated a lot the hospitality of the IROAST center and my host professor Laszlo Pusztai. Good organization of the 1st PanPacific Reverse Monte Carlo Conference should be especially noted – it was very interesting and productive event. My impression of the Kumamoto City is very positive as well.

No. 4-12	Utilization of Photons and Spins in Functional Materials		
Name	Tomoyasu Mani		
Affiliation	Email: tomoyasu.mani@uconn.edu	Title	Assistant Professor
Research Field	Nanomaterial Science		
Period of Visit	February 04, 2020 -February 07, 2020		
Host Professor	Yutaka Kuwahara		
Affiliation	Email: kuwahara@kumamoto-u.ac.jp	Title	Assistant Professor

1. Research achievements
I visited the Kumamoto University on February 04-07, 2019. I gave a talk entitled “Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules” on February 6th. We had a lively question and answer session that I really enjoyed. Before and after the talk, we discussed a couple of our collaborative projects, one of which is exploring the possibility of using electron spins to control chemical reactions. This project is the one my student Reid Wilson was working on as an IROAST intern during that time.

I went on an excursion to the Mt. Aso area on February 5th, and briefly visited the Kumamoto castle on February 7th with Prof. Kuwahara and Mr. Reid. It was my first time to visit Mt. Aso, and it was quite an interesting experience as Mt. Aso was relatively active on 6th.

2. Overview and significance of the research collaboration with Kumamoto University
Our collaboration is built on a mutual interest of developing novel functional molecules/materials. Our expertise in optical spectroscopy, including time-resolved techniques, small molecules synthesis, and computational chemistry complement well Prof. Kuwahara and his group’s expertise in molecular self-assembly and chiral chemistry. This collaboration enables us to enter a new field, expanding our research programs.

3. Comments or suggestions for IROAST/Kumamoto University
I was impressed by the depth and breadth of research that goes on at IROAST/Kumamoto University as well as their strong international collaborations. In particular, I was fortunate that IROAST has accepted my student as an IROAST intern, which significantly helped deepen our collaboration with Prof. Kuwahara.

4. Prospect for further research collaboration with Kumamoto University
In the coming years, I expect that we can further grow our collaborative efforts with Prof. Kuwahara and his group. Prof. Kuwahara plans to visit the University of Connecticut from March 6-10, 2020. We plan to further discuss our collaborative projects.

5. Impressions of Kumamoto University/Kumamoto
This was my second time visiting Kumamoto University and Kumamoto. As I did not have time to see around Kumamoto University and the Kumamoto area last time, I very much enjoyed visiting the lab and going on the excursion.



At the excursion to the Mt. Aso area

No. 4-13	Theory-Experiment Collaboration on Non-Crystalline Functional Materials		
Name	Matthieu Micoulaut		
Affiliation	Sorbonne Université Email: mmi@lptl.jussieu.fr	Title	Professor
Research Field	Nanomaterial Science		
Period of Visit	November 7, 2019-November 12, 2019		
Host Professor	Shinya Hosokawa		
Affiliation	Department of Physics, Faculty of Advanced Science and Technology Email: shhosokawa@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

Professor Matthieu Micoulaut is a professor of Physics Department in Sorbonne University, Paris, who is an expert of theoretical physics on non-crystalline materials, and published a significant number of scientific papers in high impact journals, such as Nature Communications. He was an organizer of mini symposium 'Structure-Property Relations in Amorphous Solids' in Fall Meeting of Materials Research Society in 2014, and invited SH as an invited speaker.
During the present visit, Professor Micoulaut gave an invited talk titled "Structure and dynamics of chalcogenides" in the IROAST Seminar/ Pan Pacific International Symposium on Chalcogenide Functional Materials is held on 10-11 of November at Faculty of Science, Kumamoto University. See the photograph in Fig. 1. In his presentation, he introduced his recent works on the atomic structure and dynamics of archetypal chalcogenide glasses such as As-Se, Ge-Se, and Ge-Te systems investigated from rigidity theory and molecular dynamics (MD) simulations.

2. Overview and significance of the research collaboration with Kumamoto University

The interaction and collaboration with Professor Hosokawa is mostly valuable. We have now been involved in a long-standing interaction and have been working closely together on the link between structure, rigidity and glass transition in network glasses. Our common theoretical framework builds on topological constraint theory which views a network of chemical bonds linking atoms as a network of mechanical constraints. The network as a whole is then viewed to be either in a *Flexible Phase* or an *isostatically rigid Intermediate Phase* or a *Stressed-Rigid Phase* if the number of constraints per atom, n_c , is respectively lower than, equal to or higher than the number of degrees of freedom per atom , i.e., $n_d = 3$ for 3D networks. These 3 phases have now been simulated or observed in scores of network glasses. We have been including temperature dependent bonding constraints for bond-bending and bond-stretching forces, and this has opened a new domain and possibility of interaction. It made feasible to model structure and dynamics of glassy melts using MD simulations, and by establishing the variance in bond-lengths and bond-angles as a function of Temperature one could establish constraints that are either fully or partially intact.

Common applications with Kumamoto University deal with systems such as As-Se and Ge-Se where a combination of molecular simulation methods performed in Paris can be directly

compared to Reverse Monte Carlo modelling and neutron/X-ray diffusion data and anomalous X-ray scattering that he and his colleagues are accumulating at Kumamoto University. I have proposed new extensions to the mean-field constraint counting analysis initially introduced by Phillips and Thorpe, to account for new observations that open potential and promising applications. That interaction was mutually beneficial.

3. Comments or suggestions for IROAST/Kumamoto University

No comments or suggestions. Everything went fine during the visit.

4. Prospect for further research collaboration with Kumamoto University

The question of homopolar bondings in amorphous chalcogenides such as As-Se and Ge-Se and to a larger extent Ge-Te that serves as base for optoelectronic applications will continue to stimulate a number of research activities in the future. In this respect, the partial resolution of pair correlations using anomalous X-ray scattering will continue to be a method of choice in order to check structural models obtained independently from First Principles molecular dynamics simulations.

5. Impressions of Kumamoto University/Kumamoto

A very nice impression of the campus, the guest house. I have been also impressed by the facilities that can be used to characterize glasses experimentally.



Fig.1 Photograph of the speakers at Pan Pacific International Symposium on Chalcogenide Functional Materials. Prof. Micoulaut is 4th from right of the back row.

No. 4-14	Studies on roles of nuage in piRNA biogenesis and functions		
Name	Ramesh Shanmughom Pillai		
Affiliation	Department of Molecular Biology, University of Geneva, Switzerland Email: Ramesh.Pillai@unige.ch	Title	Professor
Research Field	Advanced Green Bio		
Period of Visit	December 18, 2019-December 21, 2019		
Host Professor	Tokio Tani		
Affiliation	Faculty of Advanced Science and Technology Email: tttani@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

The central goal of the collaborative project with Prof. Tani is to understand how germline-specific RNA-protein granules called nuage are assembled. Nuage is implicated in the biogenesis of small RNAs called Piwi-interacting RNAs (piRNAs). My lab has developed a systematic imaging-based screen for such Nuage-localizing signals (NuLS). We have designed a library of DNA sequences that express thousands of peptide sequences encoding for the entire possible ~15 aa protein sequences from all the known (>20) piRNA biogenesis factors present in the *Bombyx mori* (Silkworm) BmN4 ovarian cells. These are then inserted into a vector expressing Green Fluorescent Protein (GFP) to express fusion proteins in BmN4 cells. After expression, we will use microscopy to detect those cells that have GFP localized in cytoplasmic granules. These single cells will be picked up for single-cell PCR amplification of the insert expressed. Cells with GFP being diffusely present in the cytoplasm and nucleus will be picked as negative controls. The identified NuLS peptides will then be further characterized. Our preliminary data with positive controls confirm the feasibility of the protocol. We are also developing an automated pattern-recognition software that can guide the microscope to make this process high-throughput. Overall, this screening project is proceeding well and hopefully, we should have some insights on nuage biology in the coming months.

2. Overview and significance of the research collaboration with Kumamoto University

The collaboration with Prof. Tani's laboratory at Kumamoto University is significant, as his lab is screening for compounds that can either enhance or decrease nuage formation. In fact, they have identified compounds that are either kinase or phosphatase inhibitors that have opposing effects on nuage formation. Our identification of NuLS peptides will allow the two studies to come together and synergize, as we will be able to look for phosphorylation site motifs in the NuLS that might modulate its activity. Knowledge of the NuLS peptides might help us screen for putative kinase and phosphatase regulators of nuage formation. Thus, the collaboration between University of Geneva and Kumamoto University is critical for a complete success of this project.

3. Comments or suggestions for IROAST/Kumamoto University

The IROAST program of the Kumamoto University is a shining example of how to promote international collaborations and scientific exchanges. It brings labs at Kumamoto in contact with others across the world, and provides financial means to have a meaningful interaction. The benefits for students in Kumamoto to interact with the visiting PIs is a positive aspect.

First, the IROAST could consider putting more resources at the disposal of the local collaborator to facilitate the actual research. This could take the form of a small grant that can cover the expenses involved in the Kumamoto partner's laboratory. Second, if sufficient funds are available, IROAST could fund a limited number of collaborative PhD projects with the international partner (IROAST International PhD Fellowship). This could be a 3- or 4-year PhD duration, where each partner would contribute 50% of the funding. This should mean that the PhD student will move to the international partner's lab for continuing 50% of the research: 2 years in Kumamoto and 2 years in Geneva. The costs for each phase of the project is provided by each partner. I guess this might require establishment of co-tutorship contracts between the two Universities. I support it and happy to facilitate this from my side.

4. Prospect for further research collaboration with Kumamoto University
I consider my collaboration with Prof. Tani to only increase, as we both have interests in the emerging field of RNA modifications. Our labs are in regular contact on this topic and exchanging ideas and protocols. We have already discussed ideas to develop a second project together.

5. Impressions of Kumamoto University/Kumamoto
I am always impressed by my interactions with Kumamoto students and Faculty. What strikes me the most is the fact that all the students from the Masters program land jobs in the industry, immediately after completing their course. This is a phenomenal achievement and a testimony to the excellent education and training provided by the University Faculty.



No. 4-15	3D printing of Advanced Materials		
Name	Shirley Shen		
Affiliation	Email:Shirley.shen@csiro.au	Title	Dr.
Research Field	Nanomaterial Science		
Period of Visit	06 28 2019 – 07 10 2019		
Host Professor	Prof. Kazuki Takashima		
Affiliation	Email: Takashik@gpo.kumamoto-u.au.jp	Title	Professor

1. Research achievements

We (CSIRO Manufacturing and Kumamoto University IROAST) have successfully gained a FAJS (Foundation for Australia-Japan Studies) Research Award (AU$150K for 12 months) in 2019 round on a project of “3D Printing of Novel High Vapour Pressure Metals and Metal Matrix Composites as Bio- degradable Implant Components”, which will harness leading CSIRO AM (additive Manufacturing) capabilities and Kumamoto University biodegradable alloys capabilities to develop 3D Printing of Mg-Ca and Zn-based systems. It is expected to result in new AM techniques, new geometries/customization, materials degradation, biocompatibility advances, and alloy optimization for optimized clinical care. One purpose of this visit is to discuss the details of the project and how we can work closely together to achieve proposed goal.

2. Overview and significance of the research collaboration with Kumamoto University

The relationship between CSIRO Manufacturing and Kumamoto University (KU) started with my visit to KU in 2014 with Australia Academy of Science travel grant for scientific visit to Japan. When I met Prof R. Gen and Prof T. Hiyama in 2014, we decided to purchase our further and broader collaboration. Since then, we continue working on developing our collaboration with mutual benefits. Prof Gen gained a CSIRO Distinguished Visiting Researcher (DVR) fund to visit CSIRO several times between 2018-2019, Prof T Hiyama and Prof K Takashima also paid a visit to CSIRO Manufacturing at the end of 2018. I obtained the visiting professorship in May 2019. We have formally signed a MOU in May 2019. CSIRO Manufacturing treasure our developing relationship with Kumamoto university very much. We are more than happy to work together with Kumamoto University now and in the future to continue and strengthen our relationship and bring it deeper and broader to different areas, for example, medical materials and devices.

3. Comments or suggestions for IROAST/Kumamoto University

I visit KU twice so far, really and really appreciate the excellent opportunities to being in this wonderful IROAST and KU, which are so impressive and attractive. We will work together on developing further research and educational collaboration further based on our current project and engagement. I do hope we can build deeper and further collaboration between CSIRO Manufacturing and Kumamoto University IROST soon.

4. Prospect for further research collaboration with Kumamoto University

IROAST is the current Centre we have collaboration with. During this visit, I have excellent opportunities to visit a few labs with the Centre, impressed by the lab management, staff capabilities and education activities happening in labs. I have also have excellent opportunities to have met a few staff in the Centre, for example, Prof S. Ando, Dr. Mayama and Dr Kwak and so on, apart from Prof Takashima, Prof Hiyama and Prof Gen, who have met a few times. We have discussed in different occasions for how we can further develop our collaboration through different projects. we will develop more connections and exchanges of staff, ideas, research interests and development briefs to each other further. I have also have the privilege to have met Prof Odani and also discussed how we would like to extend our collaboration and relationship to broader areas and other centers or department in KU, for example, IRCMS. I can also introduce KU to some of Australian universities, such as Monash University and RMIT university in Melbourne to develop further collaboration beyond CSIRO.

5. Impressions of Kumamoto University/Kumamoto

I have had an excellent impression of KU and Kumamoto and I am more than happy to visit KU in near future.

Kumamoto is located in the center of Kyushu Island in Japan and is rich in nature. Kumamoto has the huge volcanic Aso mountain and the picturesque Amakusa seashore with small islands connected by 5 bridges. KU is situated in Kumamoto City where historic Kumamoto castle is surrounded by many trees, so called FOREST CITY. Kumamoto is also known for its high quality fresh water springs, which provide drinking water to the residents. I climbed on the hill in fresh greenery behind the KU campus.
KU is one of the oldest universities in Japan with seven faculties, eleven graduate schools and 23 research centers/institutes (as of August 2017) that support a wide spectrum of educational and research activities. Currently, the university is home to around 8,000 undergraduate students and 2,000 graduate students, including 507 international students from 49 countries (as of May 2017). For over 100 years KU has been at the forefront of culture, advancing science and technology, and contributing to the development of the Japanese educational system.

Recently, KU has been selected by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) for the following 3 projects; the Program for Promoting the Enhancement of Research Universities, the Top Global University Project and the Center of Community Project. Consequently, KU will be seeing increased internationalization brought about by international academic and student exchange programs (as of September 2017, KU has partnered with 222 institutes from 44 countries and regions), global-collaboration research programs with the world's leading researchers, and other such international activities. The short-term international student exchange programs are conducted at both KU and partner universities. Through these activities, KU has been contributing to local communities and to global society.

KU seeks to cultivate an open mind with a broad view, a creative imagination, the ability to solve problems, and the aptitude to communicate internationally. I believe that KU will have educated many competent professionals and leaders of future societies. I do hope CSIRO and KU will have stronger and closer collaboration in the future.

No. 4-16	Understanding the role of oceanic chemoattractants in marine animal navigation		
Name	Daniel P. Zitterbart		
Affiliation	Email: dpz@whoi.edu	Title	Assistant Scientist
Research Field	Environmental Science		
Period of Visit	November 1, 2019 – November 26, 2019		
Host Professor	Kei Toda		
Affiliation	Department of Chemistry Email: todakei@kumamoto-u.ac.jp	Title	Professor

1. Research achievements

This was my first visit to Prof. Toda's lab and Kumamoto. The main topic was for me to learn more about the methods developed here in Kumamoto to measure dimethyl sulfide (DMS) in nature. This was accomplished during my time at Prof. Toda's laboratory, I could deeply increase my understanding of the theory and practice behind measuring DMS. This allowed me to put the measurement, which so far has been mainly done on land, in context what is necessary to make it work on small platforms like small boat or even underwater robots. During my visit Prof Toda and I further developed the current experimental setup and derived a new instrument setup that will be now implemented at Woods Hole Oceanographic Institution and used at the next field experiment in February. I had the pleasure to present in the IROAST seminar. We also finalized and submitted one manuscript from a previous field experiment.

2. Overview and significance of the research collaboration with Kumamoto University

My main aim during my visit at Kumamoto University was to immerse myself in the Environmental Chemistry research of Prof. Toda's research group, specifically to learn about the different methods he has developed to measure DMS in the natural environment. As DMS may play a key role in how animals orient during navigational processes which is my main research area, I am interested to incorporate such measurement in several of my research projects. After an initial experiment in June 2019, we decided to further invest and strengthen the collaboration between our two labs. We are planning several more experiments across the world using Prof Toda's DMS measuring technology with animal navigation experiments developed in my lab.
We initiated a student exchange between Woods Hole Oceanographic Institution and Kumamoto University.



Joint field experiment in June 2019.

3. Comments or suggestions for IROAST/Kumamoto University

The invitation to become an IROAST visiting associate professor, allowed me do conduct this extended visit which will greatly enhance my research program. I appreciated to be provided with an office, which gave me the quiet needed between lab research to conduct necessary writing during my stay. It would be ideal for the future if the on-campus residence would be possible for visitors with family and study space for longer stays. It would be great to facilitate IROAST social gatherings that would allow to meet the other visiting faculty during ones stay and further increase the network within IROAST.

4. Prospect for further research collaboration with Kumamoto University

Prof Toda and I are actively working on extending our collaboration. This is expressed in jointly planned field experiments (up to 6 in the next 3 years) and in coordinated Research proposals across Japanese and US funding agencies to fund our field experiments. After initiation of a student exchange program we plan to have concurrent PhD students in this research fields at both institutions.

5. Impressions of Kumamoto University/Kumamoto

Kumamoto is a great city to visit and conduct research. The University is conveniently located and just a nice stroll from downtown along the river. Kumamoto and its inhabitants are very welcoming and provided great support. I am looking forward to future visits and the scientific outcome of our collaboration in the coming years. I hope to welcome Prof. Toda and his students again in Woods Hole and provide the same hospitality.

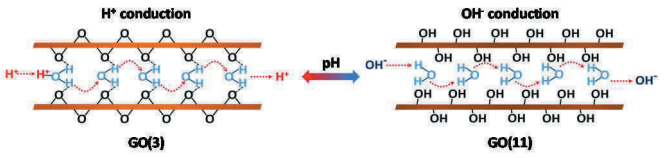
5. Research Units

No.	Unit Name	Unit Coordinator
5-1	**Development of Nano and Supramolecular Materials**	Shinya Hayami
5-2	**RNA Biology**	Tokio Tani
5-3	**Plant Cell and Developmental Biology**	Shinichiro Sawa
5-4	**Nano-Organics and Nano-Hybrids**	Hirotaka Ihara
5-5	**Nano-medicine and Drug Delivery System**	Takuro Niidome Hamid Hosano
5-6	**Multiscale Modeling of Soil and Rock Materials Using X-ray CT**	Jun Otani
5-7 5-8	**Medical Application of X-ray CT** **-Quantification of Three Dimensional Vascular Network** **-MicroCT-based Quantification of Fibrosis and Vascularization in Pancreatic Tumor**	Toshifumi Mukunoki
5-9	**Advanced Structural Materials**	Kazuki Takashima
5-10	**Microstructure Analysis and Grain Boundary Engineering**	Sadahiro Tsurekawa
5-11	**Structure and Dynamics of Materials Using Quantum Beams and Data-Driven Sciences**	Shinya Hosokawa
5-12	**Hydrological Environments**	Takahiro Hosono
5-13	**Quantitative Bioimaging**	Takumi Higaki
5-14	**Development of novel therapeutic strategy using iron targeted upconversion nanoparticles for Parkinson's disease**	Ruda Lee
5-15	**Deep Learning for Hydrology**	Kei Ishida
5-16	**Environmental Impacts of Ionic Solutes**	Shin-Ichi Ohira
5-17	**Radio Astronomy**	Keitaro Takahashi
5-18	**Plant Stem Cells and Regeneration**	Mitsuhiro Aida
5-19	**Development of microbially-aided carbon sequestration technology**	Atsushi Sainoki

No. 5-1	Development of Nano and Supramolecular Materials		
Research Field	Nanomaterial Science/ Green Energy/ Environmental Science/ Advanced Green Bio / Next-generation Technology		
Unit Coordinator			
Name	Shinya HAYAMI		
Affiliation	Kumamoto University Email: hayami@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Shintaro IDA Jorge BELTRAMINI Yang KIM Rahul Raveendran NAIR Martino DI SERIO Masaaki NAKAMURA Michio KOINUMA	Kumamoto University / Professor Queensland University of Technology / Professor Kosin University / Professor The University of Manchester / Professor University of Naples Federico II / Professor Kumamoto University / Associate Professor Kumamoto University / Associate Professor		

1. Overview of achievements

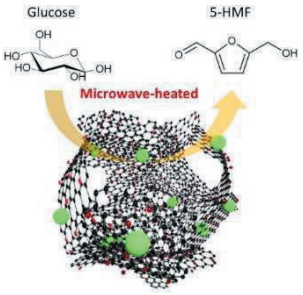
Graphene oxide (GO) has been considered as only a precursor for graphene but also one of the most promising materials because of its excellent properties such as photoluminescence, ferromagnetism, electrodes and water permeation. As it is now, it is said that GO has wider range of applications than graphene. GO has two important advantages: (1) it can be produced using inexpensive graphite as stating material by cost-effective chemical methods with a high yield, and (2) it is highly hydrophilic and can form stable aqueous colloids to facilitate the assembly of macroscopic structures by simple and cheap solution processes. These advantages indicate that GO can be easily applicate and scale up to industrial level. Therefore, it is important for industrial development to study GO. Recently, we focused on (i) ion conduction, (ii) biomass conversion reaction, (iii) drug delivery system (DDS) by using GO nanosheet and its derivatives. Detail achievements are following.



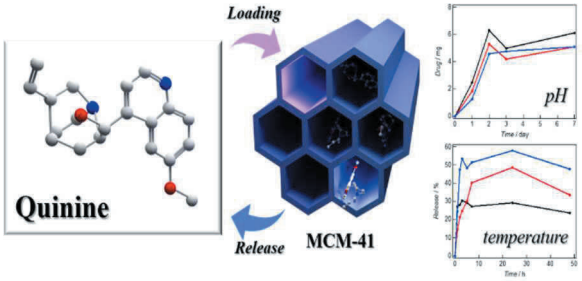
(i) Ion conduction through graphene oxide (GO) nanosheets that is pH-switchable between H^+ (in acid) and OH^- (in base) ions was demonstrated. This finding is the first observation of this type for ion conductive materials and demonstrate an example of stimuli-driven ion-conduction switching.

(ii) Hybrids of reduced graphene oxide (rGO) and metal/ metal oxide (Pt, $NiO/Ni(OH)_2$, CoO, Fe_3O_4) nano particle were prepared by reduction of graphene oxide (GO) and metal ions (Pt^{2+}, Ni^{2+}, Co^{2+}, Fe^{2+}) hybrids. The M-rGO hybrids (M = Pt, Ni-, Co and Fe) were justified for the

transformation of glucose to 5-hydroxymethylfurfural (5-HMF). High glucose → 5-HMF conversion was yielded depending on the nature of M-rGO catalyst. The Ni-rGO showed the highest 5-HMF yield. The conversion reaction tuned to the optimized state under microwave-assisted reaction accomplished by using Ni-rGO. In such case, the conversion rate was 99% with a 5-HMF yield as 75%. In order to improve both the conversion and yield, NiGO-FD was prepared by freeze-dry method. The NiGO-FD remarkably showed the highest conversion of 99% and 5-HMF yield of 95%. Beside the biomass transformation process, the physic-chemical strategy employed herein for multiplying the catalytic efficiency might be justified for catalyzing similar reactions



(iii) MCM-41 (**1**), amine and phenyl surface functionalized derivatives: aMCM-41(**2**) and pMCM-41 (**3**) were synthesized for the release of encapsulated antimalarial quinine (QN). The pH and thermal optimization studies on QN adsorption and release from the drug delivery systems of **1, 2** and **3** were investigated. Best loading of QN (*ca* 4 mg) at pH 6.0 and 45°C for **3** while **2** had optimal release (*ca* 70%) at pH 7.0 and ambient temperature respectively.



2. Presentations & Publications (incl. submitted papers)

1. Homo- and Heterosolvent Modifications of Hofmann-Type Flexible Two-Dimensional Layers for Colossal Interlayer Thermal Expansions
   R. Ohtani, J. Yanagisawa, H. Matsunari, M. Ohba, L. F. Lindoy, S. Hayami
   Inorg. Chem., 58, 19, 12739-12747 (2019)
   DOI: 10.1021/acs.inorgchem.9b01660
2. Observation of Proton Transfer Coupled Spin Transition and Trapping of Photoinduced Metastable Proton Transfer State in an Fe(Ⅱ) Complex
   T. Nakanishi, Y. Hori, H. Sato, S. Wu, A. Okazawa, N. Kojima, T. Yamamoto, Y. Einaga, S. Hayami, Y. Horie, H. Okajima, A. Sakamoto, Y. Shiota, K. Yoshizawa, O. Sato
   J. Am. Chem. Soc., 141, 36, 14384-14393 (2019)
   DOI: 10.1021/jacs.9b07204
3. Air-Stable n-Type Single-Walled Carbon Nanotubes Doped with Benzimidazole Derivatives for Thermoelectric Conversion and Their Air-Stable Mechanism
   Y. Nakashima, R. Yamaguchi, F. Toshimitsu, M. Matsumoto, A. Borah, A. Staykov, Md. S. Islam, S. Hayami, T. Fujigaya
   ACS Appl. Nano Mater., 28, 4703-4710 (2019)
   DOI: 10.1021/acsanm.9b01174
4. Effects of a strong gravitational field on Mn-trimers and magnetic properties of hexagonal $YMnO_3$ single crystal
   M. Tokuda, T. Mashimo, W. Ma, S. Hayami, S. Ando, T. Nishiyama, A. Yoshiasa
   J. Phys. Chem. Soli. , 129, 172-179 (2019)
   DOI: 10.1016/j.jpcs.2018.12.023
5. A mixed-spin spin-crossover thiozolylimine $[Fe_4L_6]^{8+}$ cage
   Li Li, A. R. Craze, O. Mustonen, H. Zenno, J. J. Whittaker, S. Hayami, L. F. Lindoy, C. E. Marjo, J. K. Clegg, J. R. Aldrich-Wright, F. Li
   Dalton. Trans., 48, 9935-9938 (2019)
   DOI: 10.1039/C9DT01947B
6. Pressure Effects with Incorporated Particle Size Dependency in Graphene Oxide Layers through Observing Spin Crossover Temperature
   H. Kitayama, R. Akiyoshi, M. Nakamura, S. Hayami
   Magnetochemistry, 5, 26 (2019)
   DOI: 10.3390/magnetochemistry5020026

7. Ferroelectric metallomesogens composed of achiral spin crossover molecules
R. Akiyoshi, Y. Hirota, D. Kosumi, M. Tsutsumi, M. Nakamura, L. F. Lindoy, S. Hayami
Chem. Sci., 10, 5843-5848(2019)
DOI: 10.1039/C9SC01229J
8. Slow Magnetic Relaxation Triggered by a Structural Phase Transition in Long-Chain Alkylated Cobalt(II) Single-Ion Magnets
F. Kobayashi, R. Ohtani, M. Nakamura, L. F. Lindoy, S. Hayami
Inorg. Chem., 58, 7409-7415(2019)
DOI: 10.1021/acs.inorgchem.9b00543
9. Water-Induced Breaking of the Coulombic Ordering in a Room-Temperature Ionic Liquid Metal Complex
T. Hiraoka, R. Ohtani, M. Nakamura, L. F. Lindoy, S. Hayami
Chem. Eur. J., 25, 7521-7525 (2019) **Hot Paper**
DOI: 10.1002/chem.201900069
10. A procession on photocatalyst for solar fuel production and waste treatment
N. N. Rabin, H. Ohmagagi, Md. S. Islam, M. R. Karim, S. Hayami
J. Incl. Phenom. Macrocycl. Chem. , 94, 263-281 (2019)
DOI: 10.1007/s10847-019-00889-8
11. Weak Ferromagnetism Derived from Spin Canting in an Amido-Bridged Homochiral Mn(III) 1-D Coordination Polymer
S. Kusumoto, A. Koga, F. Kobayashi, R. Ohtani, Y. Kim, L. F. Lindoy, S. Hayami, M. Nakamura
Dalton. Trans., 48, 8617-8622 (2019) **Back Cover**
DOI: 10.1039/C9DT00593E
12. Phosphorescence at Low Temperature by External Heavy-Atom Effect in Zinc(II) Clusters
F. Kobayashi, R. Ohtani, S. Teraoka, M. Yoshida, M. Kato, Y. Zhang, L. F. Lindoy, S. Hayami, M. Nakamura
Chem. Eur. J., 25, 5875-5879 (2019) **Cover Picture**
DOI: 10.1002/chem.201900343
13. Interaction of 2-furanylmethyl- and 2-thienylmethyl-amide derivatives of 1,3-di(carboxymethyl)calix[4]arene with metal salts
M. H. Noamane, A. B. Othmen, A. S. Al-Ayed, Y. Kim, S. Hayami, A. Hamdi
J. Incl. Phenom. Macrocycl. Chem., 94, 249-256 (2019)
DOI: 10.1007/s10847-019-00908-8
14. Synthesis, structure and magnetic properties of manganese(II) and cobalt(II) coordination polymers with bis(4-pyridyl)benzylamine
S. Y. Kim, A. R. Jeong, Y. Komatsumaru, S. Hayami, K. S. Min
J. Inclu. Phenom. Macrocycl. Chem., 94, 167-174 (2019)
DOI: 10.1007/s10847-019-00890-1
15. Consecutive oxidative additions of iodine on undulating 2D coordination polymers: Formation of I-Pt-I chains and inhomogeneous layers
R. Ohtani, R. Yamamoto, H. Ohtsu, M. Kawano, J. Pirillo, Y. Hijikata, M. Sadakiyo, L. F. Lindoy, S. Hayami
Dalton Trans., 48, 7198-7202(2019)
DOI: 10.1039/c8dt04624g
16. Triply methoxo-bridged tetranuclear nickel cubane complexes with salicylate esters
S. Kusumoto, F. Kobayashi, R. Ohtani, Y. Kim, S. Hayami, M. Nakamura
J. Incl. Phenom. Macrocycl. Chem., 94, 195-199 (2019).
DOI: 10.1007/s10847-018-0798-9
17. Morphology and magnetic property of lipid packaged iron (Ⅱ) complex
R. Akiyoshi, R. Ohtani, M. Nakamura, S. Hayami
J. Incl. Phenom. Macrocycl. Chem., 94, 189-194 (2019).
DOI: 10.1007/s10847-018-0815-z
18. Structure and magnetic property of μ-oxo bridged dinuclear iron(III) complex with trialkylated tridentated ligands
M. Tsutsumi, F. Kobayashi, R. Ohtani, M. Nakamura, S. Hayami
J. Incl. Phenom. Macrocycl. Chem., 94, 183-188 (2019).
DOI: 10.1007/s10847-018-0810-4
19. Reduced Graphene Oxide Transition Metal hybrids for hydrogen Generation by photocatalytic Water splitting
Y. Shudo, M. R. Karim, K. Wakata, H. Ohmagari, N. Kameda, S. Hayami
J. Incl. Phenom. Macrocycl. Chem., 94, 283-286 (2019).

DOI: 10.1007/s10847-018-0795-z

3. Application & acquisition status of KAKENHI and other external grants
I got KAKENHI Grant-in-Aid for Scientific Research (A) JP17H01200 for 2017-2021.
I have applied for Grant-in-Aid for Scientific Research on Innovative Areas.

4. Application & acquisition status of industrial property rights
I have applied for PATENT as following.
1. Ion conductive switching depending on pH for graphene oxide
2. Hetero atom doped diamonds

No. 5-2	RNA Biology		
Research Field	Advanced Green Bio		
Unit Coordinator			
Name	Tokio Tani		
Affiliation	FAST, Kumamoto University Email: ttani@kumamoto-u.ac.jp	Title	Prof., Dr.
Unit Members			
Name	Affiliation/Title		
Ramesh S. Pillai	Department of Molecular Biology, University of Geneva, Switzerland/ Prof., Dr.		
Takashi Ideue	FAST, Kumamoto University/ Assistant Prof., Dr.		

1. Overview of achievements

Recent advances in RNA/DNA sequencing and genome-wide microarray technologies have revealed that transcription is widespread throughout the eukaryotic genomes, generating a large number of non-coding RNAs (ncRNAs). NcRNAs are defined as RNAs with no significant protein-coding capacity. Expression of ncRNAs is in some cases regulated developmentally and tissue-specifically. We are analyzing biological roles of ncRNAs in a wide range of cellular reactions, such as pre-mRNA splicing, nuclear structure formation, chromatin remodeling and genome stability, using fission yeast, cultured mammalian and insect cells. NcRNAs can be categorized into two groups; short ncRNA, such as miRNAs and piRNAs, typically 20-200 bases in length, and long ncRNAs (lncRNA), such as satellite lncRNAs, ranging from ~200 bases to 100 kb in length.

The central goal of the collaborative project with Prof. Pillai is to understand how germline-specific RNA-protein granules called nuage are assembled in a cell. Nuage is implicated in the biogenesis of small RNAs called Piwi-interacting RNAs (piRNAs). The collaboration with Prof. Pillai is going very well in 2019. We have screened for compounds that can either enhance or decrease nuage formation and have successfully identified compounds that are either kinase or phosphatase inhibitors that have opposing effects on nuage formation. On the other hand, Pillai's laboratory has developed a systematic imaging-based screen for such Nuage-localizing signals (NuLS). Identification of NuLS peptides will allow the two studies to come together and synergize, as Ramesh group will be able to look for phosphorylation site motifs in the NuLS that might modulate its activity. Knowledge of the NuLS peptides might help us screen for putative kinase and phosphatase regulators of nuage formation. Thus, the collaboration between University of Geneva and Kumamoto University is critical for a complete success of this project.



To promote the collaborative project, Tani visited Geneva University and had stayed in Ramesh's laboratory from 23th to 28th in September, 2019, to discuss on the collaborative projects and gave a seminar on ncRNAs and nuclear structure there. At that time, Tani brought back Ramesh's antibody against Ago3 protein, which is localized in nuage. That antibody was very useful to carry out IF experiments in Tani's laboratory. Such collaborative material exchanges can promote the project on nuage.



Also, Prof. Ramesh came to Kumamoto University in December, from 17th to 21th, 2019, and did further discussion with students Tani's laboratory and gave an international seminar at Department of Biological Sciences during his stay in Kumamoto.

2. Presentations & publications

Presentations:

1) Characterization of a compound that affects formation of nuage, a germline specific structure involved in piRNA biogenesis. Umekita Morihiro, Satomi Ishikawa, Yasunori Kitaori, Ayaka Honjo, Yukako Takeshita, Ramesh Pillai, Masayuki Igarashi, Haruna Yoshimura, Hayato Ishikawa and Tokio Tani.
   ICAST 2019 Kumamoto, November 28, 2019.
2) Analysis of the compounds that inhibit formation of nuage. Ayaka Honjo, Satomi Ishikawa, Yasunori Kitaori, Umekita Morihiro, Masayuki Igarashi, Akira Nakamura, Ramesh Pillai, Tokio Tani.
   42th Annual meeting of Molecular Biology, Fukuoka, December 3, 2019.

Publication:

Centromeric non-coding RNAs: Conservation and diversity in function. Takashi Ideue and Tokio Tani. Non-coding RNA, 6(4), 2020 doi:10.3390/ncrna6010004.

3. Acquisition status of KAKENHI
   Tokio Tani, KAKENHI Grant-in Aid for Scientific Research (B)

4. Application & acquisition status of industrial property rights
   Patent application 特願 2019-190763, Identification of novel antifungal agent.

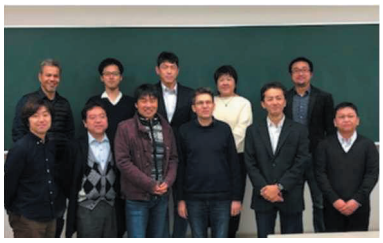
No. 5-3	Plant Cell and Developmental Biology		
Research Field	Advanced Green Bio		
Unit Coordinator			
Name	Shinichiro Sawa		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: sawa@kumamoto-u.ac.jp	Title	Professor
Unit Members			

Name	Affiliation/Title
Olivier Hamant	ENS Lyon/ Research Director
Carolina Escobar	University of Castilla La Mancha/Assitant Professor
Christian Hardtke	University of Lausanne/ Professor
Mitsuhiro Aida	IROAST/Professor
Takumi Higaki	IROAST/Associate Professor
Takashi Ishida	IROAST/Assistant Professor
Chihiro Furumizu	Faculty of Advanced Science and Technology/Project assistant professor
Yuki Yoshida	Faculty of Advanced Science and Technology/Project assistant professor
Hidehiko Sunohara	Faculty of Advanced Science and Technology/Project assistant professor

1. Overview of achievements

In this Research Unit, Plant Cell and Developmental Biology, we characterize the molecular and physical mechanisms that contribute to plant development and plant–parasitic nematodes interactions using genetic, biochemical, physiological approaches.

One of our Unit member, Christian Hardtke organized a symposium, “Mechanisms of Plant Perception – From endogenous to exogenous-” on 20th Sept 2019, in Lausanne. In the symposium, Takumi Higaki, Mitsuhiro aida, and Shinichiro Sawa were invited to have a talk together with Christian Hardtke. We could enjoy the great impressive meeting in Lausanne. Further, Shinichiro Sawa was also invited as a Scientific Advisory Committee (SAC) member in the Department of plant molecular biology, University of Lausanne, and summarized SAC report.



Shinichiro Sawa have also organized a symposium “International symposium on Strategies of mechanical optimization in plants” on 5th December 2019 in Kumamoto University. In this symposium, we have invited a unit member, Olivier Hamant, and together with him, Takumi Higaki also gave a presentation.

Carolina Escobar, a Unit member, has analyzed molecular mechanisms for root-knot nematode inductive gall formation, together with Shinichiro Sawa’s group, and published a paper about it in the New Phytologist. This international collaboration was performed in this Research Unit, and I think this unit system works quite well for fruitful performance for basic science research.

2. Presentations & Publications (incl. submitted papers)

Presentations

Takumi Higaki, Plasma membrane delivery of H+-ATPse for stomatal response. Symposium for Mechanisms of Plant Perception - From endogenous to exogenous –, 20th Sept. 2019 Lusanne

Mitsuhiro Aida, Organ boundary as a signaling source for embryonic shoot morphogenesis. Symposium for Mechanisms of Plant Perception - From endogenous to exogenous –, 20th Sept. 2019 Lusanne

Shinichiro Sawa, Plant attractant and systemic-peptide signaling supporting nematode successful infection. Symposium for Mechanisms of Plant Perception - From endogenous to exogenous –, 20th Sept. 2019 Lausanne

Publications

Kwon SH, Wi T, Park YI, Kim MW, Lee G, **Higaki T**, Choi JH, Lee R (2020) Non-invasive early detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor. **Bioconjug Chem** in press.
https://doi.org/10.1021/acs.bioconjchem.9b00870

Maeda K, Sasabe M, Hanamata S, Machida Y, Hasezawa S, **Higaki T** (2020) Actin filament disruption alters phragmoplast microtubule dynamics during the initial phase of plant cytokinesis. **Plant Cell Physiol** in press.
https://academic.oup.com/pcp/advance-article/doi/10.1093/pcp/pcaa003/5716757

Hirai R, **Higaki T,** Takenaka Y, Sakamoto Y, Hasegawa J, Matsunaga S, Demura T, Ohtani M (2020) The progression of xylem vessel cell differentiation is dependent on the activity level of VND7 in Arabidopsis thaliana. **Plants** 9: 39. https://www.mdpi.com/2223-7747/9/1/39

Jeh Haur Wong, Takehide Kato, Samuel Belteton, Rie Shimizu, Nene Kinoshita, **Takumi Higaki**, Yuichi Sakumura, Daniel B. Szymanski, Takashi Hashimoto, "Basic proline-rich protein-mediated microtubules are essential for lobe growth and flattened cell geometry," **Plant Physiology**, 181(4), 1519-1534, 2019. https://doi.org/10.1104/pp.19.00811

Akiko Nakamasu, **Takumi Higaki**, "Theoretical models for branch formation in plants," **J Plant Res**, 132(3), 325-333, 2019. doi: 10.1007/s10265-019-01107-9

Saori Misyohi, Seisuke Kimura, Ryo Ootsuki, **Takumi Higaki**, **Akiko Nakamasu**, "Developmental analyses of divarications in leaves of an aquatic fern Microsorum pteropus and its varieties," **PLOS ONE** 14, e0210141, 2019.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0210141

Minami Tanaka, Yuki Fujii, Kazumi Hirano, **Takumi Higaki**, Akira Nagasaki, Ryoki Ishikawa, Takaharu Okajima, Kaoru Katoh, "Fascin in lamellipodia contributes to cell elasticity by controlling the orientation of filamentous actin," **Genes Cells**, 24: 202-213, 2019.
https://doi.org/10.1111/gtc.12671

Yusuke Kimata, Takehide Kato, **Takumi Higaki**, Daisuke Kurihara, Tomomi Yamada, Shoji Segami, Miyo Terao Morita, Masayoshi Maeshima, Seiichiro Hasezawa, Tetsuya Higashiyama, Masao Tasaka, Minako Ueda, "Polar vacuolar distribution is essential for accurate asymmetric

division of Arabidopsis zygotes," **Proc Natl Acad Sci U S A**, 116: 2338-2343, 2019. https://doi.org/10.1073/pnas.1814160116

Allen Yi-Lun Tsai, **Takumi Higaki**, Chinh-Nghia Nguyen, Laetitia Perfus-Barbeoch, Brun Favery, **Shinichiro Sawa**, "Regulation of root-Knot nematode behavior by seed-coat mucilage-derived attractants," **Molecular Plant,** 12: 99-112, 2019. https://doi.org/10.1016/j.molp.2018.11.008

Kae Akita, **Takumi Higaki**, "An induction system for clustered stomata by sugar solution immersion treatment in Arabidopsis thaliana seedlings," **Journal of Visualized Experiments**, 144, e58951, 2019. https://www.jove.com/video/58951/an-induction-system-for-clustered-stomata-sugar-solution-immersion

Ishihara H, Sugimoto K, Tarr PT, Temman H, Kadokura S, Inui Y, Sakamoto T, Sasaki T, **Aida M**, Suzuki T, Inagaki S, Morohashi K, Seki M, Kakutani T, Meyerowitz E, Matsunaga S, "Primed histone demethylation regulates shoot regenerative competency," **Nat Commun** 10, 1786, 2019. https://doi.org/10.1038/s41467-019-09386-5

Ana Cláudia Silva1, Virginia Ruiz-Ferrer1, Ángela Martínez-Gómez1, Marta Barcala1, Carmen Fenoll1 and **Carolina Escobar,** "All in One High Quality Genomic DNA and Total RNA Extraction From Nematode Induced Galls for High Throughput Sequencing Purposes" **Front. Plant Sci.;** 10: 657, 2019. https://doi.org/10.3389/fpls.2019.00657

Ishida, T., Suzuki R., Nakagami, S., Kuroha, T., Sakamoto S., Nakata, M. T., Yokoyama, R., Kumura, S., Mitsuda, N., Nishitani, K., and **Sawa, S**. (2020) Root-knot nematodes modulate cell walls during root-knot formation in Arabidopsis roots. **J. Plant Res.** In Press.

Shikanai, Y., Yoshida, R., Hirano, T., Enomoto, Y., Li, B., Asada, M., Yamagami, M., Yamaguchi, K., Shigenobu, S., Tabata, R., **Sawa, S**., Okada, H., Ohya, Y., Kamiya, T., and Fujiwara, T. (2020) Callose synthesis suppresses cell death induced by low-calcium conditions in Arabidopsis leaves. **Plant Physiol**. In Press.

Olmo, R., Cabrera, J., Diaz-Manzano, F., Ruiz-Ferrer, V., Barcala, M., Ishida, T., Garcia A., Andres, M., Lara, S.R., Verdugo, I., Ochoa, M., Fukaki, H., del Pozo, J. C., Moreno-Risueno, M., Kyndt, T., Gheysen L., Fenoll, C., **Sawa, S**., and Escobar, C. (2020) Root-knot nematodes induce gall formation by recruiting developmental pathways of post-embryonic organogenesis and regeneration to promote pluripotency. **New Phytologist**, In Press.

Sunohara, H., Kaida, S., and **Sawa, S**. (2020) A method for evaluating root-knot nematode infection in rice using a transparent paper pouch. **Plant Biotechnology**. In Press.

Oota, M., Tsai, A, Y-L., Aoki, D., Matsushita, Y., Toyoda, S., Fukushima, K., Saeki, K., Toda, K., Perfus-Barbeoch, L., Favery, B., Ishikawa, H., and **Sawa, S**. (2020) Identification of naturally-occurring polyamines as nematode *Meloidogyne incognita* attractants. **Mol. Plant** In Press.

Suetsugu K., Kaida, S., Fukunaga, H., and **Sawa, S**. (2019) A new forma of the mycoheterotrophic orchid Lechanorchis japonica from Japan. **Acta Phytotax. Geobot**. In Press.

Hiwatashi, T., Quan, K., L., Yasui, Y., Takami, H., Kajikawa, M., Kirita, H., Sato, M., Wakazaki, M., Yamaguchi, K., Shigenobu, S., Fukaki, H., Mimura, T., Yamato, K. T., Toyooka, K., **Sawa,**

S., Urano, D., Kohchi, T., and Ishizaki, K. (2019) The RopGEF KARAPPO is Essential for the Initiation of Vegetative Reproduction in Marchantia. **Curr. Biol**. 29, 3525-3531.

Hayashi, N., Rongkavilit, N., Tetsumura, T., **Sawa, S.,** Wada, T., and Tominaga-Wada, R. (2019) Effect of the CLE14 polypeptide on *GLABRA2* homolog gene expression in rice and tomato roots. **Plant Biotec**. 36, 205-208

Yamamoto, A., Ishida, T., Yoshimura, M., Kimura, Y., **Sawa, S.** (2019) Developing heritable mutations in Arabidopsis thaliana using a modified CRISPR/Cas9 toolkit comprising PAM-altered Cas9 variants and gRNAs. **Plant Cell Physiol**. 60, 2255-2262

Suetsugu, K., Kaida, S., Hsu, T.-C., **Sawa, S.** (2019) Lecanorchis moritae (Orchidaceae, Vanilloideae), a new mycoheterotrophic species from Amami-Oshima Island, Japan, based on morphological and molecular data. **Phytotaxa**. 404, 137-145.

Hirakawa, Y., and **Sawa, S.** (2019) Diverse functions of plant peptide hormones in local signaling and development. **Curr. Opin. Plant Biol**. 51, 81-87.

Hirakawa, Y., Uchida, N., Yamaguchi, Y., L., Tabata, R., Ishida, S., Ishizaki, K., Nishihama, R., Kohchi, T., **Sawa, S**#. and Bowman, J. L. (2019) Control of haploid organ size by CLE peptide signaling in Marchantia polymorpha. **PLOS Genet**. 15. e1007997 #Corresponding author.

Zang, L., Shi, X., Zhang, Y., Wang, J., Yang, J., Ishida, T., Jiang, W., Han, X., Kang, J., Wang, X., Pan, L., Lv, S., Cao, B., Zhang, Y., Wu, J., Han, H., Hu, Z., Cui, L, **Sawa, S.**, He, J., and Wang, G. (2019) CLE9 peptide-induced stomatal closure is mediated by abscisic acid, hydrogen peroxide, and nitric oxide in Arabidopsis thaliana. **Plant Cell & Environment**. 42, 1033-1044. http://dx.doi.org/10.1111/pce.13475

3. Application & acquisition status of KAKENHI and other external grants

Takumi Higaki, Grant-in-Aid for Scientific Research on Innovative Areas (The Japan Society for the Promotion of Science), Elucidation of the strategies of mechanical optimization in plants toward the establishment of the bases for sustainable structure system, "Imaging analysis on cell geometry during mechanical optimization in leaves," June 2018-March 2023.

Takumi Higaki, Grant-in-Aid for Scientific Research on Innovative Areas (The Japan Society for the Promotion of Science), Platforms for Advanced Technologies and Research Resources "Advanced Bioimaging Support," "Consultation and technical support for bioimage analysis," April 2018-March 2022.

Mitsuhiro Aida, Yamada Science Foundation, "Growth regulation in the shoot meristem for stem cell maintenance," August 2018-March 2020.

Mitsuhiro Aida, Grant-in-Aid for Scientific Research on Innovative Areas (The Japan Society for the Promotion of Science), Principles of pluripotent stem cells underlying plant vitality, "Growth regulation and stem cell maintenance in the shoot meristem," April 2018-March 2020.

Shinichiro Sawa, Grant-in-Aid for Scientific Research on Innovative Areas (The Japan Society for the Promotion of Science), Elucidation of the strategies of mechanical optimization in plants

toward the establishment of the bases for sustainable structure system, June 2018-March 2023.
Shinichiro Sawa, Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area), April 2018-March 2023.

Shinichiro Sawa, Grant-in-Aid for Scientific Research (B) Analyses of plant parasitic infection mechanisms, April 2017-March 2019.

No. 5-4	Research for Nano-Organics and Nano-Hybrids		
Research Field	Nanomaterial Science/ Green Energy/ Next-generation Technology		
Unit Coordinator			
Name	Hirotaka IHARA		
Affiliation	Email: ihara@kumamoto-u.ac.jp	Title	Senior Professor

Unit Members	
Name	Affiliation/Title
Makoto TAKAFUJI	Kumamoto University / Professor
Tetsuya KIDA	Kumamoto University / Professor
Armando QUITAIN	Kumamoto University / Professor
Yutaka KUWAHARA	Kumamoto University / Assistant Professor
Hirotaka IHARA	Kumamoto University / Senior Professor
Reiko ODA	CNRS, Université de Bordeaux / Research Director
Josep-Lluis BARONA-VILAR	Universidad de Valencia / Professor
Zhenghe XU	Southern University of Science and Technology / Professor
Etsuko FUJITA	Brookhaven National Laboratory / Senior Chemist
Maria Jose COCERO	Universidad de Valladolid / Professor

1. Overview of achievements

1-1. Enhancement of International Collaboration with University of Bordeaux, France

A PhD course student from the University of Bordeaux (UB), who has been studying under the supervision of Prof. H. Ihara in Kumamoto University (KU) since March 1, 2018, based on the Double Degree (DD) Program with UB since 2016, have received PhD degree after passing her oral defense held in UB, France, in July, 2019, and reviewed by six professors including Prof. Ihara, Prof. Takafuji, Dr. Reiko Oda (UB), Visiting Professor of IROAST, and Prof. Jerome Lacour, University of Geneva, Switzerland, as referees.

The joint KAKEN research project with Dr. Oda of Grants-in-Aid for Fostering Joint International Research (B) funded by JSPS since 2017 is ongoing. In this project, Prof. Takafuji and Prof. Ihara are a PI and a core member, respectively, of Japan side.

The joint research project of UB with KU and Kyoto University since 2015 called as Laboratoire international associé (LIA) - “Chiral Nanostructures for Photonic Applications” (CNPA) has been re-approved as second term by Agence Nationale de la Recherche (ANR), France and restarted from this year. In this project, Prof. Ihara and Dr. Oda (Visiting Professor of IROAST) are co-PIs in Japan and French sides, respectively, and Prof. Takafuji and Dr. Kuwahara have associated as core members.

A new project with Dr. Y. Ferrand and Dr. C. Olivier, who are the LIA members of the French side is on-going from 2018. Japanese and French members visited alternately and discussed in Kumamoto and Bordeaux, France, in 2019.

The two joint papers have been published with researchers of UB in international journals in 2019.

1-2. Enhancement of International Collaboration with Universitat de València, Spain

Prof. Takafuji invited Prof. J. L. Barona-Vilar (Visiting Professor of IROAST) to KU. Prof. Barona-Vilar lectured about history of Science and Medicines in an intensive course of GJEC and also in 66th IROAST Seminar on November 25, 2019.

The joint research project with Prof. Eugenio Coronado of Open Partnership Joint Research Projects funded by JSPS since 2018 is ongoing which is conducted by Prof. Takafuji as a PI in Japan side.

Prof. Ihara visited Prof. Barona-Vilar and Prof. Coronado in Universitat de València and discussed the future collaboration.

1-3. Enhancement of International Collaboration with University of Valladolid, Spain

Supported by KAKEN Fund for the Promotion of Joint International Research, Fostering Joint International Research (2018-2020), Prof. Quitain has been actively visiting the University of Valladolid for research collaboration. One GSST M1 graduate student was also dispatched to carry out research for 3 months related to the application of supercritical fluids.

A GSST alumnus, Dr. Elaine Mission, has been awarded a two-year Marie Sklodowska-Curie Individual Fellowship (MSCA-IF 2019) for her proposal on "Cascade Hydrolytic Recovery and Conversion of Suberin in High Pressure Media." She will be joining the Instituto Bioeconomia at the University of Valladolid and will be hosted by IROAST Visiting Prof. M. J. Cocero.

Joint research paper with the host – Prof. Cocero was also accepted for publication to the Journal of Supercritical Fluids.

1-4. Establishment of International Collaboration with University of Geneva, Switzerland

Prof. Ihara, Prof. Takafuji and Dr. Kuwahara have met and discussed with Prof. Lacour of University of Geneva, who was one of referee members for thesis defense of the DD Program PhD student with UB and KU, in UB, Bordeaux, France in July, 2019. After that occasion, we invited Prof. Lacour and had an international seminar at KU in March 2020. This collaboration with Prof. Lacour has started this year.

1-5. Enhancement of International Collaboration with Brookhaven National Laboratory, USA

Based on two joint projects of the Open Partnership Joint Research Projects and the KAKEN Grants-in-Aid for Fostering Joint International Research by JSPS, which were conducted by Dr. Kuwahara, he has visited Dr. Etsuko Fujita's group for 4 months from May to September, 2019, and studied about those projects.

We also have invited Dr. Fujita as Visiting Professor of IROAST to KU. She had a lecture titled "Our Investigations of Carbon Dioxide Reduction: Past and Present" in 68th IROAST Seminar on December 12, 2019.

1-6. Enhancement of International Collaboration with University of Connecticut, USA

International Collaboration with University of Connecticut practically started after Prof. T. Mani had joined the Bilateral Joint Research Project of JSPS conducted by Dr. Kuwahara since 2018 and been invited as an invited speaker in the 4th IROAST symposium at KU. Prof. Mani have approved as a Visiting Associate Professor by the IROAST in January, 2020. We invited Dr. Mani to Kumamoto. He provided a lecture titled "Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules" in 73th IROAST Seminar on February 6, 2020.

Dr. Kuwahara visited University of Connecticut, supported by IROAST, and discussed about our recent research with Prof. Mani in March, 2020.

1-7. Enhancement of International Collaboration with Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China

After the Bilateral Joint Research Project of JSPS, we have continued the collaboration with Prof. H. Qiu's group of Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China.

Prof. Ihara was selected as a President's International Fellowship Initiative Visiting Scientist from Chinese Academy of Sciences, associated with this collaboration with Lanzhou Institute of Chemical Physics. Depending on this initiative program, Prof. Ihara visited to Lanzhou Institute of Chemical Physics and provided a lecture in December, 2019 and January, 2020. In addition, Prof. Ihara visited and had lectures in Lanzhou University and Northwest Normal University, Lanzhou, near the Lanzhou Institute of Chemical Physics.

1-8. Enhancement of International Collaboration with Beijing University of Chemical Technology

Prof. Ihara and Prof. Takafuji visited Prof. X. Li and Prof. L. Guo of Beijing University of Chemical Technology, China. The future academic and student exchanges between the two universities have been discussed.

1-9. Enhancement of International Collaboration with University of Dhaka, Bangladesh

We received total six people from the Department of Chemistry and Chemical Engineering, the University of Dhaka (UD) in August and November, 2019 under the Sakura Science Plan (B) and (A), respectively, supported by JST. They have been participated to our short training course.

Dr. M. Shahruzzaman visited to KU and researched with Prof. Takafuji for three weeks in December, 2019.

The two joint papers have been published with researchers of UD in international journals in 2019.

1-10. Enhancement of International Collaboration with Noakhali Science and Technology University, Bangladesh

We received three people from Noakhali Science and Technology University in November, 2019 under the Sakura Science Plan (A) by JST. They have been participated in our short training course.

Prof. Md. A. ALAM visited to KU and researched with Prof. Takafuji for three months from September to November, 2019 under the Follow-up Research Fellowship supported by JASSO.

1-11. Enhancement of International Collaboration with Baku State University, Azerbaijan

Prof. Ihara have been invited and attended a memorial ceremony of Baku State University (BSU), Azerbaijan, and discussed with Prof. M. A. Ramazanov and Dr. A. Rahimli about the joint research project. The future academic and student exchanges between the two universities also have been discussed.

The one joint paper has been published with researchers of BSU in an international journal in 2019.

1-12. Establishment of International Collaboration with Kyrgyz-Turkish Manas University, Kyrgyz

We received two people from Kyrgyz-Turkish Manas University in November, 2019 under the Sakura Science Plan (A) supported by JST. They have been participated in our short training course. We will start the collaboration with the Kyrgyz-Turkish Manas University from 2020.

1-13. Records of International Seminar

1. 65th IROAST Seminar on November 25, 2019
   'Lignin Biorefinery: Processes and Products'
   Prof. Maria Jose Cocero (Host: Prof. Quitain and Prof. Kida)
2. 66th IROAST Seminar on November 25, 2019
   'Technoscience. Risks & opportunities of a social revolution'
   Prof. Josep Lluis Barona-Vilar (Host: Prof. Takafuji)
3. 68th IROAST Seminar on December 12, 2019
   'Our Investigations of Carbon Dioxide Reduction: Past and Present'
   Prof. Etsuko Fujita (Host: Dr. Kuwahara)
4. 73th IROAST Seminar on February 6, 2020
   'Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules'
   Prof. Tomoyasu Mani (Host: Dr. Kuwahara)
5. International seminar on March 19, 2020
   'Cationic Helicenes, Metal-Free and Metal-Bound Ylides as Vectors to General Asymmetric Applications'
   Prof. Jerome Lacour, (Host: Prof. Takafuji and Dr. Kuwahara)
   (A planed lecture of Dr. Oda joined with Prof. Lacour have been canceled due to prevent to spread the new Coronavirus, COVID-19, disease.)

1-14. Records of International Exchange of Researchers

Visiting professors and researchers

2019.4	**H. Ihara, M. Takafuji**, *Beijing University of Chemical Technology* (Beijing, China): Prof. X. Li, Prof. L. Guo
2019.4	**A. T. Quitain**, *Valladolid University* (Valladolid, Spain): Prof. M. J. Cocero (Visiting Prof. of IROAST) and others
2019.5-9	**Y. Kuwahara**, *Brookhaven National Laboratory* (Upton, USA): Dr. E. Fujita (Visiting Prof. of IROAST), Dr. Grills and other members
2019.7	**H. Ihara, M. Takafuji, Y. Kuwahara**, *Bordeaux University* (Bordeaux, France): Dr. R. Oda (Visiting Prof. of IROAST), Prof. D. Bassani, Dr. Y. Ferrand, Dr. C. Olivier and other members associated with the LIA and Prof. J. Lacour
2019.7	**M. Takafuji,** *Thammasat University* (Rangsit, Thailand): Prof. Pakorn Opaprakasit
2019.8	**A. T. Quitain**, *Valladolid University*: Prof. M. J. Cocero (Visiting Prof. of IROAST) and others
2019.9-10	**H. Ihara**, *Bordeaux University* (Bordeaux, France): Dr. R. Oda (Visiting Prof. of IROAST), Dr. Y. Ferrand, Dr. C. Olivier
2019.10	**H. Ihara**, *Universidad de Valencia* (Valencia, Spain): Prof. J.-L. Barona-Vilar (Visiting Prof. of IROAST), Prof. E. Coronado
2019.10	**Y. Kuwahara**, *Brookhaven National Laboratory* (Upton, USA): Dr. E. Fujita (Visiting Prof. of IROAST), Dr. Grills and other members
2019.11	**H. Ihara**, Baku State University (Baku, Azerbaijan): Prof. M. A. Ramazanov, Dr. A. Rahimli
2019.12	**H. Ihara**, *Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences* (Lanzhou, China): Prof. H. Qiu
2019.12	**A. T. Quitain**, *Valladolid University* (Valladolid, Spain): Prof. M. J. Cocero (Visiting Prof. of IROAST) and others
2020.1	**H. Ihara**, *Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences* (Lanzhou, China): Prof. H. Qiu
2020.2	**H. Ihara**, *Bordeaux University* (Bordeaux, France): Dr. R. Oda (Visiting Prof. of IROAST), Dr. Y. Ferrand, Dr. C. Olivier
2020.3	**Y. Kuwahara**, *University of Connecticut* (Storrs, USA), Dr. Mani

Inviting professors and researchers

2019.9-11 **Prof. Md Ashraful Alam**, Noakhali Science and Technology University (**Bangladeshi**)
2019.11 **Aichurok Mazhitova**, Kyrgyz-Turkish Manas University (**Kyrgyz**)
2019.11 **Zhyldyzai Ozbekova**, Kyrgyz-Turkish Manas University (**Kyrgyz**)
2019.11 **Dr. Celine Olivier**, University of Bordeaux (**France**)
2019.11 **Prof. Maria Jose Cocero** (Visiting Prof. of IROAST), University of Valladolid (**Spain**)
2019.11 **Prof. J.-L. Barona-Vilar** (Visiting Prof. of IROAST), Universidad de Valencia (**Spain**)
2019.12 **Dr. Etsuko Fujita** (Visiting Prof. of IROAST), Brookhaven National Laboratory (**USA**)
2019.12 **Dr. Mohammad Shahruzzaman**, University of Dhaka (Bangladeshi)
2020.2 **Dr. Tomoyasu Mani** (Visiting Associate Prof. of IROAST), University of Connecticut (**USA**)
2020.3 **Prof. Jerome Lacour**, University of Geneva (**Switzerland**)

2. Presentations & Publications (incl. submitted papers)

2-1. Fabrication of fluorescent one-dimensional-nanocomposites through one-pot self-assembling polymerization on nano-helical silica.
Chemistry Letters, Vol.48, pp.1088-1091, 2019.
S. Pathan, H. Noguchi, N. Yamada, **Y. Kuwahara**, **M. Takafuji, R. Oda,* H. Ihara***

2-2. Reduced graphene oxide (rGO) prepared by metal induced reduction of graphite oxide improves the conductive behavior of poly(methyl methacrylate) (PMMA)/rGO composite.
Chemistry Select, Vol.4, pp.7954-7958, 2019.
A. K. Mallik, Md. L. Habib, F. N. Robel, Md. Shahruzzaman, P. Haque, M. M. Rahman, D. Vasudevan, D. J. Martin, Y. Yamauchi, A. K. Nanjundan, **M. Takafuji, H. Ihara**

2-3. Emission color control in polymer film by memorized fluorescence solvatochromism due to a new class of totally-organic fluorescent nanogel particles
Chemistry - A European Journal, Vol.25, pp.1–9, 2019.
N. Yamada, H. Noguchi, Y. Orimoto, **Y. Kuwahara, M. Takafuji**, S. Pathan, **R. Oda**, A. Rahmuri, M. Ramzanov, **H. Ihara***
[Hot Paper]

2-4. Surface charge-controlled, monodisperse black-colored nanoparticles exhibiting selective reflectance of NIR wavelengths.
ACS Applied Nano Materials, Vol.2, pp.3597-3605, 2019.
N. Hano, **M. Takafuji,*** H. Noguchi, **H. Ihara***

2-5. High refractive index hybrid thin films based on titanium oxide nanoparticles dispersed in poly(N-hydroxyethyl acrylamide) as a hydrophilic polymer matrix.
Nanomaterials, Vol.9, pp.514-522, 2019.
M. Takafuji,* M. Kajiwara, N. Hano, **Y. Kuwahara, H. Ihara***

2-6. L-Lysine-derived highly selective stationary phases for hydrophilic interaction chromatography: Effect of chain length on selectivity, efficiency, resolution, and asymmetry.
Separation Science Plus, Vol.2, pp.42-50, 2019.
A. K. Mallik, S. Guragain, M. M. Rahman, **M. Takafuji, H. Ihara**

2-7. Supercritical CO_2–subcritical H_2O system: A green reactive separation medium for selective conversion of glucose to 5-hydroxymethylfurfural
Journal of Supercritical Fluids (accepted)
R. Inoue, JKC N. Agutaya, **A. T. Quitain**,* M. Sasaki, **M. J. Cocero, T. Kida**,

3. Application & acquisition status of KAKENHI and other external grants

3-1. FY 2017 - 2021: KAKEN, Fund for the Promotion of Joint International Research (Fostering Joint International Research (B)), JSPS, PI: **M. Takafuji**, Co-PI: **H. Ihara,** N. Ryu, 13,800,000 yen.

3-2. FY 2017 - 2019: KAKEN, Fund for the Promotion of Joint International Research, Fostering Joint International Research, JSPS, PI: **Y. Kuwahara**, 9,200,000 yen.

3-3. FY 2017 - 2019: KAKEN, Grant-in-Aid for Scientific Research (C), JSPS, PI: **Y. Kuwahara**, Co-PI: **H. Ihara,** 3,600,000 yen.

3-4. FY 2017 - 2019: Open Partnership Joint Research Projects with USA, JSPS, PI: **Y. Kuwahara**, 5,000,000 yen.

3-5. FY 2017 - 2019: KAKEN, Grant-in-Aid for Scientific Research (C), JSPS, PI: N. Ryu, Co-PI: **H. Ihara**.

3-6. FY 2018 - 2020: Open Partnership Joint Research Projects with Spain, JSPS, PI: **M. Takafuji**, 5,000,000 yen.

3-7. FY 2018 - 2020: KAKEN Grant-in-Aid for Scientific Research (C), JSPS, PI: **A. T. Quitain**, 3,400,000 yen.

3-8. FY 2018- 2020: KAKEN Fund for the Promotion of Joint International Research, Fostering Joint International Research, JSPS, PI: **A. T. Quitain**, 11,700,000 yen.

3-9. FY 2019 - 2020: KAKEN Grant-in-Aid for Scientific Research (Exploratory Research), JSPS, PI: **T. Kida**, 5,000,000 yen.

3-10. FY 2019 - 2020: Open Partnership Joint Research Projects with Malaysia, JSPS, PI: **A. Quitain**, 4,000,000 yen.

3-11. FY 2019-2021: e-ASIA Joint Research Project with Thai, Indonesia, Philippines, Malaysia, Vietnam and Myanmar, JST, PI: **A. Quitain**, Co-I: **T. Kida**, 27,000,000 yen

No. 5-5-1	Nano-medicine and Drug Delivery System		
Research Field	Nanomaterial Science		
Unit Coordinator			
Name	Takuro Niidome		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: niidome@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Ick Chan KWON	Biomedical Research Institute, Korea Institute of Science and Technology, Korea / Principal Research Scientist		
Ruda LEE	International Research Organization for Advanced Science and Technology (IROAST), Kumamoto University, Japan / Associate Professor		
Keiichi MOTOYAMA	Graduate School of Pharmaceutical Sciences, Kumamoto University, Japan / Associate Professor		
Taishi HIGASHI	Priority Organization for Innovation and Excellence, Kumamoto University, Japan / Associate Professor		

1. Overview of achievements

In the last decades, the development of nanocarriers for the efficient delivery of drugs offers a wide range of biotechnology applications. Due to the advantage of the size, nanomaterials have been shown to be robust drug delivery systems and may be useful for encapsulating drugs and enabling more precise targeting with a controlled release by various external stimulation (ex. pH, ROS, Temperature and so on). Nanomedicine has revolutionized existing cancer therapies through the improvement of pharmacological kinetics and dynamics. As well as, image-guided drug delivery can be used for various different purposes, ranging from simple and straightforward biodistribution studies to extensive and elaborate experimental setups aiming to enable “personalized medicine”, and to improve the efficacy of combined modality anticancer therapy.

This research unit focus on the development of diagnosis and drug delivery system for biomedical application. The research unit’s interdisciplinary research collaboration with engineer, pharmacist, and clinician can improve a deeper knowledge and understanding of the real interactions involved in the diseased tissues is fundamental for the development of novel therapeutic approaches.

2. Presentations & Publications (incl. submitted papers)

[Presentations]

Takuro NIIDOME

1. T. Niidome, K. Kyaw, H. Ichimaru, A. Harada, Y. Miyazawa, D. Mizoguchi, Enhancement of Antimicrobial Activity of Silver Nanoplates by Gold Coating and Control of the Activity by Light Irradiation, Society for Biomaterials, Annual Meeting and Exposition 2019, April 3-6 (2019), Seattle, WA, USA
2. K. Kyaw, H. Ichimaru, A. Harada, Y. Miyazawa, D. Mizoguchi, T. Niidome, Antimicrobial activity of gold-coated silver nanoplates and its control by light irradiation, 46th Annual Meeting & Exposition of

the Controlled Release Society, July 21-24 (2019), Valencia, Spain
3. R. Yamashita, Hasita, M. Kim, R. Lee, T. Niidome, Controlled drug release system from PLGA nanoparticles responding to NIR irradiation, 2019 MRS Fall Meeting & Exhibit, December 1-5 (2019), Boston, MA, USA

other 13 presentations

Ruda LEE

1. R. Lee, K. Kim, I. Youn, Early diagnosis and evaluation of the disease activity in rheumatoid arthritis using matrix metalloproteinase-3 fluorogenic sensor, 14th European Society for Molecular Imaging 2019, March 19-22 (2019), Glasgow, Scotland
2. M. W. Kim, K. Kim, R. Lee. Thermo-responsive Lipid Nanoparticles for Controlled Drug Release and Synergistic Therapeutic Efficacy in Multidrug-Resistant Cancer, 46th Annual Meeting & Exposition of the Controlled Release Society, July 21-24 (2019), Valencia, Spain
3. Next generation invited speaker, Aslla symposium, 2019

Other 6 presentations

Ick Chan KWON

1. Symposium co-chair, invited speaker, East Asian Symposium on polymers for Advenced Technology 2019, June 16-19 (2019) Busan, Korea, https://easpat2019.pusan.ac.kr/EASPAT2019/index.do
2. Plenary lecture, 2019 International Conference of The Korean Society of Pharmaceutical Science and Technology, November 21-22 (2019), Seoul, Korea, http://www.kspst.or.kr/abstract/2019_kspst/eng/sche.html
3. Invited speaker, Nanomedicine And Drug Delivery: Research, Translation, And Commercialization, September 26 (2019), Madison, WI, USA, https://cancer.wisc.edu/research/event/nanomedicine-and-drug-delivery-research-translation-and-commercialization/
4. Keynote speaker, The 16th U.S.-Korea Forum on Nanotechnology: Nanomedicine Focusing on Single Cell Level and Sensors Related to Human Cognition and Brain Research, September 23, 24, San Diego, CA, USA, https://www.cmu.edu/nanotechnology-forum/Forum_16/Program.htm
   Other 3 presentations

Keiichi MOTOYAMA & Taishi HIGASHI

1. M. Inoue, H. Jono, T. Higashi, Y. Ando, R. Onodera, H. Arima, K. Motoyama, shRNA complex with cyclodextrin/dendrimer conjugate for treatment of hereditary amyloidogenic transthyretin amyloidosis, The 6th Global Conference on Polymer and Composite Materials (PCM), July 8-11 (2019), Bangkok, Thailand
2. K. Morita, K. Motoyama, J. Li, T. Higashi, One-pot synthesis of cyclodextrin-based polycatenanes as novel supermolecules, The 6th Global Conference on Polymer and Composite Materials (PCM), July 8-11 (2019), Bangkok, Thailand
3. K. Motoyama, R. Onodera, T. Higashi, Induction of mitophagy-mediated antitumor activity with folate-appended methyl-β-cyclodextrin, 4th Symposium on Weak Molecular Interactions, March 17-19 (2019), Matsue, Japan

other 34 presentations

[Publications]

Takuro NIIDOME, Ruda LEE

1. A. Harada, H. Tsutsuki, T. Zhang, **R. Lee**, K. Yahiro, T. Sawa, **T. Niidome**, Preparation of biodegradable PLGA-nanoparticles used for pH-sensitive intracellular delivery of an anti-inflammatory bacterial toxin to macrophages, *Chem. Pharm. Bull.*, in press
2. W. Xu, K. Yagoshi, T. Asakura, M. Sasaki, **T. Niidome**, Silk fibroin as a coating polymer for sirolimus-eluting magnesium alloy stents, *ACS Applied BioMaterials,* **3**, 531-538 (2020)
3. M. W. Kim, **T. Niidome**, **R. Lee**, Glycol chitosan-docosahexaenoic acid liposomes for drug delivery: synergistic effect of doxorubicin-rapamycin in drug-resistant breast cancer, *Mar. Drugs,* **17**, 581 (2019)

4. W. Xu, K. Sato, Y. Koga, M. Sasaki, **T. Niidome**, Corrosion resistance of HF-treated Mg alloy stent following balloon- expansion and its improvement through biodegradable polymer coating, *J. Coat. Technol. Res. in press*
5. M. Machida, **T. Niidome**, H. Onoe, A. Heisterkamp, M. Terakawa, Spatially-targeted laser fabrication of multi-metal microstructures inside a hydrogel, *Optics Express,* **27**, 14657-14666 (2019)
6. A. Harada, H. Ichimaru, T. Kawagoe, M. Tsushida, Y. Niidome, H. Tsutsuki, T. Sawa, **T. Niidome**, Gold-treated silver nanoparticles have enhanced antimicrobial activity, *Bull. Chem. Soc. Jpn.,* **92**, 297-301 (2019)
7. Y. Higuchi, **T. Niidome**, Y. Miyamoto, Y. Komohara, T. Tokunou, T. Kubota, T. Horiuchi, Accumulation of gold nano-rods in the failing heart of transgenic mice with the cardiac-specific expression of TNF-α, *Heart and Vessels,* **34**, 538-544 (2019)
8. M. W. Kim, G.Lee, T. Niidome, Y. Komohara, **R. Lee***, Y. I. Park*, Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions. *Frontiers bioengineering and biotechnology.* Accept 2020.
9. S. Kwon, T. Wi, Y. I. Park, M. W. Kim, G. Lee, T. Higaki, J. H. Choi, **R. Lee***, Non-invasive early. detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor. *Bioconjugate chem.* Accept 2020.
10. **R. Lee**, Y. J. Choi, M. S. Jeong, Y. I. Park, **K. Motoyama**, M. Wo. Kim, S. Kwon, J. H. Choi, Hyaluronic acid-decorated glycol chitosan nanoparticles for pH-sensitive controlled release of doxorubicin and celecoxib in non-small cell lung cancer. *Bioconjugate chem.* Accept 2020.
11. M. W. Kim, T. Niidome, **R. Lee***. Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer. *Marine drugs*, 17, 10, 581, 2019.
12. **R. Lee**, S. Choi, K. C. Moon, J. W. Park, K. Kim, S. Yoon, I. Youn. Fluorogenic Probe for Detecting Active Matrix Metalloproteinase-3 (MMP-3) in Plasma and Peripheral Blood Neutrophils to Indicate the Severity of Rheumatoid Arthritis. *ACS Biomaterials Science & Engineering*, 5, 6, 3039-3048, 2019.
13. M. W. Kim, H. Y. Jeong, S. J. Kang, I. H. Jeong, M. J. Choi, Y. M. You, C. S. Im, I. H. Song, T. S. Lee, J. S. Lee, **R. Lee**, Y. S. Park. Anti-EGF Receptor Aptamer-Guided Co-Delivery of Anti-Cancer siRNAs and Quantum Dots for Theranostics of Triple-Negative Breast Cancer. *Theranostics*, 9, 3, 837-852, 2019.

Ick Chan KWON

1. Effects of exercise training and detraining on atheromatous matrix metalloproteinase activity in mice. J Kim, HJ Jang, D Schellingerhout, JW Kang, S Choi, H Oh, EJ Kim, S Lee, JS Lee, **IC Kwon**, K Kim, YJ Koh, W Ryu, D Kim. *Atherosclerosis*, Accept, 2020.
2. Combination of KRAS gene silencing and PI3K inhibition for ovarian cancer treatment. MJ Kim, SJ Lee, JH Ryu, SH Kim, **IC Kwon**, TM Roberts. *Journal of Controlled Release* 318, 98-108, 2020.
3. Development of microRNA-21 mimic nanocarriers for the treatment of cutaneous wounds. SY Wang, H Kim, G Kwak, SD Jo, D Cho, Y Yang, **IC Kwon**, JH Jeong, SH Kim. *Theranostics* 10 (7), 3240, 2020.
4. Targeted delivery of anti-inflammatory cytokine by nanocarrier reduces atherosclerosis in Apo E−/-mice. M Kim, A Sahu, Y Hwang, GB Kim, GH Nam, IS Kim, **IC Kwon**, G Tae. *Biomaterials* 226, 119550, 2020.
5. Non-invasive in vivo imaging of caspase-1 activation enables rapid and spatiotemporal detection of acute and chronic inflammatory disorders. YJ Ko, JW Lee, EJ Yang, N Jang, J Park, YK Jeon, JW Yu, NH Cho, HS Kim, **IC Kwon**. *Biomaterials* 226, 119543, 2020.
6. Visible light-induced apoptosis activatable nanoparticles of photosensitizer-DEVD-anticancer drug conjugate for targeted cancer therapy. W Um, J Park, H Ko, S Lim, HY Yoon, MK Shim, S Lee, YJ Ko, MJ Kim, JH Park, DK Lim, Y Byun, **IC Kwon**, K Kim. *Biomaterials* 224, 119494, 2019.
7. Exosome-Guided Phenotypic Switch of M1 to M2 Macrophages for Cutaneous Wound Healing. H Kim, SY Wang, G Kwak, Y Yang, **IC Kwon**, SH Kim. *Advanced Science* 6 (20), 1900513, 2019.

8. Activatable NIRF/MRI dual imaging probe using bio-inspired coating of glycol chitosan on superparamagnetic iron oxide nanoparticles. IJ Chung, SI Jeon, EJ Cha, Y Byun, **IC Kwon**, YI Kim, K Kim, CH Ahn. *Journal of Industrial and Engineering Chemistry* 76, 403-409, 2019.
9. Tumor-targeting glycol chitosan nanocarriers: overcoming the challenges posed by chemotherapeutics. Y Choi, S Lim, HY Yoon, BS Kim, **IC Kwon**, K Kim. *Expert opinion on drug delivery* 16 (8), 835-846, 2019.
10. Dually Stabilized Triblock Copolymer Micelles with Hydrophilic Shell and Hydrophobic Interlayer for Systemic Antisense Oligonucleotide Delivery to Solid Tumor. BS Kim, HJ Kim, S Osawa, K Hayashi, K Toh, M Naito, HS Min, Y Yi, **IC Kwon**, K Kataoka, K Miyata. *ACS Biomaterials Science & Engineering* 5 (11), 5770-5780, 2019.
11. Advances in the strategies for designing receptor-targeted molecular imaging probes for cancer research. YJ Ko, WJ Kim, K Kim, **IC Kwon**. *Journal of Controlled Release* 305, 1-17, 2019.
12. Cumulative directional calcium gluing between phosphate and silicate: A facile, robust and biocompatible strategy for siRNA delivery by amine-free non-positive vector. E Choi, J Lee, **IC Kwon**, DK Lim, S Kim. *Biomaterials* 209, 126-137, 2019.
13. Immunomodulatory nanodiamond aggregate-based platform for the treatment of rheumatoid arthritis. A Pentecost, MJ Kim, S Jeon, YJ Ko, **IC Kwon**, Y Gogotsi, K Kim, KL Spiller. *Regenerative Biomaterials* 6 (3), 163-174, 2019.
14. Enhancing Systemic Delivery of Enzymatically Generated RNAi Nanocomplexes for Cancer Therapy. H Nam, SH Ku, HY Yoon, K Kim, **IC Kwon**, SH Kim, JB Lee. *Advanced Therapeutics* 2 (6), 1900014, 2019.
15. Theranostic designs of biomaterials for precision medicine in cancer therapy. H Kim, G Kwak, K Kim, HY Yoon, **IC Kwon**. *Biomaterials*, 2019.
16. Rational Design of Inflammation-Responsive Inflatable Nanogels for Ultrasound Molecular Imaging. J Heo, CK Lim, HS Min, KE Lee, K Jeong, YH Seo, YD Lee, JY Yhee, K Kim, **IC Kwon**, SY Park, S Kim. *Chemistry of Materials* 31 (8), 2905-2912, 2019.
17. Self-Assembly of siRNA/PEG-*b*-Catiomer at Integer Molar Ratio into 100 nm-Sized Vesicular Polyion Complexes (siRNAsomes) for RNAi and Codelivery of Cargo. BS Kim, S Chuanoi, T Suma, Y Anraku, K Hayashi, M Naito, HJ Kim, **IC Kwon**, K Miyata, A Kishimura, K Kataoka. *Journal of the American Chemical Society* 141 (8), 3699-3709, 2019.
18. Carrier-free nanoparticles of cathepsin B-cleavable peptide-conjugated doxorubicin prodrug for cancer targeting therapy. MK Shim, J Park, HY Yoon, S Lee, W Um, JH Kim, SW Kang, JW Seo, SW Hyun, JH Park, Y Byun, **IC Kwon**, K Kim. *Journal of controlled release* 294, 376-389, 2019.
19. Alliance with EPR effect: Combined strategies to improve the EPR effect in the tumor microenvironment. J Park, Y Choi, H Chang, W Um, JH Ryu, **IC Kwon**. *Theranostics* 9 (26), 8073, 2019.
20. Collective progress in drug delivery. JC Leroux, D Peer, T Lammers, P Caliceti, S Schwendeman, YH Bae, S Mitragotri, **IC Kwon**, JV Harten, MV Twisk, F Ogochi. *Journal of Controlled Release* 300, 197-199, 2019.

Keiichi MOTOYAMA & Taishi HIGASHI

1. M. Okubo, D. Iohara, M. Anraku, **T. Higashi**, K. Uekama, F. Hirayama, A thermoresponsive hydrophobically modified hydroxypropylmethyl cellulose/cyclodextrin injectable hydrogel for the sustained release of drugs. *Int. J. Pharm*., in press
2. T. Yokoyama, M. Yukuhiro, Y. Iwasaki, C. Tanaka, K. Sankoda, R. Fujiwara, A. Shibuta, **T. Higashi**, **K. Motoyama**, H. Arima, K. Yoshida, N. Sugimoto, H. Morimoto, H. Kosako, T. Ohshima, M. Fujita, Identification of candidate molecular targets of the novel antineoplastic antimitotic NP-10. *Sci. Rep*., **9**, 16825 (2019)
3. Y. Hayashi, **T. Higashi**, **K. Motoyama**, H. Jono, Y. Ando, H. Arima, Hepatocyte-targeted delivery of siRNA polyplex with PEG-modified lactosylated dendrimer/cyclodextrin conjugates for transthyretin-related amyloidosis therapy. *Biol. Pharm. Bull*., **42**, 1679-1688 (2019)

4. Y. Mori, **T. Higashi**, **K. Motoyama**, M. Ishida, R. Onodera, H. Arima, A comprehensive understanding of lowly-hydrolyzed polyvinyl alcohol based ternary solid dispersions by application of a combined mixture experimental design. *Drug Dev. Ind. Pharm*., **45**, 1599-1609 (2019)
5. **T. Higashi**, K. Morita, X. Song, J. Zhu, A. Tamura, N. Yui, **K. Motoyama**, H. Arima, J. Li, One-pot synthesis of cyclodextrin-based radial poly[n]catenanes, *Commun. Chem*., **2**, 78 (2019)
6. Y. Maeda, **K. Motoyama**, R. Nishiyama, **T. Higashi**, R. Onodera, H. Nakamura, T. Takeo, N. Nakagata, Y. Yamagata, Y. Ishitsuka, Y. Kondo, T. Irie, T. Era, H. Arima, In vivo efficacy and safety evaluation of lactosyl-β-cyclodextrin as a therapeutic agent for hepatomegaly in Niemann-Pick Type C disease. *Nanomaterials*, **9**, 802 (2019)
7. A.F. Abdelwahab, **T. Higashi**, **K. Motoyama**, A. Ohyama, R. Onodera, K.A. Khaled, H.A. Sarhan, A.K. Hussein, H. Arima, In vitro and in vivo co-delivery of siRNA and doxorubicin by folate-PEG-appended dendrimer/glucuronylglucosyl-β-cyclodextrin conjugate. *AAPS J*., **21**, 1-10 (2019)
8. M. Inoue, M. Ueda, **T. Higashi**, T. Anno, K. Fujisawa, **K. Motoyama**, M. Mizuguchi, Y. Ando, H. Jono, H. Arima, Therapeutic potential of PAMAM dendrimer for amyloidogenic transthyretin amyloidosis. *ACS Chem. Neurosci*., **10**, 2584-2590 (2019)
9. N. Yasmin, Y. Ishitsuka, M. Fukaura, Y. Yamada, S. Nakahara, A. Ishii, Y. Kondo, T. Takeo, N. Nakagata, **K. Motoyama**, **T. Higashi**, Y. Okada, J. Nishikawa, A. Ichikawa, D. Iohara, F. Hirayama, K. Higaki, K. Ohno, M. Matsuo, T. Irie, In vitro and in vivo evaluation of 6-*O*-α-maltosyl-β-cyclodextrin as a potential therapeutic agent against Niemann-Pick disease Type C. *Int. J. Mol. Sci*., **20**, E1152 (2019)
10. **T. Higashi**, Cyclodextrin-based molecular accessories for drug discovery and drug delivery. *Chem. Pharm. Bull.*, **67**, 289-298 (2019)
11. A.F. Abdelwahab, **T. Higashi**, **K. Motoyama**, A. Ohyama, R. Onodera, K.A. Khaled, H.A. Sarhan, A.K. Hussein, H. Arima, Targeted siRNA delivery to tumor cells by folate-PEG-appended dendrimer/glucuronylglucosyl-β-cyclodextrin conjugate. *J. Incl. Phenom. Macro. Chem.*, **93**, 41-52 (2019)
12. Y. Maeda, **K. Motoyama**, **T. Higashi**, R. Onodera, T. Takeo, N. Nakagata, Y. Kurauchi, H. Katsuki, Y. Ishitsuka, Y. Kondo, T. Irie, T. Era, H. Arima, Lowering effect of dimethyl-α-cyclodextrin on GM1-ganglioside accumulation in GM1-gangliosidosis model cells and in brain of β-galactosidase-knockout mice. *J. Incl. Phenom. Macro. Chem.*, **93**, 53-66 (2019)
13. Y. Mori, **K. Motoyama**, M. Ishida, R. Onodera, **T. Higashi**, H. Arima, Theoretical and practical evaluation of lowly hydrolyzed polyvinyl alcohol as a potential carrier for hot-melt extrusion, *Int. J. Pharm.*, **555**, 124-134 (2019)

3. Application & acquisition status of KAKENHI and other external grants

Takuro NIIDOME

1. KAKENHI, Basic research A (assigned researcher)
2. KAKENHI, Basic research B (assigned researcher)
3. KAKENHI, Basic research C (assigned researcher)
4. JSPS Bilateral Collaboration Research (representative researcher)
5. AMED, CiCLE (assigned researcher)
6. AMED, J-PRIDE (assigned researcher)
7. JST, CREST (assigned researcher)

Ruda LEE

1. JSPS, Early career researcher grant (representative researcher)

Ick Chan KWON

1. KIST-DFCI collaboration research (PI: Kwon) 01/01/19 – 12/31/21, Korea Institute of Science and Technology (KIST)

Keiichi MOTOYAMA

1. AMED, Research on Development of New Drugs (representative researcher)

Taishi HIGASHI

1. KAKENHI, Basic research C (representative researcher)
2. Leading Initiative for Excellent Young Researchers (representative researcher)
3. Research Center for Biomedical Engineering (representative researcher)
4. The Research Foundation for Pharmaceutical Sciences (representative researcher)
5. The Naito Foundation (representative researcher)
6. AMED, Research on Development of New Drugs (assigned researcher)

4. Application & acquisition status of industrial property rights

Takuro NIIDOME

1. Bioresorbable stent, Takuro Niidome, Wei Xu, Makoto Sasaki, Shuzo Yamashita, P2019-115506, June 21st, 2019

Ick Chan KWON

1. Therapeutic agent for treating cancer comprising anti-mirna-albumin composite.
   SH Kim, IC Kwon, KIM Kwangmeyung, HY Yoon, K Gi-Jung, J Park. US Patent App. 16/425,849
2. Method for inducing trans-differentiation of cardiomyocytes based on exosome.
   IC Kwon, SH Kim, Y Yoosoo, H Kim. US Patent App. 16/456,127
3. Method of using methylene blue nanoparticle for detecting cancer by bioimaging.
   S Kim, IC Kwon, S Lee. US Patent 10,500,289
4. Method for inducing transdifferentiation of immune cells based on exosomes.
   H Yeon-Sun, HS Kim, YS Yang, SH Kim, IS Kim, IC Kwon. US Patent App. 16/379,523
5. Tumor-targeting photosensitizer-drug conjugate, method for preparing same and pharmaceutical composition for preventing or treating tumor containing same.
   KIM Kwangmeyung, IC Kwon, J Park. US Patent App. 15/944,025
6. Method for treating cancer by photodynamic therapy.
   S Kim, IC Kwon, S Lee. US Patent 10,335,488
7. Tumor cell-specific responsive self-assembling drug nanoconjugate.
   KIM Kwangmeyung, IC Kwon, J Park. US Patent App. 15/925,830
8. Method of treating cancer by using siRNA nanocomplexes.
   S Kim, IC Kwon, E Lee. US Patent App. 16/198,727
9. Glycopeptide for contrast agent targeting cancer cells and contrast agent kit containing the same.
   KIM Kwangmeyung, JH Ryu, IC Kwon, MK Shim, HY Yoon. US Patent 10,213,515
10. Nanocomplexes for co-delivering a drug and siRNA and uses thereof.
    S Kim, IC Kwon, E Lee. US Patent 10,172,879

Keiichi MOTOYAMA & Taishi HIGASHI

1. Drug carriers and their production methods, Keiichi Motoyama, Taishi Higashi, Risako Onodera, Ryoma Yokoyama, Kandai Ishikura, Kazunori Yanagihara, Hiroki Takagi, JP2019-183725, October 4th, 2019

No. 5-5-2	Nano-medicine and Drug Delivery System		
Research Field	Nanomaterial Science/ Advanced Green Bio		
Unit Coordinator			
Name	Hamid Hosano		
Affiliation	Institute of Pulsed Power Science Email: hamid@kumamoto-u.ac.jp	Title	Professor
Unit Members			

Name	Affiliation/Title
Hamid Ghandehari	Professor; Director of Utah Center for Nanomedicine; Professor of Department of Pharmaceutics and Pharmaceutical Chemistry and Bioengineering, University of Utah, USA
Amir A. Farajian	Associate Professor; Department of Mechanical and Materials Engineering, Wright State University, USA
Viren Ivor Menezes	Professor; Department of Aerospace Engineering, Indian Institute of Technology Bombay, India
Konstantinos Kontis	Professor; School of Engineering, Dean for Global Engagement-East Asia & China, University of Glasgow, UK / Distinguished Professor; IROAST, Kumamoto University
Firuz Zare	Professor; Power Electronics and Energy Group, The University of Queensland, Australia
Nushin Hosano	Visiting Associate Professor, Bioelectrics Department, Institute of Pulsed Power Science, Kumamoto University, Japan

Details of activities

We are studying the use of physical delivery of drug or reprogramming factors into the cells and tissue, as a safe and reliable method. We are also exploring integrated diagnostic and therapeutic (theranostics) modalities/nanoparticles/agents, as a unique approach in nanomedicine. The research has potential to be used in a wide range of medical applications.
Our physical delivery approaches are based on applying electrical/mechanical stresses to the cells. In this respect, attention has been made to understand biophysical reactions to reversibly manipulate the cells by the external stress. We have been investigating promising physical delivery methods including: electroporation with nanosecond pulsed electric fields, needle-free painless microinjection, micro/nano-particle carrier laser-biolistic delivery, sonoporation with microfluidics, and shock waves; which are shown to be appropriate for clinical applications.

Joint publication with Prof. Zare's group:

N. Ghasemi, F. Zare, H. Hosano, A Review of Pulsed Power Effectiveness on Degradation of Water Pollutants Ranging from Microorganisms to Organic Compounds, IEEE Access, Vol. 7; pp. 150863-91, (2019)

DOI: 10.1109/ACCESS.2019.2947632

Joint submitted paper with Prof. Menezes's group:

M. Thorat; S.N. Sahu; V. Menezes; H. Hosano, A. Gokhale, Shock loading of closed cell aluminum foams in the presence of an air cavity, *Revision submitted*, Applied Sciences (MDPI)

Joint submitted paper with Prof. Zare's group:

F. Zare, N. Ghasemi, N. Bansal, G. Abhishek, H. Hosano, Increasing the production yield of white oyster mushrooms with pulsed electric fields, *Submitted*, Food and Bioprocess Technology (Springer)

Other publications:

M. Sato, T. Sakugawa*, T. Yamashita, N. Hosano, H. Hosano*, Effects of Voltage and Current Waveforms on Pulse Discharge Energy Transfer to Underwater Shock Waves for Medical Applications, *Online first*, IEEE Trans. Plasma Science (2019)
DOI: 10.1109/TPS.2020.2992638

T. Yamashita, H. Akiyama, T. Sakugawa, H. Hosano*, Metal-coated plastics recycling by pulsed electric discharge, Waste Management, Vol. 89, pp. 57-63 (2019)
DOI: 10.1016/j.wasman.2019.03.069

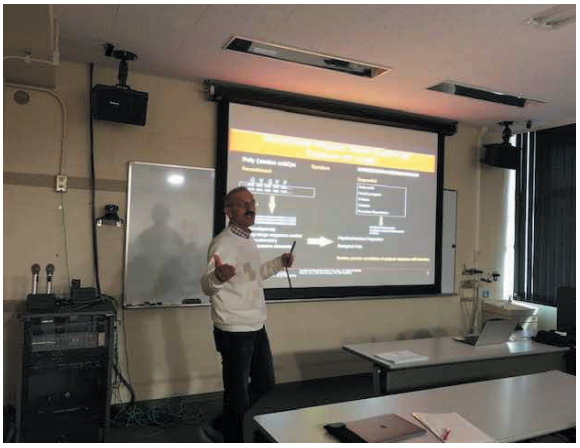
T. Yamashita, H. Hosano, H. Akiyama, T. Sakugawa, Mechanism of metal removal from metal-coated plastics using pulsed power, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 26(2) pp. 523 - 529 (2019)
DOI: 10.1109/TDEI.2019.007720 (I.F. 2.115)

A. Guionet, K. Oura, H. Akiyama, H. Hosano, The narrow window of energy application for oil extraction by arc discharge. J. Appl. Phycol., Vol. 31, pp. 89-96 (2019)
DOI: 10.1007/s10811-018-1579-y

External grant: Grant in-Aid for Scientific Research (Kakenhi) from the Ministry of Education, Culture, Sports, Science and Technology of Japan, Grant 17K06163 (April 2017 to March 2020).



Prof. Kontis gave the 67th IROAST Lecture & Seminar to graduate students and researchers of Kumamoto University on Dec. 3, 2019.



Prof. Ghandehari gave the 71st IROAST Lecture & Seminar to graduate students and researchers of Kumamoto University on Dec. 18, 2019.

No. 5-6	Multiscale Modeling of Soil and Rock Materials Using X-ray CT		
Research Field	Advanced Green Bio / (Application of X-ray CT)		
Unit Coordinator			
Name	Jun Otani		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: junotani@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Gioacchino VIGGIANI José E. ANDRADE	Professor, University of Grenoble Alpes France George W. Housner Professor of Civil and Mechanical Engineering, Cecil and Sally Drinkward Leadership Chair, Executive Officer for Mechanical and Civil Engineering, Engineering and Applied Science Division, California Institute of Technology US		

1. Overview of achievements

The topic of this research unit is the application of x-ray imaging to engineering, especially for geomaterials (soils, rock, and concrete). X-ray imaging plays a key role for the experimental multi-scale analysis of geomechanics, in that it helps linking the mechanisms occurring at the micro scale to the mechanical behavior observed at the macro scale.

In this year, we had a series of discussions about the progress on this collaboration using e-mail, especially the submission of collaborative technical paper and we have set a kick-off meeting on this issue at Kumamoto University in April of 2020. However, because of the CORONA Virus, we could not have this meeting. Anyway, our discussion of publishing papers is continued. The possible technical paper will be soon and the title will be “Micro-Macro behavior of geomaterials using X-ray CT and Distinct Element Method ((DEM)” [Tentative]. And of course, when it is ready, we will have a meeting at either Caltech, Grenoble or Kumamoto.

2. Presentations & Publications (incl. submitted papers)

As mentioned above, we are preparing joint paper but in order to complete, we need the meeting, so that we try to have this in the year of 2020.

3. Application & acquisition status of KAKENHI and other external grants

In fact, Prof. Otani is a member of KAKENHI (International Collaboratio (B)) with Prof. Mukunoki and this project is with the members of Grenoble. So that we will be able to do some action under this KAKENHI, Prof. Otani will visit Grenoble and be able to have discussion with Prof. Viggiani.

No. 5-7	Three-dimensional reconstruction of vascular beds in murine hind-limbs		
Research Field	Biological science		
Unit Coordinator			
Name	Toshifumi Mukunoki		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: mukunoki@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Yuichiro Arima Jun Otani	Department of Cardiovascular Medicine, Kumamoto university/Assistant Professor Faculty of Advanced Science and Technology, Kumamoto University/Professor		

Overview of activities

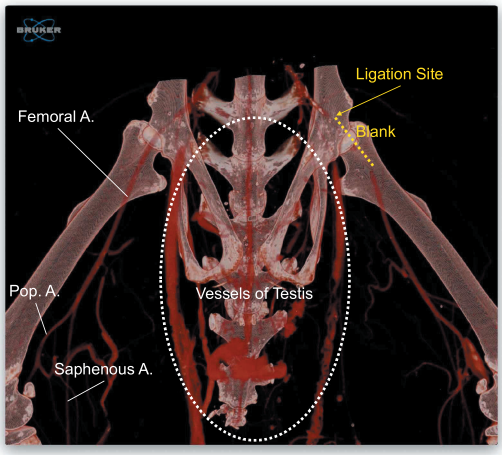
In this project, we tried to reconstruct the three-dimensional architecture of vascular beds in murine hind-limbs. Whole vasculatures were filled with radiopaque resin and stacked images were obtained by using nano-X-ray CT (Skyscan2211) (Figure1).

Vascular regions were extracted (Fiji) and reconstructed by using Three-dimensional image segmentation software (ScanIP) (Figure2). We could reconstruct the vascular bed in the calf region. In the case of hind limb ischemia, the volume of vasculature was significantly increased in the ischemic side, in spite of poor perfusion.

Compare to the microvasculature, analysis of mid-size vasculature has not progressed. One of the problems was that there was no imaging technology to evaluate the whole architecture, X-ray CT analysis will solve this problem.

We are trying to make computational fluid dynamics (CFD) analysis and compare the blood flow in both legs. To understand histological changes, we are also trying to make whole mount immunostaining. Combined usage of X-ray CT and microscopic analysis will provide an integrated understanding of blood vessels.

Figure1





No. 5-8	Micro CT-based quantification of fibrosis and vascularization in pancreatic tumor		
Research Field	Nanomaterial Science/ Green Energy/ Environmental Science/ Advanced Green Bio / Next-generation Technology		
Unit Coordinator			
Name	Toshifumi Mukunoki		
Affiliation	FAST, Kumamoto University Email: mukunoki@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Jun Otani	IROAST/FAST; Professor		
Takatsugu Ishimoto	IRCMS; Assoc. Professor		
Bu luke	IRCMS; Researcher		

Overview of activities

Inflammation and cancer are closely related and favor each other mutually. We are aiming to find the connection between pancreatic cancer and arachidonic cascade, in which we knocked out the key enzyme15pgdh in mice and established an inflammatory syngeneic mouse model. Arachidonate cascade is a major inflammatory pathway that produces prostaglandin E2 (PGE2) and prostaglandin F2α (PGF2α). We have reported that accumulation of PGE2 in 15pgdh KO mouse promoted cancer stem cell fraction and tumor formation (Arima et al. *Oncogene*). At present we focus on angiogenesis in 15pgdh depleted tumor microenvironment, and have already confirmed enhancement of vascular structure in 15pgdh+/- mouse comparing to wildtype mouse by NanoCT (Figure 1).

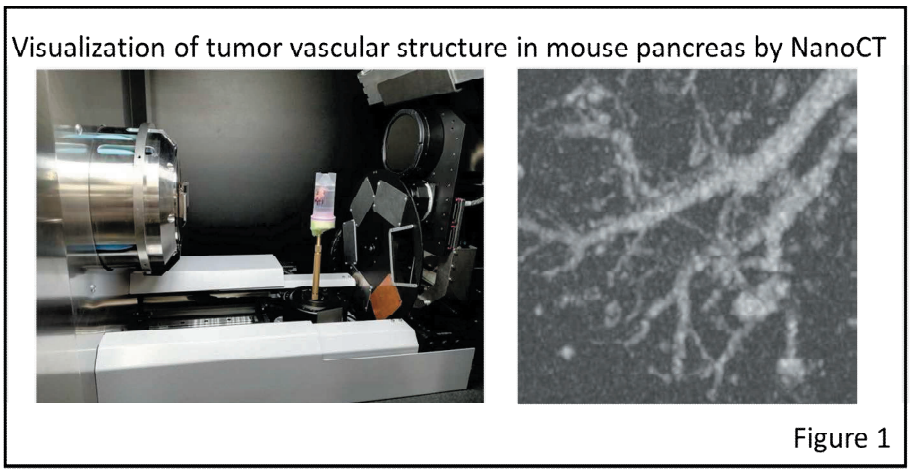


Figure 1

No. 5-9	Micromechanical Characterization of Advanced Structural Materials		
Research Field	Nanomaterial Science		
Unit Coordinator			
Name	Kazuki Takashima		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: takashik@gpo.kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Yoji Mine	Faculty of Advanced Science and Technology, Professor		
Kwangsik Kwak	Faculty of Advanced Science and Technology, Assistant Professor		
Yufen Zheng	IROAST, Distinguished Professor (Peking University, Professor)		
Paul Bowen	IROAST, Visiting Professor (University of Birmingham, Professor)		
Martin Dienwiebel	IROAST, Visiting Professor (Karlsruhe Institute of Technology, Professor)		
Shirley Shen	IROAST, Visiting Professor (CSIRO, Principal Research Scientist)		

1. Overview of achievements

The mechanical properties of materials are dominated by their microstructures such as grain size, precipitates, phase boundary, grain boundary, etc. In our research group, we aim to clarify the mechanical properties at microscopic level, including tensile properties, fracture and fatigue properties, using the micromechanical testing technology that we have developed. Furthermore, in conjunction with crystal plasticity finite element simulation, we aim to predict the mechanical properties of bulk materials based on those at microscopic scale. The followings are our achievement of our research unit in FY2019.

1) Mechanical Properties of Biomaterial

This research has been conducted in collaboration with Professor Zheng, Distinguished Professor of IROAST. In the development of biomaterials, it is important to evaluate the mechanical properties in a shape close to the final shape and size. As the stents are used intravascularly, the effects of fatigue associated with cyclic loading by the pulse must be considered in addition to the effects of material corrosion in the in vivo environment. Previously, corrosion fatigue has been studied using bulk-sized specimens made from the same material as the stent. However, stents are usually several mm thick and are microfabricated using lasers and other processes. Therefore, in order to evaluate the actual mechanical properties of the stent, it is necessary to evaluate the mechanical properties for the miniature-sized specimens prepared from the stent fabricated by actual processes. Therefore, we have developed a testing machine that can measure the environmental fatigue properties in the same size as a stent. Using this testing machine, fatigue tests for ring-shaped specimens of austenitic stainless steel with an outer

diameter of 3 mm, an inner diameter of 2 mm and a thickness of 1 mm were carried out in air and in 3% NaCl aqueous solution that simulates the body environment. As a result, we succeeded to apply cyclic load to the specimens, and to determine the fatigue life in air and the aqueous solution. In addition to the above, the development of new Zn-Li-based biometallic materials with excellent mechanical properties and biodegradability, which melt with time in vivo, have been also developed.

2) Elucidation of Fatigue Crack Growth Mechanism in Ti-Based Alloys

Ti alloys are expected to be used as aerospace materials, and improvement of fatigue properties is required from the viewpoint of long-term durability and reliability. In the fatigue of metallic materials, it is important to know the fundamental mechanism of crack propagation in order to improve their lifetime. Fatigue crack propagation is based on cyclic plastic deformation at the crack tip, and the crack propagation length per cycle is on the order of submicron. Therefore, it is necessary to directly observe the propagation process at the crack tip in the sub-micron order. We have collaborated with Professor Bowen, visiting professor at IROAST and professor at the University of Birmingham to elucidate the mechanism of fatigue crack propagation using the micro-fatigue testing technique developed in our research group. In this fiscal year, a graduate student (one in the doctoral course and one in the master's course) of our laboratory stayed at Professor Bowen's laboratory at the University of Birmingham from April 1991 to November 1991 with JSPS and “Tobitate Ryugaku Japan” scholarships, respectively, and conducted joint research. In addition, Professors Takashima and Mine visited Professor Bowen's laboratory in August and September, and discussed the development of future collaborations.

3) Nanotribology of Metals

We have collaborated with Prof. Dienwiebel, visiting professor at IROAST and professor at Karlsruhe Institute of Technology, on the tribological properties of Mg alloys. In this fiscal year, we invited Professor Dienwiebel to our laboratory in August, and conducted joint research as well as seminars for graduate students. In addition, Professor Mine and a graduate student (master's course) of our laboratory stayed at the Karlsruhe Institute of Technology from August to September and discussed the results of transmission electron microscopy of the surface layer of Mg alloy after the tribology tests. We are planning to publish a co-authored paper in FY2020.

4) Evaluation of Mechanical Properties of Additive Manufacturing Materials

From this year, we started a joint research on the mechanical properties of additive manufacturing materials with Dr. Shen of CSIRO, who is a visiting professor at IROAST. We invited her to our university from June to July, and she gave a seminar on additive manufacturing for graduate and undergraduate students, and we held a meeting on future international joint research. As a first step, we evaluated the characteristics of the metal powders used in the joint research at our university and examined the possibility of additive manufacturing at CSIRO.

2. Publications

International co-authored papers with visiting professors (All of the following papers have been published in Top 10% journals).

Wei Yuana, Dandan Xia, Yufeng Zheng, Xiangmei Liu, Shuilin Wu, Bo Li, Yong Han, Zhajun Jia,

Donghui Zhu, Liqun Ruan, Kazuki Takashima, Yunsong Liu, Yongsheng Zhou: “Controllable biodegradation and enhanced osseointegration of ZrO_2-nanofilm coated Zn-Li alloy: In vitro and in vivo studies”, Acta Biomaterialia, **105** (2020) pp. 290-303.

Guannan Li, Hongtao Yang, Yufeng Zheng, Xie-Hui Chen, Jian-An Yang, Donghui Zhu, Liqun Ruan, Kazuki Takashima: “Challenges in the use of zinc and its alloys as biodegradable metals: Perspective from biomechanical compatibility”, Acta Biomaterialia, **97** (2019) pp. 23-45.

Y. Mine, S. Katashima, R. Ding, P. Bowen, K. Takashima: “Fatigue crack growth behaviour in single-colony lamellar structure of Ti–6Al–4V”, Scripta Materialia, **165** (2019) pp. 107-111.

In addition to the above, we have published the following papers.

Kosuke Takagi, Michiaki Yamasaki, Yoji Mine, Kazuki Takashima: “Temperature dependence of prismatic slip in a single-crystalline long-period stacking ordered Mg–Zn–Y alloy”, Scripta Materialia, **178** (2020) pp. 498-502.

Yoji Mine, Yuya Matsuzaki, Kazuki Takashima: “Anisotropy of strength and plasticity in single-colony lamellar structure of Ti–6Al–4V alloy”, Scripta Materialia, **177** (2020) pp. 223-228.

Shohei Ueki, Yoji Mine, Kazuki Takashima: “Microstructure-sensitive fatigue crack growth in lath martensite of low carbon steel”, Materials Science and Engineering A, **773** (2020) Article 13883.

Shohei Ueki, Takuya Matsumura, Yoji Mine, Shigekazu Morito, Kazuki Takashima: “Microstructural fatigue crack growth in single-packet structures of ultra-low carbon steel lath martensite”, Scripta Materialia, **173** (2019) pp. 80-85.

Kosuke Takagi, Tsuyoshi Mayama, Yoji Mine, Yu Lung Chiu, Kazuki Takashima: “Extended ductility due to kink band formation and growth under tensile loading in single crystals of Mg-Zn-Y alloy with 18R-LPSO structure”, Journal of Alloys and Compounds, **806** (2019) pp. 1384-1393.

3. Application & acquisition status of KAKENHI and other external grants

Elucidation of Fatigue Crack Growth Mechanism using Microtesting Technique and Application to Fatigue Strengthening Design, KAKENHI Grant-in-Aid for Scientific Research (A) 2020-2024, (Adopted)

Exploration of Guiding Principles for Hydra Toughening Design by Multiscale Mechanical Tests, KAKENHI Grant-in-Aid for Scientific Research (B) 2019-2021 (Continuing)

3D Printing of Novel High Vapour Pressure Metals and Metal Matrix Composites as Biodegradable Implant Components, Foundation for Australia-Japan Studies (FAJS) Grant, 2019-2020 (Continuing)

No. 5-10	Microstructure Analysis and Grain Boundary Engineering		
Research Field	Nanomaterial Science		
Unit Coordinator			
Name	Sadahiro Tsurekawa		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: turekawa@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Mitsuhiro Matsuda	Faculty of Advanced Science and Technology, Kumamoto University / Associate Professor		
Yoshitaka Matsukawa	Faculty of Advanced Science and Technology, Kumamoto University / Associate Professor		
Pavel Lejček	Institute of Physics, Academy of Sciences of the Czech Republic; University of Chemistry and Technology, Prague / Professor		
Dmitri A. Molodov	Institute of Physical Metallurgy and Metal Physics, RWTH, Aachen University Germany / Professor		
Thomas Waitz	Faculty of Physics, University of Vienna, Austria / Associate University Professor		
Christian Rentenberger	Faculty of Physics, University of Vienna, Austria / Associate Professor		

Overview of achievements

Materials properties are significantly affected by microstructure. In particular, the grain boundary that is inevitably included in polycrystalline materials often control the mechanical and functional properties of the entire polycrystalline material. One example of the importance of grain boundaries is the issue in solar cells of polycrystalline materials, a key technology in the search for greener and sustainable energy, grain boundaries are one of the main causes of losses causing decreases in the conversion efficiency of sunlight to electrical energy, but an important point is that not all grain boundaries contribute to this loss to the same extent. There are certain types at which the decrease in the conversion efficiency hardly occurs at all. This example shows that it is important to make the best use of the individual characteristics of grain boundaries to design and control materials properties. The research in our group takes as its basis grain boundary and interface science and engineering with the aim of developing advanced materials with excellent function and performance.

S. Tsurekawa's (ST) group mainly conducted the study on the incipient of plasticity in the vicinity of the grain boundary in materials with hexagonal structure like magnesium and zinc, in collaboration with Prof. Dmitri A. Molodov (RWTH Aachen University) in FY2019. Nanoindentation tests for orientation-controlled Mg and Zn bicrystals revealed that the critical stress required for nucleation of dislocations is lower at the grain boundary than in the grain interior, and that the critical stress depends on the grain boundary character and structure. In addition, ST group also studied the influence of plastic deformation on local mechanical properties of grain boundary in Ni bicrystals with Prof. Pavel Lejček (Institute of Physics, Czech Academy of Sciences) to make clear the mechanical properties of non-equilibrium grain boundary introduced by sever plastic deformation that is expected to be a useful technique to produce ultrafine grained materials, and found that the difference between in the critical stress for incipient plastic deformation at the grain boundary and that in the grain interior became insignificant with increasing plastic strain.

M. Matsuda's (MM) group discussed the structural and mechanical properties of nanocrystalline materials and experimented with Vienna's Group (Prof. T. Waitz and Prof. C. Rentenberger) throughout the year. Also, they successfully acquired "Promotion of Joint International Research (Fostering Joint International Research(B)) of KAKENHI", and proposed for the "Scientific Research B" to collaborate the research more strongly.

We planned to hold an "IROAST Workshop on the Fundamental of Grain Boundary Phenomena" in March 2020, which included invited talks from Professors Pavel Lejček and Dmitri A. Molodov. However, it was cancelled unfortunately due to the worldwide COVID-19 pandemic.

Publications

1. S. Uemura, S. Yamamoto Kamata, K. Yoshimi, S. Tsurekawa, Microstructural evolution during high-temperature tensile creep at 1500°C of a MoSiBTiC alloy, High Temperature Materials and Processing, 39 (2020), 1-10.
2. S. Kobayashi, W. Yang, Y. Tomobe, S. Tsurekawa, Low-angle boundary engineering for improving high-cycle fatigue property of 430 ferritic stainless steel, Journal of Materials Science (published online 18 March 2020).
3. S. Ii, K. Hirayama, S. Tsurekawa, Experimental Confirmation of Grain Boundary Magnetism in Fe–Si and Fe–Sn Alloys by TEM-EELS, Materials Transaactions, 60 (2019), 636-641.
4. S. Kobayashi, S. Ogoe, S. Tsurekawa, Grain Boundary Engineering for Control of Fatigue Fracture in 316L Austenitic Stainless Steel, Materials Transaactions, 60 (2019), 623-630.

Presentations

1. T. Tanoue, M. Matsuda, M. Kerber, T. Waitz, *Microstructural modifications during heating and martensitic transformation of Zr-Co-Ni alloys produced by high-pressure torsion*, Autumn Meeting of The Japan Institute of Metals and Materials, Okayama Univ. (2019, 9).
2. J.-E. Brandenburg, M. So, S. Tsurekawa, *Local Mechanical Properties in the vicinity of* $<10\bar{1}0>$ *and* $<0001>$ *Grain Boundaries in Mg*, Autumn Meeting of The Japan Institute of Metals and Materials, Okayama Univ. (2019, 9).
3. M. Tashiro, S. Tsurekawa, *Local mechanical properties at grain boundary in orientation-controlled Zn bicrystals*, Autumn Meeting of The Japan Institute of Metals and Materials, Okayama Univ. (2019, 9).

4. S. Uemura, T. Yamamuro, K. Yoshimi, S. Yamamoto-Kamata, S. Nakayama, G. Eggeler, K. Maruyama, S. Tsurekawa, *Microstructural evolution during ultra high-temperature tensile creep of MoSiBTiC alloy*, The 10th Pacific Rim International Conference on advanced Materials and Processing (PRICM 10), Xi'an, China, (2019, 8).
5. S. Kobayashi, S. Tsurekawa, *Control of low-angle boundary network for improving high-cycle fatigue in 430 ferritic stainless steel*, Intergranular and Interphase Boundaries in Materials (iib2019), Paris, France, (2019, 7).
6. S. Tsurekawa, D. A. Molodov, P. Lejček, *Critical stress required to propagate yield past the grain boundary*, Intergranular and Interphase Boundaries in Materials (iib2019), Paris, France, (2019, 7).
7. S. Uemura, T. Yoshida, M. Všianská, M. Friák, M. Šob, K. Yoshimi, S. Tsurekawa, *Ab-initio study of alloying effect of titanium and carbon on Young's modulus of Mo5SiB2 (T2) phase*, International Conference on Materials Structure and Micromechanics of Fracture (MSMF 9), Brno, Czech Republic, (2019, 6).
8. J. Yamaguchi, S. Ii, T. Ohmura, S. Tsurekawa, *Real time analysis of mechanical response associated with dislocation motion in magnesium bicrystal via in-situ TEM deformation*, Annual meeting of Kyushu Branches of The Japan Institute of Materials, The Iron and Steel Institute of Japan, and The Japan Institute of Light Metals, Kumamoto, (2019, 6).

Acquisition status of KAKENHI

1. M. Matsuda: Promotion of Joint International Research (Fostering Joint International Research(B)), *Development of innovative functional materials based on the evaluation and control for interface dynamics*, Grant Number JP19KK0125.
2. S. Tsurekawa: Granmt-in-Aid for Scientific Research (S), *Breakthrough toward "second-generation" grain boundary engineering*, Grant Number 16H06366.

No. 5-11	Structure and Dynamics of Materials Using Quantum Beams and Data-Driven Sciences		
Research Field	Nanomaterial Science		
Unit Coordinator			
Name	Shinya Hosokawa		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: shhosokawa@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Marc de Boissiuu	SIMaP, CNRS & Université Grenoble Alpes, France / Dr.		
Matthieu Micoulaut	Sorbonne Université, France / Professor		
Anita Zeidler	University of Bath, UK / Dr.		
László Pusztai	IROAST, Kumamoto University, Japan & Wigner Research Center, Hungary / Professor		
Alexei Kuzmin	Institute of Solid State Physics, University of Latvia, Latvia / Professor		
Ichiro Akai	Institute of Pulsed Power Science, Kumamoto University, Japan / Professor		
Masaru Aniya	Faculty of Advanced Science and Technology, Kumamoto University, Japan / Professor		
Masahiro Hara	Faculty of Advanced Science and Technology, Kumamoto University, Japan / Professor		
Yoichi Nakajima	Priority Organization for Innovation and Excellence, Kumamoto University, Japan / Dr.		

1. Overview of achievements

The aim of this research group is to investigate structure and dynamics of materials using quantum beam facilities in combination with data-driven sciences and computer simulations. Recent developments of quantum beam facilities, such as synchrotron radiation, x-ray free electron laser, and intense neutron sources, lead remarkable progresses in the quality of experimental data. In conjunction with them, new varieties of the data sets appear, such as two-dimensional images etc. and the corresponding data volumes explosively increase. The present task for researchers is how to extract scientifically valuable information from the experimental data of huge size in quantity but of still insufficient in quality. In this research unit, thus, we carry out state-of-art experiments such as scattering and imaging using quantum beam facilities, and analyze the data using, e.g., Inverse problem, Bayesian inference with Metropolis' algorithm (reverse Monte Carlo modeling) and some others. Furthermore, the data-driven science such as Sparse modeling is a very promising tool for handling the data. To support the experimental

results, first principles computer simulations are also indispensable.

At the beginning of the 2019 fiscal year, we started this research unit. In this fiscal year, we were supported totally 6 grants and published approximately 47 papers. As the IROAST meeting, we organized two international symposia at Kumamoto University, i.e., Pan Pacific International Symposium on Chalcogenide Functional Materials (10-11 November 2019) and 1st Pan Pacific Reverse Monte Carlo Conference (20-21 February 2020). Publications concerning the topics of these meetings are either on going (the former) or planning (the latter) as special issues of international journals with impact factors.

2. Presentations & Publications (incl. submitted papers)

1) S. Yakura, K. Iwamitsu, S. Hira, T. Yamasaki, Y. Miyata, E. Magome, I. Akai, Strained lateral structure and its relaxation in a Cu_2O thin crystal epitaxially grown on MgO surface, Jpn. J. Appl. Phys. **59**, 025506 (2020).
2) I. Sakata, Y. Nagano, Y. Igarashi, S. Murata, K. Mizoguchi, I. Akai, M. Okada, Normal mode analysis of a relaxation process with Bayesian inference, Sci. Tech. Adv. Mat. **21**, 67 (2020).
3) K. Iwamitsu, M. Okada, I. Akai, Bayesian Spectroscopy with a Replica Exchange Monte Carlo Method for Study of a Biaxial Stress Effect on Excitons in a Cu_2O Thin Crystal, J. Phys.: Conf. Ser. **1220**, 012009 (2019).
4) B. Klee, B. Paulus, S. Hosokawa, M. Wharmby, E. Dornsiepen, S. Dehnen, and W.-C. Pilgrim, Generating large starting configurations for molecular Reverse Monte Carlo modelling of an unique non-linear optical amorphous solid, J. Phys. Commun. **4**, 035004 (2020).
5) S. Hosokawa, N. Happo, K. Hayashi, K. Kimura, T. Matsushita, J. R. Stellhorn, M. Mizumaki, M. Suzuki, H. Sato, and K. Hiraoka, Valence-selective local atomic structures on an $YbInCu_4$ valence transition material by x-ray fluorescence holography, J. Phys. Soc. Jpn. **89**, 034603 (2020).
6) M. Inui, Y. Kajihara, Y. Tsuchiya, S. Hosokawa, K. Matsuda, H. Uchiyama, S. Tsutsui, and A. Q. R. Baron, Peculiar temperature dependence of dynamical sound speed in liquid $Se_{50}Te_{50}$ by inelastic x-ray scattering, J. Phys.: Condens. Matter **32**, 214003 (2020).
7) K. Kimura, K. Yamamoto, K. Hayashi, S. Tsutsui, N. Happo, S. Yamazoe, H. Miyazaki, S. Nakagami, J. R. Stellhorn, S. Hosokawa, T. Matsushita, H. Tajiri, A. K. R. Ang, and Y. Nishino, Local structure and atomic dynamics in Fe_2VAl Heusler-type thermoelectric material: The effect of heavy element doping, Phys. Rev. B **101**, 024302 (2020).
8) J. R. Stellhorn, S. Hosokawa, and S. Kohara, Local- and intermediate-range structures on ordinal and exotic phase-change materials by anomalous x-ray scattering, Analyt. Sci. **36**, 5 (2020).
9) S. Hosokawa, N. Happo, T. Matsushita, J. R. Stellhorn, K. Kimura, and K. Hayashi, Valence-selective local atomic structures in inorganic materials by X-ray fluorescence holography, Jpn. J. Appl. Phys. **58**, 120601 (2019).
10) S. Hosokawa, M. Inui, T. Bryk, I. Mryglod, W.-C. Pilgrim, Y. Kajihara, K. Matsuda, Y. Ohmasa, and S. Tsutsui, Detection of collective optic excitations in molten NaI, Condens. Matter Phys. **22**, 43602 (2019).
11) S. Hosokawa, J.-F. Bérar, N. Boudet, W.-C. Pilgrim, L. Pusztai, S. Hiroi, K. Maruyama, S. Kohara, H. Kato, H. E. Fischer, and A. Zeidler, Partial structure investigation of the traditional bulk metallic glass $Pd_{40}Ni_{40}P_{20}$, Phys. Rev. B **100**, 054204 (2019).
12) K. Kudo, S. Ioka, N. Happo, H. Ota, Y. Ebisu, K. Kimura, T. Hada, T. Kimura, H. Tajiri, S. Hosokawa, K. Hayashi, and M. Nohara, Impact of local atomic fluctuations on superconductivity of Pr-substituted $CaFe_2As_2$ studied by x-ray fluorescence holography, J. Phys. Soc. Jpn. **88**, 063704 (2019).

13) S. Shirakata, N. Happo, and S. Hosokawa, X-ray fluorescence holography analysis of local structure in $CuInSe_2$ and $CuGaSe_2$, Phys. Status Solidi A **216**, 1800971 (2019).
14) Y. Kuwayama, G. Morard, Y. Nakajima, K. Hirose, A. Q. R. Baron, S. I. Kawaguchi, T. Tsuchiya, D. Ishikawa, N. Hirano, and Y. Ohishi, Equation of state of liquid iron under extreme conditions, Phys. Rev. Lett., in press.
15) R. Sinmyo, Y. Nakajima, C. A. McCammon, N. Miyajima, S. Petitgirard, R. Myhill, L. Dubrovinsky, and D.J. Frost. Effect of Fe^{3+} on Phase Relations in the Lower Mantle: Implications for Redox Melting in Stagnant Slabs, J. Geophys. Res. **124**, 12484 (2019).
16) K. Oka, K. Hirose, S. Tagawa, Y. Kidokoro, Y. Nakajima, G. Morard, N. Coudurier, and G. Fiquet Melting in Fe-FeO to 204 GPa: Implications for oxygen in Earth's core, Ame. Mineral. **104**, 1603 (2019).
17) A. Baroni, F. Pacaud, M. Salanne, M. Micoulaut, J.-M. Delaye, A. Zeidler, P. S. Salmon, and G. Ferlat, Many-body effects at the origin of structural transitions in B_2O_3, J. Chem. Phys. **151**, 224508 (2019).
18) P. S. Salmon and A. Zeidler, Ordering on different length scales in liquid and amorphous materials, J. Stat. Mech. **2019**, 114006 (2019).
19) P. S. Salmon, G. S. Moody, Y. Ishii, K. J. Pizzey, A. Polidori, M. Salanne, A. Zeidler, M. Buscemi, H. E. Fischer, C. L. Bull, S. Klotz, R. Weber, C. J. Benmore, and S. G. MacLeod, Pressure induced structural transformations in amorphous $MgSiO_3$ and $CaSiO_3$, J. Non-Cryst. Solids X **3**, 100024 (2019).
20) R. F. Rowlands, A. Zeidler, H. E. Fischer, and P. S. Salmon, Structure of the intermediate phase glasses $GeSe_3$ and $GeSe_4$: The deployment of neutron diffraction with isotope substitution, Front. Mater. **6**, 133 (2019).
21) C. Chatelier, Y. Garreau, L. Piccolo, A. Vlad, A. Resta, J. Ledieu, V. Fournée, M.-C. de Weerd, F.-E. Picca, M. de Boissieu, R. Felici, A. Coati, and É. Gaudry, From the Surface Structure to Catalytic Properties of Al_5Co_2(2-10): A Study Combining Experimental and Theoretical Approaches, J. Phys. Chem. C **124**, 4552 (2020).
22) A. J. Blake, M. de Boissieu, and A. Nangia, Electron crystallography, IUCrJ **6**, 786 (2019).
23) I. Buganski, K. Toyonaga, H. Takakura, T. Yamada, M. de Boissieu, O. Perez, P. Fertey, J. Wolny, The structure solution of the F-type i-ZnMgHf from the X-ray diffraction, Mat. Sci. Tech., in press.
24) J. Cerar, A. Jamnik, I. Pethes, L. Temleitner, L. Pusztai, and M. Tomšič, Structural, rheological and dynamic aspects of hydrogen-bonding molecular liquids: Aqueous solutions of hydrotropic tert-butyl alcohol, J. Colloid Interf. Sci. **560**, 730 (2020).
25) I. Bakó, J. Daru, S. Pothoczki, L. Pusztai, and K. Hermansson, Effects of H-bond asymmetry on the electronic properties of liquid water – An AIMD analysis, J. Mol. Liq. **293**, 111579 (2019).
26) S. Pothoczki, L. Pusztai, and I. Bakó, Molecular Dynamics Simulation Studies of the Temperature-Dependent Structure and Dynamics of Isopropanol–Water Liquid Mixtures at Low Alcohol Content, J. Phys. Chem. B **123**, 7599 (2019).
27) I. Bakó, I. Mayer, A. Hamza, and L. Pusztai, Two- and three-body, and relaxation energy terms in water clusters: Application of the hierarchical BSSE corrected decomposition scheme, J. Mol. Liq. **285**, 171 (2019).
28) A. Rida, M. Micoulaut, E. Rouhaud, and A. Makke, Understanding the strain rate sensitivity of nanocrystalline copper using molecular dynamics simulations, Comp. Mat. Sci. **172**, 109294 (2020).
29) M. Micoulaut and P. Boolchand, Signature of Coordination Defects in the Vibrational Spectrum of Amorphous Chalcogenides, Front. Mater. **6**, 283 (2019).
30) R. Chbeir, M. Bauchy, M. Micoulaut, and P. Boolchand, Evidence for a Correlation of Melt Fragility Index with Topological Phases of Multicomponent Glasses, Front. Mater.

6, 173 (2019).
31) S. Chakravarty, R. Chbeir, P. Chen, M. Micoulaut, and P. Boolchand, Correlating melt dynamics and configurational entropy change with topological phases of As_xS_{100-x} glasses and the crucial role of melt/glass homogenization, Front. Mater. **6**, 166 (2019).
32) C. Mohanty, A. Mandal, V. K. Gogi, P. Chen, D. Novita, R. Chbeir, M. Bauchy, M. Micoulaut, and P. Boolchand, Linking melt dynamics with topological phases and molecular structure of sodium phosphate glasses from calorimetry, Raman scattering, and infrared reflectance, Front. Mater. **6**, 69 (2019).
33) M. Micoulaut, Diffraction patterns of amorphous materials as a series expansion of neighbor distribution functions, J. Phys.: Condens. Matter **31**, 285402 (2019).
34) A. Rida, M. Micoulaut, E. Rouhaud, and A. Makke, Crystals at High Deformation Rates Displaying Glassy Behavior, Phys. Stat. Solidi B 256, 1800649 (2019).
35) A. Kuzmin, J. Timoshenko, A. Kalinko, I. Jonane, and A. Anspoks, Treatment of disorder effects in X-ray absorption spectra beyond the conventional approach, Rad. Phys. Chem., in press.
36) D. Bocharov, M. Krack, Y. Rafalskij, A. Kuzmin, and J. Purans, Ab initio molecular dynamics simulations of negative thermal expansion in ScF_3: The effect of the supercell size, Comp. Mat. Sci. **171**, 109198 (2020).
37) L. Nataf, F. Baudelet, A. Polian, I. Jonane, A. Anspoks, A. Kuzmin, and T. Irifune, Recent progress in high pressure X-ray absorption spectroscopy studies at the ODE beamline, High Pressure Res. **40**, 82 (2020).
38) I. Manika, J.Maniks, R. Zabels, R. Grants, A. Kuzmin, and K.Schwartz, Depth profiles of damage creation and hardening in MgO irradiated with GeV heavy ions, Nucl. Instrum. Met. Phys. Res. B **461**, 77 (2019).
39) I. Jonane, A. Anspoks, G. Aquilanti, and A. Kuzmin, High-temperature X-ray absorption spectroscopy study of thermochromic copper molybdate, Acta Mater. **179**, 26 (2019).
40) S. Rahman, S. Samanta, A. Kuzmin, D. Errandonea, H. Saqib, D. L. Brewe, J. Kim, J. Lu, and L. Wang, Tuning the Photoresponse of Nano-Heterojunction: Pressure-Induced Inverse Photoconductance in Functionalized WO_3 Nanocuboids, Adv. Sci. **6**, 1901132 (2019).
41) N. Mironova-Ulmane, A. Kuzmin, I. Sildos, L. Puust, and J. Grabis, Magnon and Phonon Excitations in Nanosized NiO, Latv. J. Phys. Tech. Sci. **56**, 61 (2019).
42) D. Bocharov, Y. Rafalskij, M. Krack, M. Putnina, and A. Kuzmin, Negative thermal expansion of ScF_3: first principles vs empirical molecular dynamics, IOP Conf. Ser.: Mater. Sci. Eng. **503**, 012001 (2019).
43) I. Jonane, A. Anspoks, L. Nataf, F. Baudelet, T. Irifune, and A. Kuzmin, Pressure-induced structural changes in α-MoO_3 probed by X-ray absorption spectroscopy, IOP Conf. Ser.: Mater. Sci. Eng. **503**, 012018 (2019).
44) I. Jonane, A. Cintins, A. Kalinko, R. Chernikov, and A. Kuzmin, Low temperature X-ray absorption spectroscopy study of $CuMoO_4$ and $CuMo_{0.90}W_{0.10}O_4$ using reverse Monte-Carlo method, Rad. Phys. Chem., in press.
45) M. Ikeda and M. Aniya, Description of the unusual non-Arrhenius viscosity pattern of metallic glass-forming liquids, J. Alloys Compd. **805**, 904 (2019).
46) M. Aniya and M. Ikeda, A model for non-arrhenius ionic conductivity, Nanomater. **9**, 911 (2019).
47) M. Aniya, Bonding character and ionic conduction in solid electrolytes, Pure Appl. Chem. **91**, 1797 (2019).

3. Application & acquisition status of KAKENHI and other external grants

1) JST CREST (Continued), Main Proposer: I. Akai, 10,950,000 JPY

2) JSPS Grant-in-Aid for Scientific Research (B) (Continued): Main Proposer: S. Hosokawa, 1,500,000 JPY
3) JSPS Challenging Research (Exploratory) (Continued), Main Proposer: S. Hosokawa, 600,000 JPY
4) JSPS Grant-in-Aid for Scientific Research (C) (Continued), Main Proposer: M. Hara, 700,000 JPY
5) JSPS Grant-in-Aid for Scientific Research (C) (New), Main Proposer: Y. Nakajima, 1,200,000 JPY
6) Sumitomo Foundation Grant for Basic Science Research Project (Continued), Main Proposer: Y. Nakajima, Total 1,500,000 JPY

No. 5-12	Study for Hydrological Environments		
Research Field	Environmental Science		
Unit Coordinator			
Name	Takahiro HOSONO		
Affiliation	Faculty of Advanced Science and Technology	Title	Associate Professor
Unit Members			
Name	Affiliation/Title		
Kimpei ICHIYANAGI	Associate Professor, Faculty of Advanced Science and Technology, Kumamoto University, Japan		
Jens HARTMANN	Professor, Institute for Geology, University of Hamburg, Germany		
Rusmawan SUWARMAN	Assistant Professor, Faculty of Earth Science and Technology, Bandung Institute of Technology (ITB), Indonesia		
Pascale LOUVAT	CNRS research engineer, Institut de Physique du Globe de Paris, France		

1. Overview of achievements

1.1. Discussing a new publication about the joint research on water from the Aso-caldera

The study of controls on the water quality in tectonically active areas like Japan is of relevance as several under-researched processes control the water quality and the mobilization of matter and transport to the ocean. This includes seismotectonic processes causing deep water upwelling into the shallow groundwater and hydrothermal processes affecting the water quality directly at a local level. To be able to understand the regional controls on these fluxes, a research area like the Aso caldera or Kirishima represent unique opportunities due the given infrastructure. Unit members Drs. J. Hartmann and T. Hosono have conducted surveys for the past five years due this infrastructure and have now a set of samples and data partly with a help of geochemical analysis by Dr. P. Louvat, which allows us to analyses in depth the diverse processes controlling the water quality, also using novel isotope approaches, which were not combined in the way as it is now down. Drs. J. Hartmann and T. Hosono had research meeting on April 2019 at Kumamoto University and discussed the contents of paper which is under submission.

1.2. Discussing future cooperation on a global water quality database, considering a long-term plan and strategy building on the previous GLORICH database.

Dr. J. Hartmann is trying to develop a global water quality database, GLORICH database, https://www.geo.uni-hamburg.de/geologie/forschung/geochemie/glowachem.html, with several key scientists over the world. Dr. T. Hosono is in charge of data collection from southeast Asian division. Dr. T. Hosono has collected database from whole Japanese islands and some southeastern countries that were added in the database. We had discussion about future data collection and research output on April 2019 at Kumamoto University and via email communication.

1.3. IROAST seminar

Dr. J. Hartmann provide his talk on our IROAST seminar with the title 'Carbon Dioxide Removal: Costs, potentials and side effects' on 12 April 2019. In total 87 persons attended the seminar and was great opportunity for us to learn and discuss about the issue raised. Please see 'FY2019 IROAST Activities Report_Visiting Professor' for details.

1.4. Beppu visit

Drs. J. Hartmann and T. Hosono discussed about future research plan in other volcano-hydrothermal systems in Kyushu. We made a plan to visit Beppu, one of the largest active geothermal areas in Japan, to see possibility for future corroboration research.

1.5. Isotopic study using precipitation samples from Indonesia

Drs. Kimpei Ichiyanagi and R. Suwarman met at Kumamoto University on March 2020 to discuss about future corroboration research with a team of Dr. R. Suwarman from ITB, Indonesia.

1.6. Laboratory equipment

Dr. Takahiro Hosono has received financial support (615,120 JPY) for repairing ICPMS in his laboratory, which is quite important equipment to promote research activity of this research unit. The machine has successfully been recovered and now is in good condition. The equipment repairment was quite efficient improving the performance of the research activities. Takahiro Hosono thanks this financial support.

2. Presentations & Publications (incl. submitted papers)

Presentations

Atwood, A., West, A. J., Ide, K., Hosono,T., Clark, M., Zekkos, D., Medwedeff, W., Tiwari, S., Chamlagain, D. Response of chemical weathering and hillslope hydrology along an exhumation gradient in central Nepal. AGU Fall Meeting, 9-13 December 2019, in Moscone Center San Francisco CA, San Fransisco, USA.

Atwood, A., West, A. J., Ide, K., Hosono,T., Clark, M., Zekkos, D., Medwedeff, B., Tiwari, S., Chamlagain, D. Response of chemical weathering and hillslope hydrology along an exhumation gradient in central Nepal: Landslides, fracturing and more. Galileo Conferences, 13-19 October 2019, in Hotel View Bhrikuti, Godawari, Nepal.

Hermawan, O. R, Hosono, T., Yasumoto, J., Nozaki, M. Underground dam construction impact to the grandwater quantity and quality of Ryukyu limestone aquifer in southern Okinawa island, Japan. 46th IAH Congress, 22-27 September 2019, in FYCMA, Malaga, Spain.

Hosono, T., Manga, M., Wang, C.-Y. and Working Group of Japanese Association for Groundwater Hydrology. Coseismic hydroenvironmental changes in response to 2016 Mw 7.0 Kumamoto crustal earthquake, southern Japan: insights from multidisciplinary approaches. AGU Fall Meeting, 9-13 December 2019, in Moscone Center San Francisco CA, San Fransisco, USA.

Ichiyanagi, K. and Tanoue, M., Spatial and temporal variability of stable isotopes in precipitation in Kumamoto, southern Japan. International Symposium on Isotope Hydrology: Advancing the Understanding of Water Cycle Processes, IAEA Headquarters, Vienna, Austria.

Laonamsai, J., and Ichiyanagi, K., The latitude effect on the stable isotopic composition of precipitation across Thailand. International Symposium on Isotope Hydrology: Advancing the Understanding of Water Cycle Processes, IAEA Headquarters, Vienna, Austria.

Okamura, K., Hosono, T., Romero-Mujalli, G., Amann, T., Louvat, P., Hartmann, J. Distribution and formation of highly saline water in the northwest plain of Aso caldera, south Japan. Goldschmidt 2019, 18-23 August 2019, in CCBI, Barcelona, Spain.

Tanoue, M., Ichiyanagi, K. and Hirabayashi, Y., Seasonal variation of the latitude effect in a mid-latitude region. International Symposium on Isotope Hydrology: Advancing the Understanding

of Water Cycle Processes, IAEA Headquarters, Vienna, Austria.

Publications

Gusyev, M.A., U.Morgenstern, T.Nishihara, T.Hayashi, N.Akata, K.Ichiyanagi, A.Sugimoto, A.Hasegawa, M.K.Stewart, 2019, Evaluating anthropogenic and environmental tritium effects using precipitation and Hokkaido snowpack at selected coastal locations in Asia. Science of The Total Environment, 659, 1307-1321.

Hosono, T., Yamada, C., Shibata, T., Tawara, Y., Wang, C.-Y., Manga, M., Rahman, A.T.M.S., Shimada, J., 2019. Coseismic groundwater drawdown along crustal ruptures during the 2016 Mw 7.0 Kumamoto earthquake. Water Resources Research, 55(7), 5891-5903.

Ichiyanagi, Rusmawan Suwarman, Halda Aditya Belgaman, Masahiro Tanoue, Takayuki Uesugi and Warjono, 2019, Diurnal variation of stable isotopes in rainfall observed at Bengkulu for the YMC-Sumatra 2017. IOP Conference Series: Earth and Environmental Science, 303, 012008.

Mizota, C., Hosono, T., Matsunaga, M., Okumura, A., Yamanaka, T., 2019. Anthoropogenic saltpetre: dual (oxygen and nitrogen) isotopic constraints to the biogeochemical processes. Archaeometry, 61(5), 1175-1192.

Nakagawa, K., Amano, H., Berndtsson, R., Takao, Y., Hosono, T., 2019. Use of sterols to monitor surface water quality change and nitrate pollution source. Ecological Indicators, 107,105534.

Nejatijahromi, Z., Nassery, H.R., Hosono, T., Nakhaei, M., Alijani, F., Okumura, A., 2019. Groundwater nitrate contamination in an area using urban wastewaters for agricultural irrigation under arid climate condition, southeast of Tehran, Iran. Agricultural Water Management, 221, 397-414.

Nikpeyman, Y., Hosono, T., Ono, M., Yang, H., Ichiyanagi, K., Shimada, J., Takikawa, K., 2019. Sea surficial waves as a driving force that enhances the fresh shallow coastal groundwater flux into the oceans. Environmental Earth Sciences, 78, 252.

Romero-Mujall, G., Hartmann, J., Hosono, T., Amann, T., Louvat, P., Böttcher, M. E., submitted. A geochemical estimate of magmatic contributions to surface waters in the Aso caldera (Japan): Implications for weathering rates in volcanic areas.

Taniguchi, M., Burnett, K., Shimada, J., Hosono, T., Wada, C.A., Ide, K., 2019. Recovery of lost nexus synergy via payment for environmental services in Kumamoto, Japan. Frontiers in Environmental Science, 7, 28.

Taufiq, A., Effendi, A.J., Iskandar, I., Hosono, T., Hutasoit, L.M., 2019. Controlling factors and driving mechanisms of nitrate contamination in groundwater system of Bandung Basin, Indonesia, deduced by combined use of stable isotope ratios, CFC age dating, and socioeconomic parameters. Water Research, 148, 292-305.

3. Application & acquisition status of KAKENHI and other external grants

T. Hosono, principle investigator, JSPS Fostering Joint International Research (A), 2020-2023, 19KK0291

T. Hosono, principle investigator, JSPS Grant-in-Aid for Scientific Research (B), 2017-2020, 17H01861

T. Hosono, co-investigator, JSPS Grant-in-Aid for Scientific Research (C), 2017-2019, 17K00572

K. Ichiyanagi, principle investigator, JSPS Grant-in-Aid for Scientific Research (B), 2016-2020, 16H05619

K. Ichiyanagi, investigator, JSPS Grant-in-Aid for Scientific Research (C), 2016-2019, 16KT0151

K. Ichiyanagi, co-investigator, JSPS Grant-in-Aid for Scientific Research (B), 2017-2020, 17H01870

No. 5-13	Quantitative Bioimaging Unit		
Research Field	Advanced Green Bio		
Unit Coordinator			
Name	Takumi Higaki		
Affiliation	IROAST Email: thigaki@kumamoto-u.ac.jp	Title	Associate Professor
Unit Members			
Name	Affiliation/Title		
Fei Du	Chinese Academy of Sciences/Postdoctral Fellow		
Masaki Shimono	Michigan State University/Research Associate		
Kae Akita	Japan Women's University/Assistant Professor		

Details of activities

Recent advances in bioimaging equipment have enabled scientists to acquire large amounts of bioimage data within a short period of time. Following this influx of bioimage information, biologists are now engaging in bioimage informatics, an emerging area of bioinformatics. In this Quantitative Bioimaging Unit, we focus on microscopic image analysis on cytoskeleton. Cytoskeleton relates cell dynamics including cell division, growth, and differentiation. Its higher-order structures (e.g. bundles or meshworks) dynamically changes in response to developmental or environmental cues. We are working on development of bioimage analysis framework to quantitatively evaluate multi-dimensional cytoskeletal organizations (i.e. XYZTN images) based on tight collaboration among experts in cell biology (F. Du and M. Shimono) and bioimage informatics (T. Higaki and K. Akita). Specifically, we are now trying to make a new image analysis system that (1) does not need manual segmentation, (2) provides multi-dimensional features without laborious pre-processing, and (3) makes results visualization based on multi-dimensional features by multivariate analysis and image clustering method. In FY2019, we worked on collection of various types of cytoskeletal images and development of the image analysis framework to quantitatively evaluate multidimensional cytoskeletal organizations. Our image analysis techniques were used for quantitative evaluations of various plant cell biological phenomena including maintenance of phragmoplast microtubule organization in cytokinetic tobacco BY-2 cultured cells (Maeda et al. 2020 *Plant Cell Physiol*), xylem vessel cell differentiation in cotyledons (Hirai et al. 2020 *Plants*), leaf pavement cell morphogenesis (Wong et al. 2019 *Plant Physiol*), plant immunity (Lu et al. submitted.; Shimono et al. in preparation.). In addition, as a spin-off project, image analyst group (T. Higaki and K. Akita) analyzed wide-range confocal images in order to reveal relationship between spatial distribution pattern of stomatal development and atmospheric CO_2 concentrations in young cotyledons of *Arabidopsis thaliana* (Higaki and Akita et al. accepted.). Based on these progresses of this Research Unit, the unit coordinator applied for FY2020 KAKEN Grant-in-Aid for Scientific Research.

Publications

Lu Y-J, Li P, Corrion A, Shimono M, Yamauchi R, Higaki T, Day B CPK3 is required for the regulation of pathogen-induced changes in actin cytoskeletal organization. submitted.

Higaki T, Akita K, Hasezawa S Elevated CO_2 promotes satellite stomata production in young cotyledons of *Arabidopsis thaliana*. accepted.

Maeda K, Sasabe M, Hanamata S, Machida Y, Hasezawa S, Higaki T (2020) Actin filament disruption alters phragmoplast microtubule dynamics during the initial phase of plant cytokinesis. *Plant Cell Physiol* 61: 445–456.

Hirai R, Higaki T, Takenaka Y, Sakamoto Y, Hasegawa J, Matsunaga S, Demura T, Ohtani M (2020) The progression of xylem vessel cell differentiation is dependent on the activity level of VND7 in *Arabidopsis thaliana*. *Plants* 9: 39.

Wong JH, Kato T, Belteton S, Shimizu R, Kinoshita N, Higaki T, Sakumura Y, Szymanski DB, Hashimoto T (2019) Basic proline-rich protein-mediated microtubules are essential for lobe growth and flattened cell geometry. *Plant Physiol* 181: 1535-1551.

Invited oral presentations

Quantification, classification, and recognition of bioimages. Takumi Higaki Symposium in the 67th Annual Meeting of the Ecological Society of Japan (Organized by Koji Noshita (Kyushu University)), March, 2020

Three-dimensional imaging and morphometry of large vacuole regeneration in plant cultured cells. Takumi Higaki Workshop in the 42nd Annual Meeting of the Molecular Biology Society of Japan “The vacuole/lysosome; Where does it come from, how is it maintained and what does it do in the cell?” (Organized by Yui Jin (Tokyo Institute of Technology, Yoko Kimura (Shizuoka University)), December, 2019

Detection and recognition of intracellular structures using electron microscopic image analysis. Takumi Higaki The 62nd Symposium of the Japanese Society of Microscopy (Organized by Yoshihiro Akimoto (Kyorin University)), November, 2019

Plasma membrane delivery of H^+-ATPse for stomatal response. Takumi Higaki Mechanisms of plant perception –from the endogenous to the exogenous– (Organized by Hardtke Christian (UNIL)), September, 2019

No. 5-14	Development of novel therapeutic strategy using iron targeted upconversion nanoparticles for Parkinson's disease		
Research Field	Advanced Green Bio		
Unit Coordinator			
Name	Ruda Lee		
Affiliation	IROAST Email: aeju-lee@kumamoto-u.ac.jp	Title	Associate Professor
Unit Members			
Name	Affiliation/Title		
Yong Il PARK	Chonnam National University, Republic of Korea/ Associate Professor		
Jung Hoon CHOI	Kangwon National University, Republic of Korea/ Associate Professor		
Xiaoxue XU	University of Technology Sydney, Australia/ Chancellor Postdoctoral Research Fellow		

Overview of achievements

1. Presentations & Publications (incl. submitted papers)

[Presentations]

Ruda LEE

1. R. Lee, K. Kim, I. Youn, Early diagnosis and evaluation of the disease activity in rheumatoid arthritis using matrix metalloproteinase-3 fluorogenic sensor, 14th European Society for Molecular Imaging 2019, March 19-22 (2019), Glasgow, Scotland
2. M. W. Kim, K. Kim, R. Lee. Thermo-responsive Lipid Nanoparticles for Controlled Drug Release and Synergistic Therapeutic Efficacy in Multidrug-Resistant Cancer, 46th Annual Meeting & Exposition of the Controlled Release Society, July 21-24 (2019), Valencia, Spain
3. Next generation invited speaker, Aslla symposium, 2019
4. Role of Bio-imaging in Biomedical field, KBSI, 2019

Other 6 presentations

Yong Il PARK

1. S. Y. Lee, Y.-S. Lee, Y. I. Park, Prussian blue and graphene oxide composite for high-performance sodium-ion capacitor, 2019 Korean Society of Industrial and Engineering Chemistry Spring Meeting, May 1-3 (2019), Busan, Korea
2. Y. I. Park, Near-infrared upconversion nanoparticles for biomedical applications, Nano Korea 2019, July 3-5 (2019), KINTEX, Korea
3. S. Y. Lee, Y.-S. Lee, Y. I. Park, Visible/near-infrared driven photocatalyst based on upconversion nanoparticles and g-C_3N_4, Materials Challenges in Alternative and Renewable Energy 2019 (MCARE 2019), August 19-23 (2019), Jeju Island, Korea
4. Y. Lim, S. Y. Lee, Y. I. Park, U. Sim, The upconversion effects of $NaYF_4$ particles for enhancing photoelectrochemical water splitting performances of $ZnFe_2O_4/TiO_2$ photoelectrode, 2019 Korea Photovoltaic Society Fall Meeting, November 21-22 (2019), Yeosu, Korea
5. Y. I. Park, Visible/near-infrared driven photocatalyst based on upconversion nanoparticles and graphitic carbon nitride, 2019 Materials Research Society Fall Meeting, December 1-6 (2019), Boston, United

States

Jung Hoon CHOI

1. "Serum cystatin-C levels in dogs with kidney disease managed by hemodialysis", Asian Meeting of Animal Medicine Specialties, October 23-25 (2019), Shanghai, China
2. "C-kit expression in a feline splenic mast cell tumor", The 6th Asian Meeting of Animal Medicine Specialties & Asian small animal specialist veterinary congress, Asian Meeting of Animal Medicine Specialties , October 23-25 (2019), Shanghai, China
3. "RbAp expression and neural damage in the gerbil hippocampus following 5 min of transient ischemia", The 10th IBRO World Congress of neuroscience, International Brain Research Organization and Federation of Asian-Oceanian Neuroscience Societies, September 21~25 (2019). Daegu, Korea
4. "Pre-treatment with yes10(a combination of clematis mandshurica rurp. and erigeron annuus (I.) pers. extract) protects neurons and attenuates gliosis in the gerbil hippocampus following ischemia/reperfusion", The 10th IBRO World Congress of Neuroscience, International Brain Research Organization and Federation of Asian-Oceanian Neuroscience societies, September 21~25 (2019). Daegu, Korea
5. "Changes of HCN channels in pyramidal neurons and their new expressions in pericytes and/or astrocytes in the gerbil hippocampal CA1 subfield after transient ischemia", 2019 KALAS International symposium, Korean association for laboratory animal science, July 17-20 (2019). Jeju, Korea

Xiaoxue XU

1, Xiaoxue. Xu, Invited talk, Upconversion nanostructures for bimodal biomedical imaging and multiplex sensing, 20th International Union of Materials Research Societies International Conference in Asia, September 16-23, 2019, Perth Australia
2, Xiaoxue Xu, Invited Talk, 20th International Union of Materials Research Societies International Conference in Asia at UNSW, 2019
3, Xiaoxue Xu, Invited Talk, Winter School in ARC Centre for Organic Electronics at University of Newcastle 2019
4, Ziqing. Du, Abhishek Gupta, David Clase, Bill Price, Xiaoxue Xu, Porous Upconversion Nanostructures as Bimodal Biomedical Imaging Contrast Agents, International Conference on Nanomaterials and Nanotechnology, February 9-13, 2020, Brisbane, Australia
5, Matt Cappadonna, Ziqing Du, Xiaoxue Xu, Investigation into energy transfer process between UCNPs and TiO2 hybrid nanomaterials for photocatalysis, International Conference on Nanomaterials and Nanotechnology, February 9-13, 2020, Brisbane, Australia

[Publications]

Ruda Lee

1. Song Yeul Lee, **Ruda Lee**†, Eunha Kim, Sanghee Lee, Yong Il Park, "Near-infrared light-triggered photodynamic therapy and apoptosis using upconversion nanoparticles with dual photosensitizers," Frontiers in Bioengineering and Biotechnology, in press, 2020. (†co-first)
2. **Ruda Lee**, Yu Jin Choi, Myeong Seon Jeong, Yong Il Park, Keiichi Motoyama, Min Woo Kim, Seung-Hae Kwon, Jung Hoon Choi, "Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Nonsmall Cell Lung Cancer," Bioconjugate Chem., 31(3), 923-932, 2020.
3. Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, **Ruda Lee***, Yong Il Park, "Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions," Frontiers in Bioengineering and Biotechnology, 8, p133, 2020. (*co-corresponding)
4. Kwon SH, Wi T, Park YI, Kim MW, Lee G, Higaki T, Choi JH, **Lee R**, "Non-invasive early detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor," Bioconjug Chem., 31(3), 803-812, 2020.

5. Ayaka Harada, Hiroyasu Tsutsuki, Tianli Zhang, **Ruda Lee**, Kinnosuke Yahiro, Tomohiro Sawa, Takuro Niidome, "Preparation of biodegradable PLGA-nanoparticles used for pH-sensitive intracellular delivery of an anti-inflammatory bacterial toxin to macrophages," Chem. Pharm. Bull., 68(4), 363-368, 2020.
6. Sofiane Hamidi, Yukiko Nakaya, Hiroki Nagai, Cantas Alev, Takeya Kasukawa, Sapna Chhabra, **Ruda Lee**, Hitoshi Niwa, Aryeh Warmflash, Tatsuo Shibata, and Guojun Sheng, "Mesenchymal-Epithelial Transition Regulates Initiation of Pluripotency Exit before Gastrulation," Development, 147(3), dev184960, 2020.
7. Min Woo Kim, Takuro Niidome, **Ruda Lee**, "Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer," Marine Drugs, 17 (10), 581, 2019.
8. **Ruda Lee**, Sung-Jae Choi, Kyung Chul Moon, Jong Woong Park, Kwangmeyung Kim, Soo-Young Yoon and Inchan Youn, "Fluorogenic Probe for Detecting Active Matrix Metalloproteinase-3 (MMP-3) in Plasma and Peripheral Blood Neutrophils to Indicate the Severity of Rheumatoid Arthritis," ACS Biomater. Sci. Eng., 5, 6, 3039-3048, 2019.

Yong Il PARK

1. Song Yeul Lee, Ruda Lee, Eunha Kim, Sanghee Lee, **Yong Il Park**,* “Near-Infrared Light-Triggered Photodynamic Therapy and Apoptosis using Upconversion Nanoparticles with Dual Photosensitizers” *Front. Bioeng. Biotech.* **2020**, in press.
2. Ruda Lee, Yu Jin Choi, Myeong Seon Jeong, **Yong Il Park**, Keiichi Motoyama, Min Woo Kim, Seung-Hae Kwon, Jung Hoon Choi, “Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Non-Small Cell Lung Cancer” *Bioconjugate Chem.* **2020**, *31*, 923–932.
3. Seung-Hae Kwon, Taemin Wi, **Yong Il Park**, Min Woo Kim, Gibok Lee, Takumi Higaki , Jung Hoon Choi, Ruda Lee, “Noninvasive Early Detection of Calpain 2-Enriched Non-Small Cell Lung Cancer Using a Human Serum Albumin-Bounded Calpain-2 Nanosensor” *Bioconjugate Chem.* **2020**, *31*, 803–812.
4. Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, Ruda Lee, **Yong Il Park**,* “Platelet-Like Gold Nanostars for Cancer Therapy: The Ability to Treat Cancer and Evade Immune Reactions” *Front. Bioeng. Biotech.* **2020**, *8*, 133.
5. Song Yeul Lee, Gibok Lee, Young-Si Jun, **Yong Il Park**,* “Visible/Near-Infrared Driven Highly Efficient Photocatalyst Based on Upconversion Nanoparticles/g-C_3N_4 Nanocomposite” *Appl. Surf. Sci.* **2020**, *508*, 144839.
6. Youngho Cho, Soo Yeong Lim, Song Yeul Lee, Jae Hun Kim, **Yong Il Park**, Chan Ryang Park, Hyung Min Kim, “Statistical Time-Resolved Spectroscopic Study on Upconversion Luminescence” *J. Phys. Chem. C* **2020**, *124*, 2680–2688.
7. Anudeep Yekula, Valentina R. Minciacchi, Matteo Morello, Huilin Shao, **Yong Il Park**, Xuan Zhang, Koushik Muralidharana, Michael R. Freeman, Ralph Weissleder, Hakho Lee, Bob Carter, Xandra O. Breakefield, Dolores Di Vizio, Leonora Balaj, “Large and Small Extracellular Vesicles Released by Glioma Cells *in vitro* and *in vivo*” *J. Extracell. Vesicles* **2020**, 9, 1689784.
8. Chen-Han Huang,† **Yong Il Park**,† Hsing-Ying Lin,† Divya Pathania, Ki Soo Park, Maria Avila-Wallace, Cesar M. Castro, Ralph Weissleder, Hakho Lee, “Compact and Filter-Free Luminescence Biosensor for Mobile *in Vitro* Diagnoses” *ACS Nano* **2019**, *13*, 11698–11706. († equal contribution)
9. Hyeong Woo Ban, Jong Gyu Oh, Seungki Jo, Hyewon Jeong, Da Hwi Gu, Seongheon Baek, Song Yeul Lee, **Yong Il Park**, Jaeyoung Jang, Jae Sung Son, “Polyphosphide Precursor for Low-Temperature Solution-Processed Fibrous Phosphorus Thin Films” *Chem. Mater.* **2019**, *31*, 5909–5918.

Jung Hoon CHOI

1. Kim W, Kang MS, Kim TH, Yoo DY, Park JH, Jung HY, Won MH, **Choi JH**, Hwang IK. “Ischemia-related changes of fat-mass and obesity-associated protein expression in the gerbil hippocampus”. Metab Brain Dis. 2020 Feb;35(2):335-342.

2. Yun S, Kim W, Kang MS, Kim TH, Kim Y, Ahn JO, **Choi JH**, Hwang IK, Chung JY. “Neuropathological changes in dorsal root ganglia induced by pyridoxine in dogs”. BMC Neurosci. 2020 Mar 24;21(1):11
3. Cho HK, Kim W, Lee KY, Ahn JO, **Choi JH**, Hwang IK, Chung JY. “Beta-nerve growth factor gene therapy alleviates pyridoxine-induced neuropathic damage by increasing doublecortin and tyrosine kinase A in the dorsal root ganglion”. Neural Regen Res. 2020 Jan;15(1):162-168. doi: 10.4103/1673-5374.264472.
4. Kwon SH, Wi T, Park YI, Kim MW, Lee G, Higaki T, **Choi JH**, Lee R. “Noninvasive Early Detection of Calpain 2-Enriched Non-Small Cell Lung Cancer Using a Human Serum Albumin-Bounded Calpain 2 Nanosensor”. Bioconjug Chem. 2020 Mar 18;31(3):803-812.
5. Lee R, Choi YJ, Jeong MS, Park YI, Motoyama K, Kim MW, Kwon SH, **Choi JH**. “Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Nonsmall Cell Lung Cancer”. Bioconjug Chem. 2020 Mar 18;31(3):923-932

Xiaoxue XU

1. Z. Du, A. Gupta, C. Clarke, M. Cappadana, D. Clases, D. Liu, Z Yang, P. Doble, B. Price, X. Xu*, Porous upconversion nanostructures as bimodal biomedical imaging contrast agents, Journal of Physical Chemistry Letters, 2020, accepted
2. J. Fröch, S. Kim, C. Stewart, X. Xu, Z. Du, M. Lockrey, M. Toth, I. Aharonovich, Photonic Nanobeam Cavities with Nanopockets for Efficient Integration of Fluorescent Nanoparticles, 2020, Nanoletters, https://dx.doi.org/10.1021/acs.nanolett.0c00466
3. X. Xu*, H. Lu, A. Lee, Near Infrared Light Triggered Photo/Immuno-therapy Towards Cancers, Frontiers Bioengineering and Biotechnology, 2020, Accepted
4. Y Liu, F Wang, H Lu, G Fang, S Wen, C Chen, X Shan, X Xu, M Stenzel and D Jin, Super-resolution mapping of single nanoparticles inside spheroids, Small, 2020, https://doi.org/10.1002/smll.201905572

2. Application & acquisition status of KAKENHI and other external grants

Ruda LEE

1. JSPS, Early career researcher grant (representative researcher)

Jung Hoon CHOI

1. NRF, Regional Researcher Program (Enhance S&T research capacity in the relevant region and support the fostering of outstanding researchers)

Xiaoxue XU

1, Bernie Tuch, Xiaoxue Xu, Tim Dargaville, Juvenile Diabetes Research Foundation, Innovative Grant, Luminescent Nanoparticles for Controlled Release of Immunomodulatory Agents for Diabetes II, 2020.03-2021.02

No. 5-15	Deep Learning for Hydrology		
Research Field	Environmental Science		
Unit Coordinator			
Name	KEI ISHIDA		
Affiliation	Kumamoto University Email: keiishida@kumamoto-u.ac.jp	Title	Assistant Professor
Unit Members			
Name	Affiliation/Title		
MOTOKI AMAGASAKI	Kumamoto University/ Associate Professor		
MASATO KIYAMA	Kumamoto University/ Assistant Professor		
Ali Ercan	Assistant Professional Researcher (Assistant Research Professor), University of California, Davis		
Tongbi Tu	Department of Environmental Science, Policy and Management, University of California, Berkeley, Postdoctoral Scholar		

1. Overview of achievements

The objectives of this study are to apply new machine learning techniques to hydrological issues, and meanwhile develop new machine learning techniques with hydrological data. In the first year of this project, we set up international and interdisciplinary research studies. We had a meeting between the hydrology members and the IT members of our research unit several times every month. Meanwhile, the unit coordinator KEI ISHIDA visited California to meet the international members in August, 2019, Ali Ercan and Tongbi Tu. Also, the international members came to Kumamoto in December, 2019. We had discussions on our research studies. Then, we successfully set up the international and interdisciplinary research studies.

In the first year, we worked on several topics. First, we used recurrent neural networks to implement rainfall-runoff models in Japan. We had presentations based on the results at the CWMD international conference 2019 and at the AGU Fall Meeting 2019. Second, we had a collaboration with Dr. Tsujimoto, who is a professor on Coastal Engineering at Kumamoto University. We developed a coastal sea level estimation model by means of a recurrent neural network, long short-term memory neural network. We also introduced a new idea to deal with impacts of climate change on coastal sea level. We wrote a journal paper based on the results. The journal paper was already accepted and published by an international journal, Science of the Total Environment. In additional, we have been working on some other topics. The results will hopefully be published as journal papers in the second project year.

2. Presentations & Publications

Publications

Ishida, K., Tsujimoto, G., Ercan, A., Tu, T., Kiyama, M., Amagasaki, M., 2020. Hourly-scale

coastal sea level modeling in a changing climate using long short-term memory neural network. Sci. Total Environ. 720, 137613. https://doi.org/10.1016/j.scitotenv.2020.137613

Presentations at international conferences

Ishida, K., Une H., Kondo H. and Kuranaga K.: Application of Deep Learning to Rainfall-Runoff Modeling at Kikuchi River Basin CWMD International Conference 2019, Kumamoto, Japan, Sep 19-21, 2019.

Nagasato T., Ishida K., Ercan A., Kiyama M., and Amagasaki M.: Applicability of Long Short Term Memory Network to Flow Discharge Modelingat Watershed in Kyushu Region, Japan, AGU Fall Meeting 2019, San Francisco, CA, Dec 9-13, 2019.

No. 5-16	Environmental Impacts of Ionic Solutes		
Research Field	Environmental Science		
Unit Coordinator			
Name	Shin-Ichi Ohira		
Affiliation	Faculty of Advanced Science and Technology, Kumamoto University Email: ohira@kumamoto-u.ac.jp	Title	Associate Professor
Unit Members			
Name	Affiliation/Title		
Jian Ma	Professor, College of the Environment and Ecology, Xiamen University, China		
C. Phillip Shelor	Assistant Research Professor, Department of Chemistry and Biochemistry, University of Texas at Arlington		
Yuta Nakashima	Associate Professor, Research Field of Bioengineering, Division of Industrial Fundamentals, Faculty of Advanced Science and Technology, Kumamoto University, Japan		

1. Overview of achievements

This research unit is targeted "ion" especially in environment. Ions plays an important role in the environment. Ions are one of the key chemical form of the global cycles and observed in marine, soil, river/lake, atmosphere, and living cells. In the research unit, the specialists of analytical chemistry, marine chemistry, and cell science are gathered worldwide. This year we have started from the kick-off meeting which is purposed to share the past and present researches of members via on-line system (Oct. 30, 2019). Furthermore, the coordinator visited Prof. Jian Ma to share more details researches and discussed about the future study and grant application for collaborative study (Nov. 24-27, 2019). Also, we have obtained the opportunities to gather at the conference. We have discussed more details about the research plans (Dec. 20-24, 2019).



Prof. Ma's lab (Xiamen university)



Drs. Shelor, Ohira, Ma from left

The research is going well. Drs. Ohira and Shelor developed the universal detection of ionic solutes by pH detection. The system can determine organic acids without the calibration procedure. And the manuscript is under preparation. Dr. Ohira's group are working on Fe speciation analysis in natural and sea water with closs-flow electrodialytic FIA system. Dr. Shelor developed new concept of ion chromatography data analysis. Drs Ma and Ohira are working on nutrients analysis in marine environment. Dr. Nakashima is studying the cell

response to the out coming stresses. Drs Nakashima and Ohira plans to collaborate on the chemical analysis of cell stresses.

In the 1st year, we have also agreed several future collaborative studies. Additionally, the financial support will be applied for acceleration of the collaborative studies.

2. Presentations and publications

Presentations (Total 51)

1. C.P. Shelor, A Continuously Renewed Copper Electrode for Amino Acid Detection, International symposium on miniaturized systems for chemical separation and analysis, Dianchi Garden Resort Hotel & SPA in Kunming, China, Dec. 21, 2019.
2. J. Ma, Determination of Dissolved Reactive Phosphorus in Natural Waters with an Integrated Syringe-pump-based Environmental-water Analyzer (iSEA) International symposium on miniaturized systems for chemical separation and analysis, Dianchi Garden Resort Hotel & SPA in Kunming, China, Dec. 21, 2019.
3. S. Ohira, Miniaturized cross flow electrodialytic device for flow injection analysis and post-column enhancement on an ion chromatography, International symposium on miniaturized systems for chemical separation and analysis, Dianchi Garden Resort Hotel & SPA in Kunming, China, Dec. 21, 2019.
4. Y. Nakashima, M.M. Rajab, Y. Fujiwara, Y. Komohara, Y. Nakanishi, Experimental evaluation of influence of microplastics on macrophage responses, 8th International Conference on Mechanics of Biomaterials and Tissues 2019, Hawaii, USA, 15-19 Dec. 2019.

Publications (Total 18)

1. S. Ohira, T. Sakaki, R. Miyachi, A. Otsubo, A. Umemoto, Y. Kuwahara, K. Toda, “Miniaturized crossflow ion transfer device for post-column enrichment in ion chromatography”, *Talanta* (IF. 4.916), accepted on Mar. 28, 2020.
2. W.C. Nugraha, H. Nagai, S. Ohira, K. Toda, “Semi-Continuous Monitoring of Cr(VI) and Cr(III) during a Soil Extraction Process by Means of an Ion Transfer Device and Graphite Furnace Atomic Absorption Spectroscopy”, *Anal. Sci.*, *in print* (2020).
3. B. Chouhan, C.P. Shelor, W. Huang, Y. Chen, P.K. Dasgupta, “Nanovolume Gas-Free Hydroxide Eluent Generator for Open Tubular Ion Chromatography”, *Analytical Chemistry* (IF. 6.35), **92**, 5561–5568 (2020).
4. P.K. Dasgupta, C. Qin, C.P. Shelor, A. Florence, K. Jianzhong, S. Karsten, G.K. Graham, D. Marshall, Attenuation Coefficients of Tubular Conduits for Liquid Phase Absorbance Measurement: Shot Noise Limited Optimum Path Length, *Analytical Chemistry* (IF. 6.35), **92**, 5561–5568 (2020).

3. Application & acquisition status of KAKENHI and other external grants

Total 12 grants

S. Ohira, Grant-in-Aid for Scientific Research (C) as representative, 2017 – 2020FY 900kJPY for 2019

S. Ohira, JSPS Researcher Exchange Program, 2018 – 2019FY 2350kJPY for 2019

Y. Nakashima, Grant-in-Aid for Scientific Research (B) as representative, 2019 – 2022FY 6,400k JPY for 2019

Y. Nakashima, Strategic Foundational Technology Improvement Support Operation

Y. Nakashima, Environment Research and Technology Development Fund of the Ministry, 2019–2022FY

4. Application & acquisition status of industrial property rights

Dr. Ohira plans to apply 2 of the patents with the obtained results.

No. 5-17	Probing First Stars in the Universe with Radio Telescope and Artificial Intelligence		
Research Field	Next–generation Technology		
Unit Coordinator			
Name	Keitaro Takahashi		
Affiliation	Kumamoto University Email: keitaro@kumamoto-u.ac.jp	Title	Associate Professor
Unit Members			
Name	Affiliation/Title		
Rachel Webster Bart Pindor Shintaro Yoshiura Takuya Akahori Takeshi Fukusako	The University of Melbourne, Professor The University of Melbourne, Researcher The University of Melbourne, JSPS Fellow National Astronomical Observatory of Japan, Researcher Kumamoto University, Professor		

1. Overview of achievements

The purpose of our project is to detect radio waves, 21cm line, from neutral hydrogen in inter-galactic space during the Epoch of Reionization. Our group consists of Kumamoto University, National Astronomical Observatory of Japan and the University of Melbourne and we are operating a radio telescope named Murchison Widefield Array (MWA) to observe radio waves from the universe. However, the radio-wave signal we are interested in is so weak that we need to remove very bright foreground emission from our Galaxy to detect the signal.

This year, we developed a deep learning architecture to construct a template to take a cross correlation with the obtained data in order to reduce the foreground emission statistically. To do this, Keitaro Takahashi and one of his students, Shoichiro Tanaka, visited the University of Melbourne and had an intensive discussion with Rachel Webster, Bart Pindor and Shintaro Yoshiura. The feasibility of our methodology was investigated through numerical simulations, and the result was submitted as a paper.

Machine learning and artificial intelligence is recently getting popular in astronomy but it is still in its infancy. We are now extending our scope to apply our methodology to another research field of astronomy, gravitational-wave detection with pulsar timing array. To discuss possible collaboration between our group and USA group named NANOGrav, Keitaro Takahashi and one of his students, Shinnosuke Hisano, participated in a NANOGrav workshop. There we agreed that we continue our discussion on the application of machine learning to pulsar timing array and Shinnosuke Hisano visits USA for a several months to enhance our collaboration.

2. Presentations & Publications

Cathryn M. Trott, Catherine A. Watkinson, Christopher H. Jordan, Shintaro Yoshiura, Suman Majumdar, N. Barry, R. Byrne, B.J. Hazelton, K. Hasegawa, R. Joseph, T. Kaneuji, K. Kubota, W. Li, J. Line, C. Lynch, B. McKinley, D.A. Mitchell, M.F. Morales, S. Murray, B. Pindor, J.C. Pober, M. Rahimi, J. Riding, K. Takahashi, S.J. Tingay, R.B. Wayth, R.L. Webster, M. Wilensky,

J.S.B. Wyithe, Q. Zheng, David Emrich, A.P. Beardsley, T. Booler, B. Crosse, T.M.O. Franzen, L. Horsley, M. Johnston-Hollitt, D.L. Kaplan, D. Kenney, D. Pallot, G. Sleap, K. Steele, M. Walker, A. Williams, C. Wu,
"Gridded and direct Epoch of Reionisation bispectrum estimates using the Murchison Widefield Array"
Publications of the Astronomical Society of Australia 36 (2019) id. e023, 07/2019

Hiroki Kumamoto, Yuya Imasato, Naoyuki Yonemaru, Keitaro Takahashi, Sachiko Kuroyanagi,
"Constraints on ultra-low-frequency gravitational waves with statistics of pulsar spin-down rates"
Monthly Notices of the Royal Astronomical Society 489 (2019) 3547-3552, 11/2019

Beardsley, A. P.; Johnston-Hollitt, M.; Trott, C. M.; Pober, J. C.; Morgan, J.; Oberoi, D.; Kaplan, D. L.; Lynch, C. R.; Anderson, G. E.; McCauley, P. I.; Croft, S.; James, C. W.; Wong, O. I.; Tremblay, C. D.; Norris, R. P.; Cairns, I. H.; Lonsdale, C. J.; Hancock, P. J.; Gaensler, B. M.; Bhat, N. D. R. Li, W.; Hurley-Walker, N.; Callingham, J. R.; Seymour, N.; Yoshiura, S.; Joseph, R. C.; Takahashi, K.; Sokolowski, M.; Miller-Jones, J. C. A.; Chauhan, J. V.; Bojičić, I.; Filipović, M. D.; Leahy, D.; Su, H.; Tian, W. W.; McSweeney, S. J.; Meyers, B. W.; Kitaeff, S.; Vernstrom, T.; Gürkan, G.; Heald, G.; Xue, M.; Riseley, C. J.; Duchesne, S. W.; Bowman, J. D.; Jacobs, D. C.; Crosse, B.; Emrich, D.; Franzen, T. M. O.; Horsley, L.; Kenney, D.; Morales, M. F.; Pallot, D.; Steele, K.; Tingay, S. J.; Walker, M.; Wayth, R. B.; Williams, A.; Wu, C.,
"Science with the Murchison Widefield Array: Phase I results and Phase II opportunities"
Publications of the Astronomical Society of Australia 36 (2019) id. e050, 38pp, 12/2019,

Li, W.; Pober, J. C.; Barry, N.; Hazelton, B. J.; Morales, M. F.; Trott, C. M.; Lanman, A.; Wilensky, M.; Sullivan, I.; Beardsley, A. P.; Booler, T.; Bowman, J. D.; Byrne, R.; Crosse, B.; Emrich, D.; Franzen, T. M. O.; Hasegawa, K.; Horsley, L.; Johnston-Hollitt, M.; Jacobs, D. C. Jordan, C. H.; Joseph, R. C.; Kaneuji, T.; Kaplan, D. L.; Kenney, D.; Kubota, K.; Line, J.; Lynch, C.; McKinley, B.; Mitchell, D. A.; Murray, S.; Pallot, D.; Pindor, B.; Rahimi, M.; Riding, J.; Sleap, G.; Steele, K.; Takahashi, K.; Tingay, S. J.; Walker, M.; Wayth, R. B.; Webster, R. L.; Williams, A.; Wu, C.; Wyithe, J. S. B.; Yoshiura, S.; Zheng, Q.,
"First Season MWA Phase II Epoch of Reionization Power Spectrum Results at Redshift 7"
Astrophys. J. 887 (2019) article id. 141, 20pp, 12/2019

Cathryn M. Trott, C. H. Jordan, S. Midgley, N. Barry, B. Greig, B. Pindor, J. H. Cook, G. Sleap, S. J. Tingay, D. Ung, P. Hancock, A. Williams, J. Bowman, R. Byrne, A. Chokshi, B. J. Hazelton, K. Hasegawa, D. Jacobs, R. C. Joseph, W. Li, J.L.B Line, C. Lynch, B. McKinley, D. A. Mitchell, M. F. Morales, M. Ouchi, J. C. Pober, M. Rahimi, K. Takahashi, R. B. Wayth, R. L. Webster, M. Wilensky, J. S. B. Wyithe, S. Yoshiura, Z. Zhang, Q. Zheng,
"Deep multi-redshift limits on Epoch of Reionisation 21cm Power Spectra from Four Seasons of Murchison Widefield Array Observations"
Monthly Notices of the Royal Astronomical Society 493 (2020) 4711–4727, 02/2020

Yoshiura, Shintaro; Takahashi, Keitaro; Takahashi, Tomo,
"Probing Small Scale Primordial Power Spectrum with 21cm Line Global Signal"
accepted in Phys. Rev. D, 2020
Kenji Kubota, Akio. K. Inoue, Kenji Hasegawa, Keitaro Takahashi,
"Detectability of 21cm signal during the Epoch of Reionization with 21cm-Lyman-α emitter cross-correlation. III. Model dependence"
accepted in Monthly Notices of the Royal Astronomical Society, 2020

Naoyuki Yonemaru, Keitaro Takahashi, Hiroki Kumamoto, Shi Dai, Shintaro Yoshiura and Shinsuke Ideguchi,
“Artificial neural networks for selection of pulsar candidates from the radio continuum surveys”
accepted in Monthly Notices of the Royal Astronomical Society, 2020

3. Application & acquisition status of KAKENHI and other external grants

Kiban A (rep: Masami Ouchi (University of Tokyo)), accepted (2021-2025)

No. 5-18	Plant Stem Cells and Regeneration		
Research Field	Advanced Green Bio		
Unit Coordinator			
Name	Mitsuhiro Aida		
Affiliation	IROAST Email: m-aida@kumamoto-u.ac.jp	Title	Professor
Unit Members			
Name	Affiliation/Title		
Yoshihisa Ikeda	Department of Molecular Biology, Palacky University in Olomouc/Junior Researcher		

1. Overview of achievements

This research unit started in August, 2019. We have previously reported that the *CUP-SHAPED COTYLEDON 1* (*CUC1*) gene is one of the direct target candidates of the transcription factors ENHANCER OF SHOOT REGENERATION 1 and 2 (ESR1, ESR2). This result was supported mostly based on gain-of-function experiments (Ikeda et al., 2006 PCP 47, 1443-1456). In this research unit, we intend to corroborate our hypothesis of ESR1 and ESR2 directly regulating *CUC1* expression by employing genetic and cell biology approaches. To begin with, we exerted our efforts on material preparation. Fluorescent reporter lines of CUC1 (*CUC1p:CUC1-GFP* and *CUCp:cuc1(miRNA-resistant)-GFP*) were developed by the unit coordinator. Another reporter line, M0233, which reflects promoter activity of *CUC1* (Cary et al, 2002 Plant J. 32. 867-877), was obtained from the NASC stock center. These reporter lines will be crossed with *esr1-1 esr2-2* double mutants and the expression of *CUC1* will be examined. For analyzing M0233 enhancer trap line, the CRISPR/Cas9 genome editing technique was carried out to edit ESR1 and ESR2 genomic sequences. After confirming the mutations in both ESR genes, *esr1 esr2* double mutants will be generated and the *CUC1* expression will be compared between wild-type (the original M0233 in C24 accession) and the double mutant background.

In parallel, we extend our research to the novel regulatory mechanism of *CUC1* expression by ERF transcriptional repressors. Both ESR1 and ESR1 belong to the AP2/ERF subclass B1b and act as transcription activators whereas the close homologs of the ERF repressors ERF4, ERF8, ERF9, ERF10, ERF11, and ERF12 belong to the subclass B1a and share high homology with ESR in the AP2/ERF DNA-binding domain, implying that ERF repressors share the same downstream genes with ESR and repress their expression. We have made *erf4;8;9;12* quadruple mutants and found that the expression of *CUC1* in shoot regeneration medium in tissue culture was significantly elevated (unpublished result), suggesting that ERF repressors are novel regulators of *CUC1* and suppress its transcription. The expression pattern of the *CUC1-GFP* reporters will be examined in *erf4;8;9;12* mutant, as well.

The role of ERF repressor in shoot meristem development remains elusive. Translational GFP reporter line for analyzing ERF repressors (ERF4, ERF9, and ERF12) expression will be made available in near future. Cytokinin and auxin reporter lines, TCSn:GFPER or DR5rev:3xVENUS respectively, were crossed with *erf* repressor mutants and the expression analysis of these fluorescent reporters in *erf* repressor mutant shoot meristem is underway.

2. Application & acquisition status of KAKENHI and other external grants

Mitsuhiro Aida, Grant-in-Aid for Scientific Research on Innovative Areas (The Japan Society for the Promotion of Science), Principles of pluripotent stem cells underlying plant vitality, "Establishment of plant hormone microenvironment during shoot stem cell formation," April 2020-March 2022 (Informal decision).

No. 5-19	Development of microbially-aided carbon sequestration technology		
Research Field	Green Energy		
Unit Coordinator			
Name	Atsushi SAINOKI		
Affiliation	IROAST Email: atsushi_sainoki@kumamoto-u.ac.jp	Title	Associate Prof.
Unit Members			
Name	Affiliation/Title		
Akira Sato Kazunori Nakashima Murat Karakus Hiroaki Ito	Kumamoto University, Associate Prof. Hokkaido University, Associate Prof. Adelaide University, Associate Prof. Kumamoto University, Assistant Prof.		

1. Overview of achievements

The aim of this project is to develop a more efficient and stable carbon sequestration technology that mitigates the risk of CO_2 leak-off to the ground surface. For this purpose, microbial-aided chemical reactions are studied. As such, two different methodologies are being investigated: i) application of bio-grout technology with aerobic microbes to seal fractures in a cap rock, and ii) improvement of CO_2 mineralization with anaerobic microbes. In the followings, what has been achieved in 2019 will be described for each methodology.

i) Application of bio-grout technology with aerobic microbes to seal fractures in a cap rock

In this study, a new method, "the active mineral deposition method", has been proposed in order to decrease the permeability of rock. This is the method that some minerals are actively precipitated in aquifers and that the pores in the rock mass are closed by precipitated minerals. Since the pores are filled by minerals, it is expected that the permeability of rock mass is decreased and the leakage of CO_2 is prevented. In this method, the action of enzymes is utilized. As an enzyme, urease, which is a kind of urea-degrading enzyme and produced by aerobic microbes, is applied in this study. Here, the solution of urea, calcium chloride and urease was prepared. The solution was then injected in pores of the rock, the calcium carbonate was precipitated in pores. As rock samples, Berea Sandstone and Ainoura Sandstone were used as representatives of porous rock samples. First, the mass of the water-saturated rock sample was measured and density distribution inside of rock samples was visualized by the X-ray CT scanner (Figures 1 and 2). Subsequently, the rock samples were completely dried, and the active mineral deposition method was applied. After that, the state was also investigated by the X-ray CT scanner, and the one-dimensional permeation test was performed. In order to find the optimum concentration of minerals and urease, several kinds of solutions which have different concentration were prepared. It was found that the calcium carbonate was precipitated before the solution migrates into the rock samples under high-concentration and high-temperature conditions in many cases. However, by controlling the concentration and temperatures, the existence of precipitated calcium carbonate was confirmed in the CT images in the region where it is near free surfaces. Moreover, it was found that some pores were isolated from the other pores by closing some pores due to

precipitation of minerals. From the measurement of masses before and after the active mineral deposition method, approximately 1% and 4% of the pores were isolated in the case of Berea Sandstone and Ainoura Sandstone, respectively. It was also found that the intrinsic permeability was decreased by the active mineral deposition method. The improvement effect of permeability towards Ainoura Sandstone was larger than the one of Berea Sandstone.

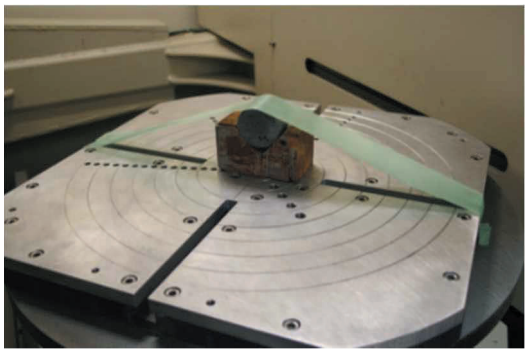


Fig. 1: Rock sample fixed in an X-ray CT scanner

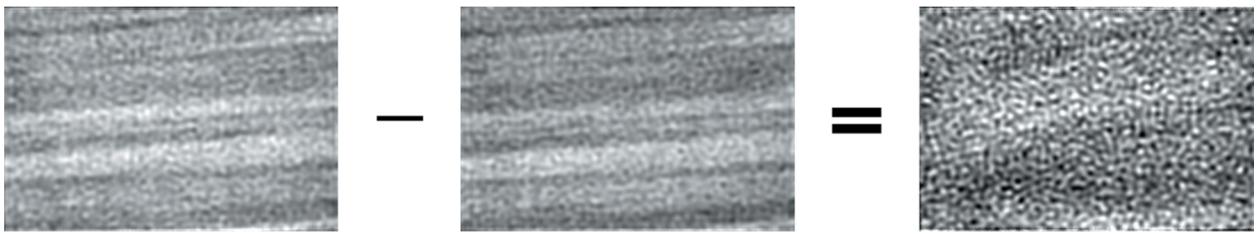


Fig. 2: Difference in CT values between samples with and without “active mineral deposition method”. (a) X-ray CT image for a sample to which the active mineral deposition method was applied, (b) a fully saturated sample without mineralization, and (c) difference in CT values between the samples.

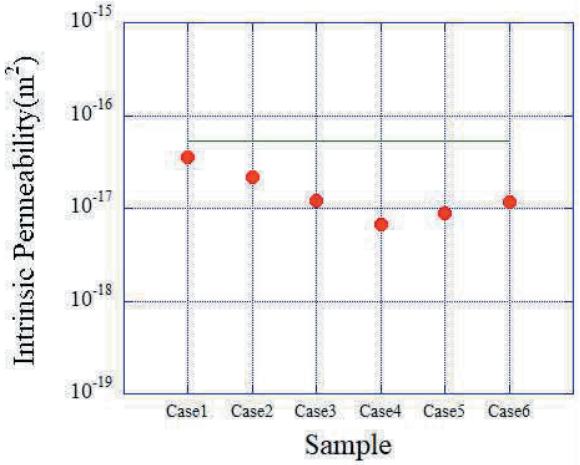


Fig. 3: Permeability of samples to which the active mineral deposition method was applied. The green line represents the average permeability of rock samples without mineral precipitation.

ii) Improvement of CO_2 mineralization with anaerobic microbes

In the fiscal year of 2019, for this study, the efforts have been made in setting up experiment devices and collecting rock samples. Frist, regarding the collection of rock samples, a quarry in

Oita prefecture and a tunnel in Hokkaido were used. For the quarry, a large rock block was directly transported to Kumamoto University, from which rock core samples were drilled. For the tunnel, I visited an abandoned tunnel in Hokkaido where rock coring was conducted. At that site, as soon as rock cores were drilled and extracted from the rock mass in the tunnel, the cores were cut out to an appropriate length and stored in a plastic box kept under anaerobic conditions. Figure 4 shows the samples.



Fig. 4: Rock samples under anaerobic conditions collected from the quarry in Oita and the abandoned tunnel in Hokkaido

According to our initial plan, another core was supposed to be obtained from an underground coal mine located in Kushiro, Hokkaido in March. However, the trip was cancelled because of the coronavirus outbreak.

Regarding the experimental apparatus, the figure below shows a glove chamber for experiments under anaerobic conditions. In addition to the chamber, a vacuum pump, gas cylinders, and a device to break the rock cores in the chamber were prepared.



Fig. 5: Glove chamber for experiments under anaerobic conditions

6. Researchers Supported by the IROAST International Joint Research Travel Support Program

No.	Name	Project Title
6-1	**Takeshi Fukusako**	Development of MIMO Telecommunication System in HF band and Novel Broadband Antennas Techniques using Meta-space for Radar Applications
6-2	**Shinya Hayami**	Development of energy devises by using nano carbon materials
6-3	**Hamid Hosano**	Acousto-electric interface for intervening brain disorders by neural stimulations
6-4	**Shinya Hosokawa**	Studies on the structure and dynamics of functional materials using synchrotron radiation
6-5	**Toshifumi Komatsu**	Reconstructions of Phanerozoic biofacies in Vietnam
6-6	**Toshifumi Mukunoki**	Assessment of Loading Application on Sediment Material Properties in Downstream and Estuary at Bengawan Solo River

No. 6-1	Development of MIMO Telecommunication System in HF band and Novel Broadband Antennas Techniques using Meta-space for Radar Applications		
Name	Takeshi Fukusako		
Affiliation	Kumamoto University Email: fukusako@cs.kumamoto-u.ac.jp	Title	Professor
Research Field	Other (Antennas and Propagation Engineering)		
Period of Travel	August 7, 2019 - August 11, 2019		
Visited Researcher	Gamantyo Hendrantoro and Eko Setijadi		
Affiliation	Institut Teknologi Sepuluh Nopember Surabaya (ITS), Indonesia	Title	Professor and Lecture

In this visit to Surabaya, Indonesia, we had a research meeting with Prof. Gamantyo Hendrantoro and the members of antenna and propagation laboratory in Institut Teknologi Sepuluh Nopember Surabaya (ITS). There are two major joint research projects between us, one is MIMO (Multiple Input Multiple Output) communication technology in the HF (High frequency:3 - 30MHz) band, and the other is development of array antennas for such as disaster detection radars. Before the discussions, I gave a talk about our recent researches in my lab (Fig. 1).



Fig. 1: After the lecture.

As for the HF MIMO technique, Indonesia has a lot of islands and large sea area, therefore communication between islands is important with low cost over long distances of several thousand kilometers, but the communication infrastructure is not always in place. Consequently, communication in the HF band is useful but the band is narrow and not suitable for large-capacity communication. Therefore, we have examined the possibility of expanding communication capacity furthermore using multiple antennas with MIMO technology at HF band. The results have been published in some journals and conferences including IEEE journal and been summarized as a PhD thesis. Furthermore, we have developed antennas and surrounding systems suitable for this system. In the meeting at Antenna and Propagation Laboratory (Fig. 2), we discussed our past study and continue to develop this technique for larger channel capacity.



Fig. 2 With Prof. Gamantyo (right) and Ms Umaisaroh (PhD candidate, middle) in front of Antennas and Propagation Lab.

In the next discussion, we have already conducted research on the broadband array antenna, and examined the technology for reducing mutual coupling between arrays. These results have been published in such as IEEE journal and been summarized as another PhD thesis (Ms Nurhayati). We have discussed our next collaboration in this opportunity. As a next step, we would like to explore the technology to control the beam, aiming at application to disaster detection radar. Furthermore, we would make the array antenna circularly polarized. In this way, we could target many potential applications but for now, we would target two applications. One is radar applications such as monitor landslides that frequently occur in Indonesia and Japan based on the principle of image radar. The other one is to apply the array for radio telescope. For those, we are going to develop some additional antenna technologies.



Fig. 3: With rector, vice-rector and principal staffs. They are Prof. Ardyono, Prof. Adi, Prof. Bambang, Prof. Ashari, Fukusako, Dr. Ria, Prof. Mukunoki, Prof. Ketut, Prof. Gamantyo, and Dr. Trika (from left to right).

Finally, before these discussions above, two professors at Kumamoto University（KU）, (Profs. Mukunoki and Fukusako) met Prof. Ashari (Rector), Profs. Adi and Bambang (Vice-Rectors) and several principal members of ITS such as Prof. Ketut (ex-Vice Rector), Prof. Ardyono (Head of department of Electrical Engineering), Dr. Trika (International Affair), Dr Ria (Civil Engineering) and Prof Gamantyo (Fig. 3). Then we have heard that the ITS is globalizing their university having collaborations with many universities in various countries. ITS is a principle partner university for Kumamoto University, and we said the partnership will be continuing for a long time. In a meeting with the principal members, we discussed how we could enhance programs for international students. Finally, I met some professors and researchers such as Dr. Yono (Head of department of physics), Dr. Purba (Telecommunication University, ITT) and Ms Nurhayati (Surabaya State University, UNESA). We had fulfilling discussions on future collaborations (Fig. 4). With universities in different countries, I believe that it must be good for not only students but also professors and researchers to interact with each other so that we can enhance diversity resulting in creating new technologies and cultures. I hope that IROAST can be a great help for this.



Fig. 4: With Dr. Purba (ITT), Dr. Yono (Dept Physics), Ms Nurhayati (UNESA), Prof. Gamantyo, Fukusako and Dr Eko (from left to right).

No. 6-2	Development of energy devises by using nano carbon materials		
Name	Shinya Hayami		
Affiliation	Faculty of Advanced Science and Technology Email: hayami@kumamoto-u.ac.jp	Title	Professor
Research Field	Nanomaterial Science/ Green Energy/ Advanced Green Bio		
Period of Travel	January 27, 2020 - February 7, 2020		
Visited Researcher	Prof. Shizhang Qiao		
Affiliation	The University of Adelaide	Title	Professor

1. Overview and significance of the international research collaboration
2D materials are ideal for constructing flexible electrochemical energy storage devices due to their great advantages of flexibility, thinness, and transparency. We have also focused on 2D materials, i.e. metal oxide (MO), metal hydroxide (MOH), metal (M), graphene oxide (GO) and reduced graphene oxide (rGO) nano sheets. We have aimed at development energy devices and catalysis by using 2D and its hybrid materials. In this time, I visited Sydney (US and WSU), Brisbane (UQ and QUT) and Adelaide (UA) in Australia in order to discuss about our collaboration. I visited University of Sydney and University of Western Sydney University, and I had my lecture, and discussed with Prof. Lindoy and Prof. Feng Li about magnetism and conductivity of GO, rGO and its hybrids. Next, I visited University of Queensland and Queensland University of Technology, and I had my lecture, and discussed with Prof. Yu and Prof. Doherty about biomass experiment by GO, rGO hybrids. Finally, I visited University of Adelaide, and I had my lecture, and discussed with Prof. Qiao about energy device by GO, rGO.

2. Research achievements and progress of the international joint research
I collaborate with Prof. Lindoy and Prof. Feng Li about magnetism and conductivity of GO, rGO and its hybrids. We already published many papers for collaboration results, and some of them is over IF = 10. And I collaborate with Prof. Yu and we published one paper about anti-malaria DDS by MCM-41. And in this time, we have agreement with Prof. Doherty in Queensland University of Technology, and we start about collaboration about biomass catalyst reaction by GO hybrids. My DC student stay in University of Adelaide, and Prof. Qiao is supervisor for him. His results are successfully good, and we can publish the results as soon as possible.

3. Prospect for further research collaboration with the visited university/institution
All collaborator research work and facilities at the University is very well international recognized for the contribution on material synthesis and macromolecular design catalysts that open further international collaboration with research centers on the area of supramolecular chemistry, material design and cahractization, catalystis and production of key and fine chemicals as well as sustainable fuels for the future economy in the world. I hope our collaboration can keep continually with more high level and strong relationship.

4. Comments/suggestions for IROAST (programs).
Now I have many international collaborators because I could have visiting Australia in this IROST support. Our collaboration is very strong society and each researcher is also very high level in the world. For some our results, we have submitted and published in top class journals. We will also collaborate in this project each other from now. Finally, I would like to thank this support for our research collaborations.

No. 6-3	Acousto-electric interface for intervening brain disorders by neural stimulations		
Name	Hamid Hosano		
Affiliation	Institute of Pulsed Power Science Email: hamid@kumamoto-u.ac.jp	Title	Professor
Research Field	Nanomaterial Science/ Advanced Green Bio		
Period of Travel	September 25, 2019 – October 04, 2019		
Visited Researcher	Prof. Nir Grossman, Prof. Stelios Rigopoulos		
Affiliation	Imperial College London	Title	Lecturer; UK DRi Fellow Leader

1. Overview and significance of the international research collaboration

Imperial College London (ICL) is a leading public research university in UK, with 14 Nobel laureates. The ICL has several world class centers including Department of Brain Sciences, Department of Bioengineering, Centre for Blast Injury Studies, Graphene Study Group (Computational Materials Science), and Nanomaterials (Department of Mechanical Engineering), with research interests of the IROAST and IPPS, Kumamoto University.
In this respect collaborative researches were proposed with Prof. Grossman, Department of Brain Sciences, to study acousto-electric intervention of brain disorders; and with Prof. Rigopoulos, Department of Mechanical Engineering, to study nanoparticle formation.
A large population of patients suffer from brain disorders, causing serious impairment of their ability to function and impact their quality of life; accounting for about 30% of the global burden of the disease.
Most patients with brain disorders are unamenable to any form of treatment when first- and second-line interventions are ineffective. Neuromodulation technologies can help millions of patients who suffer from such brain disorders.

2. Research achievements and progress of the international joint research

The research will perform to develop a new efficient non-surgical methods to treat brain disorders as an acousto-electric interface for neural stimulations.
A set of electro-acoustic interactions and bioengineering questions need addressing in order to fully demonstrate the potential of this approach.
To achieve our goals of this multidisciplinary subject, we have mobilized a team with complementary expertise for the project.

3. Prospect for further research collaboration with the visited university/institution

Discussions and lab visits were performed at Prof. Grossman's laboratories to facilitate the joint research and collaboration. Prospects and required devices for experiments in the Department of Brain Sciences, ICL, and IPPS, Kumamoto University, were discussed and arranged. The collaboration program will be followed up during future visits.
During visit of Prof. Rigopoulos, Department of Mechanical Engineering, ICL, collaboration on nanoparticle formation/production were considered. Arrangements for inviting Prof. Rigopoulos as a Visiting Professor of IROAST, Kumamoto University, were discussed. Proposal for an MOU agreement between Departments was considered.

4. Comments or suggestions for IROAST (programs).

The support of IROAST to facilitate the visit and to make the collaboration to be possible is much appreciated.
The IROAST programs play a key role in providing opportunity to Kumamoto University's young and research faculties to extend their experiences/knowledge through collaboration with world renowned groups.



Meeting Prof. Grossman, Department of Brain Sciences, Hammersmith Hospital, Imperial College London.



Meeting Prof. Rigopoulos, Department of Mechanical Engineering, Imperial College London.

No. 6-4	Studies on the structure and dynamics of functional materials using synchrotron radiation		
Name	Shinya Hosokawa		
Affiliation	Department of Physics, Faculty of Advanced Science and Technology Email: shhosokawa@kumamoto-u.ac.jp	Title	Professor
Research Field	Nanomaterial Science		
Period of Travel	December 15, 2019-December 26, 2019		
Visited Researcher	Ronald Redmer Wolf-Christian Pilgrim		
Affiliation	Institute of Physics, University of Rostock Faculty of Chemistry, University of Marburg	Title	Professor Professor

1. Overview and significance of the international research collaboration

Kumamoto University concludes Academic Exchange and Student Exchange Agreements with University of Rostock and University of Marburg, for both of which SH is a Contact Coordinator. Based on these agreements, they would like to submit a proposal for a Bilateral Program to Japan Society for the Promotion of Science (JSPS) from Japanese side and to Deutche Forschungsgemeinschaft (DFG) from German side, for carrying out joint research projects and joint seminars on “Materials at Extreme Conditions of High Temperature and High Pressure”. The Contact Coordinator for the German proposal will be Professor Ronald Redmer of University of Rostock. The aim to visit University of Rostock was to discuss and prepare the proposal in this July.

SH has collaborated for a long time with Professor Wolf-Christian Pilgrim of University of Marburg on the studies of atomic structures and dynamics of functional materials, such as Ge-based phase change materials, Fe-based high-temperature superconductors, and Bi-based topological insulators using third-generation synchrotron radiation facilities at the ESRF at Grenoble, France, and at the SPring-8 at Sayo, Japan. From University of Marburg, SH was a host for a JSPS fellow, Dr. J. R. Stellhorn (currently Hiroshima University), for two years and a doctor course student, Mr. B. Paulus, for a half year to intensively carry out the cooperative studies on the above subjects. The aim of the laboratory visit was to summarize the previously conducted experimental results and to prepare or to conclude papers for publications. He will be also a member of the Bilateral Program to DFG.

2. Research achievements and progress of the international joint research

Concerning the Bilateral Program, SH discussed with Professor Redmer and Professor Pilgrim, and agreed with each other on the purpose of the joint works.

On the experimental methods of the collaborated works with University of Marburg, anomalous x-ray scattering (AXS) and x-ray fluorescence holography (XFH), SH and his collaborators in Japan had excellent experimental techniques, and achieved remarkable results on several functional materials, the latter of which was one of the important driving forces that the Grant-in-Aid for scientific Research on Innovative Areas (3D Active Site Science) was approved by JSPS in 2014. To improve these techniques further, the use of new-generation synchrotron radiation facilities, such as PETRA ring at DESY in Hamburg, Germany and MAXIV in Lund, Sweden, is necessary, and strong international collaborations are essential.

At this time, they mainly discussed some publications for a special issue of the 14th International Conference on the Structure of Non-Crystalline Materials (3-8 November 2019,

Kobe), for which SH was the chief organizer. They also discussed other publications, and several papers were already published or in press as listed in 5. Professor Pilgrim agreed to come to Kumamoto University with his doctor course student, Mr. B. Klee to give two talks in the IROAST seminar/1st PanPacific Reverse Monte Carlo Conference (20-21 February 2020, Kumamoto University), and to make a proposal to become an IROAST guest-professor from 2020.



Fig. 1. Discussion with Prof. Pilgrim

3. Prospect for further research collaboration with the visited university/institution

They will propose the Germany-Japan Bilateral Program to DFG by Professor Redmer with Professor Pilgrim, and to JSPS by Professor Kazuhiro Matsuda of Kumamoto University with SH and Professor Masanori Inui of Hiroshima University, in this July.

Professor Laszlo Pusztai of the IROAST guest-professor and SH will plan to organize a special issue concerning the IROAST seminar/1st PanPacific Reverse Monte Carlo Conference as the conference organizers. For this, Professor Pilgrim and SH will make a review paper on their collaborative works for more twenty years.

4. Recent joint publications

i) S. Hosokawa, M. Inui, T. Bryk, I. Mryglod, W.-C. Pilgrim, Y. Kajihara, K. Matsuda, Y. Ohmasa, and S. Tsutsui, Detection of collective optic excitations in molten NaI, Condensed Matter Physics **22**, 43602-1-7 (2019).

ii) S. Hosokawa, N. Happo, T. Matsushita, J. R. Stellhorn, K. Kimura, and K. Hayashi, Valence-selective local atomic structures in inorganic materials by X-ray fluorescence holography, Japanese Journal of Applied Physics **58**, 120601-1-9 (2019).

iii) J. R. Stellhorn, S. Hosokawa, and S. Kohara, Local- and intermediate-range structures on ordinal and exotic phase-change materials by anomalous x-ray scattering, Analytical Sciences **36**, 5-16 (2020).

iv) K. Kimura, K. Yamamoto, K. Hayashi, S. Tsutsui, N. Happo, S. Yamazoe, H. Miyazaki, S. Nakagami, J. R. Stellhorn, S. Hosokawa, T. Matsushita, H. Tajiri, A. K. R. Ang, and Y. Nishino, Local structure and atomic dynamics in Fe_2VAl Heusler-type thermoelectric material: The effect of heavy element doping, Physical Review B **101**, 024302-1-10 (2020).

v) S. Hosokawa, N. Happo, K. Hayashi, K. Kimura, T. Matsushita, J. R. Stellhorn, M. Mizumaki, M. Suzuki, H. Sato, and K. Hiraoka, Valence-selective local atomic structures on an

$YbInCu_4$ valence transition material by x-ray fluorescence holography, The Journal of Physical Society of Japan **89**, 034603-1-5 (2020).

vi) B. Klee, B. Paulus, S. Hosokawa, M. Wharmby, E. Dornsiepen, S. Dehnen, and W.-C. Pilgrim, Generating large starting configurations for molecular Reverse Monte Carlo modelling of a unique non-linear optical amorphous solid, Journal of Physics Communications **4**, 035004-1-7 (2020).

vii) S. Hosokawa, J. R. Stellhorn, Y. Onodera, S. Kohara, H. Tajiri, E. Magome, L. Pusztai, K. Ikeda, T. Otomo, M. Krbal, and T. Wagner, Local- and Intermediate-Range Atomic Order in $Ga_2Ge_3Se_9$ Glass: Complementary Use of X-Rays and Neutrons, JPS Conference Proceedings, in press.

viii) S. Hosokawa, Y. Kawakita, J. R. Stellhorn, L. Pusztai, N. Blanc, N. Boudet, K. Ikeda, and T. Otomo, Local- and Intermediate-Range Order in Room Temperature Superionic Conducting Ag-$GeSe_3$ Glasses, JPS Conference Proceedings, in press.

ix) J. R. Stellhorn, S. Hosokawa, B. Kaiser, K. Kimura, N. Boudet, N. Blanc, H. Tajiri, S. Kohara, and W.-C. Pilgrim, The structure of the amorphous $(GeTe)_{1-x}(Sb_2Te_3)_x$ system and implications for its phase-change properties, Zeitschrift für Physikalische Chemie, in press.

No. 6-5	Reconstructions of Phanerozoic biofacies in Vietnam		
Name	Toshifumi Komatsu		
Affiliation	Faculty of Advanced Science and Technology Email: tkomatsu@kumamoto-u.ac.jp	Title	Ph D / Associate Professor
Research Field	Nanomaterial Science/ Green Energy/ Environmental Science/ Advanced Green Bio/ Other (Paleoenvironmental Science)		
Period of Travel	21th Feb., 2020 - 29th Feb., 2020		
Visited Researcher	Doan Dinh Hung		
Affiliation	Vietnam National Museum of Nature, Vietnam Academy Science and Technology (VAST)	Title	Researcher

Reconstructions of Phanerozoic biofacies in Vietnam

Toshifumi Komatsu (Earth and Environmental Science, Division of Natural Science, Faculty of Advanced Science and Technology, Kumamoto University)

This research follows in the footsteps of the French Indochinese Geological Survey, who in the first decades of the 20th century discovered many new Paleozoic and Mesozoic fossils in northern Vietnam and southern China. Vietnamese mapping geologists later worked systematically throughout this region in the 1970s. These surveys and subsequent work identified a rich early Phanerozoic history for northern Vietnam that is geologically linked to southern China, both regions once forming part of the ancient South China paleocontinent. Across the border in China, the discovery of well-preserved fossils in the 1980s led to a renaissance in the study of the Paleozoic and Mesozoic rocks of southern China. In contrast, large regions of Vietnam have yet to be explored in detail. Our project focuses on the Phanerozoic rocks of Northern Vietnam, which have yielded rich, newly identified shelly and vertebrate faunal assemblages, with the goal of reconstructing Phanerozoic biofacies in Vietnam. Moreover, there is a chance of finding some mass-extinction and extinction-event horizons from the Paleozoic to the end of the Triassic, and to elucidate the nature of the Early Paleozoic and Middle to Late Triassic adaptive radiations. This project, which is part of an ongoing collaboration between Vietnamese and Japanese geologists, would involve two seasons of fieldwork in northern Vietnam, collaboration with the Vietnam National Museum of Nature in Hanoi, and laboratory work at Kumamoto University in Japan. Participants will become expert in the lower Mesozoic geology of Southeast Asia and have widely transferable skills in organizing fieldwork in remote areas, conveying scientific discoveries to the public, biostratigraphy, paleontological analysis, geological mapping, and problem solving.

In late February 2020, I visited Hanoi to conclude a Memorandum of Understanding (MOU) between the laboratory of Doan Dinh Hung in the Vietnam National Museum of Nature (VNMN) and my laboratory, and to conduct preliminarily geological research in some coal fields. The objective was to promote cooperation in various areas of education (making geological and paleontological exhibitions) and scientific research (reconstruction of the Mesozoic biofacies in Vietnam). In addition, we organized exchanges of professors, professional personnel, and students.

Outline of MOU

1. Objectives of cooperation

Promote cooperation in various areas of education and scientific research as follows,

(1) Reconstructions of Mesozoic non-marine and marine biofacies in Vietnam (2020–2023).

(2) Reconstructions of Paleozoic and Cenozoic non-marine biofacies in northern Vietnam (subsequent research).

2. Content of cooperation

(1) Co-organize exchanges of professors, professional personnel, and students, and exchanges of research material and data that require permission from relevant agencies in Vietnam.

(2) Coordinate postgraduate training.

(3) Hold joint workshops and seminars.

(4) Co-organize research courses, fieldwork, geochemical and paleontological analyses, and joint publication of research results.

(5) Exchange specimens for study and exhibition.

(6) Other areas of interest to both parties.

3. Financial obligations

This MOU does not deal with financial specifics. Financial details will be reflected in specific projects. We will apply regulations from Bilateral Programs Joint Research Projects/Seminars between Vietnam and Japan, JSPS.

4. Ownership

The parties will jointly publish research results, and will joint own patents (if any).

5. Duration of MOU

This MOU is valid for 3 years and may be extended by written agreement between the parties.

Preliminary research in coal mines, northern Vietnam.

We conducted preliminary research in Na Duong Coal Mine, Lang Son Province, but did not investigate the Dam Dun and Me coal mines, Ninh Binh Province, due to emergency measures undertaken for the coronavirus. At the Na Duong Coal Mine Company, we discussed cooperative research between Vietnam and Japan, and had time to observe fossils from the mine (Fig. 1).



Figure 1. **A**, Na Duong Coal Mine Company, Na Duong Town, Loc Binh District, Lang Son Province, northern Vietnam. **B**, Meeting at the Na Duong Coal Mine Company, discussing cooperative geological and paleontological research in the Na Duong area. **C**, Na Duong Coal Mine, Coal Bed No. 4 (CB4), where abundant, well-preserved vertebrate and plant fossils were obtained.

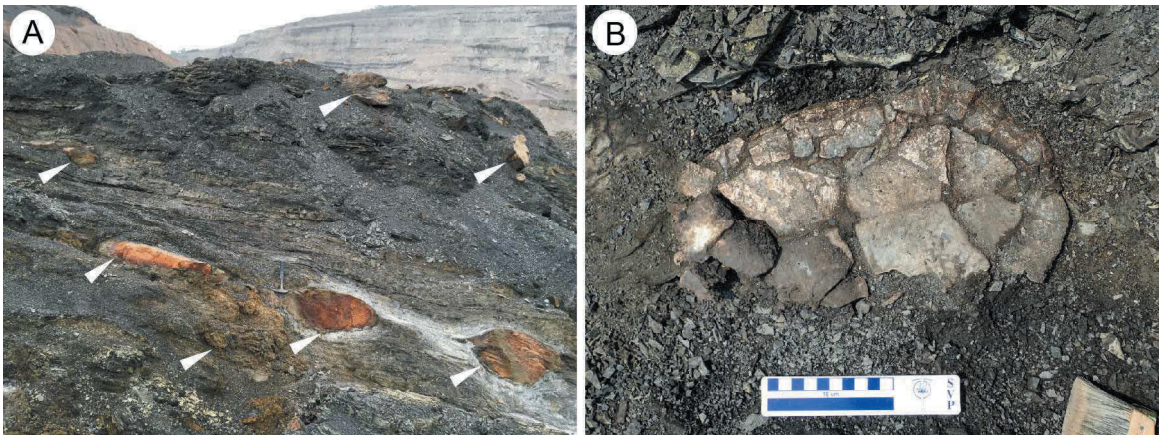


Figure 2. Fossils from the Na Duong Formation. **A**, Large pieces of siliciclastic wood (arrows) in CB4. **B**, Nearly complete plastron of a fossil aquatic turtle, *Banhxeochelys train*, in a bedding plane of coaly mudstone.

At the Na Duong Coal Mine, there are extensive outcrops of the Na Duong and Linh Chua formations. The Na Duong Formation consists of Paleogene non-marine sandstone and mudstone intercalated with nine thick coal beds (CB1–9). These coal beds abundantly yield silicified wood, plants, freshwater mollusks, and vertebrate fossils (Fig. 2). Well-preserved vertebrate material,

including fishes, turtles, crocodiles, mammal bones, and coprolites, is especially common in CB4, which is over 20 m thick. Some species of vertebrates have already been described by European scientists (Böhme et al., 2013; Rafaella et al., 2019), but we found several undescribed species of aquatic freshwater turtles and crocodiles in CB4. In addition, we collected some mudstone specimens to analyze for pollen age, because the geologic age of the Na Duong Formation remains largely unexplored in detail.

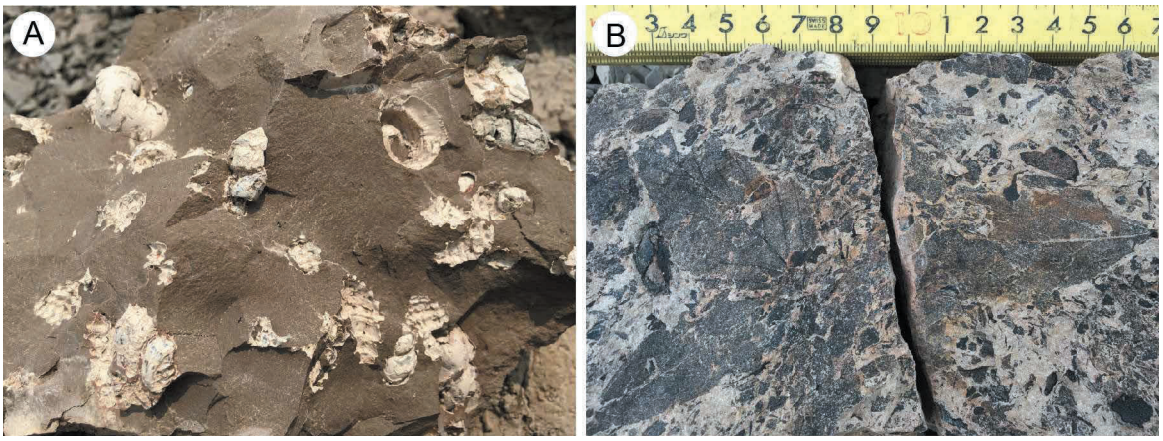


Figure 3. Fossils from the Linh Chua Formation. **A**, Lenticular shell concentration composed mainly of the gastropods *Brotia henriettae* and *Bellamya* sp., in a mudstone bedding plane. **B**, Angiosperm leaves and coaly debris in a parallel-laminated sandstone bedding plane.

The Linh Chua Formation is composed of fossiliferous mudstone and very fine- to fine-grained sandstone containing coaly mudstone layers and beds. Well-preserved freshwater bivalves (*Unio douglasiae*, *Cristaria* sp., and *Hyriopsis* sp.), gastropods (*Brotia henriettae* and *Bellamya* sp.), and angiosperm leaves are abundant in bioturbated mudstone and ripple-laminated sandstone (Fig. 3). Some of the articulated bivalves are preserved positionally in-situ in bioturbated organic-rich mudstone. Gastropods and disarticulated bivalve shells form thin lenticular concentrations. The genetic compositions of these molluscan fossil assemblages are common in the recent shallow lake. Unfortunately, we were unable to collect vertebrate fossils from the Linh Chua Fm. In late February and/or March next year, we will again conduct geological research and collect fossils in Na Duong Coal Mine and in the stratotype section of the Linh Chua Fm. In May or October, we will probably again visit the Dam Dun and Me coal mines for Triassic research.

References

Böhme, M., Aiglstorfer, M., Antoine, P. O., Appel, E., Havlik, P., Métais, G., Phuc, L. T., Schneider, S., Setzer, F., Tappert, R., Tran, D. N., Uhl, D., Prieto, J., 2013, Na Duong (northern Vietnam) – an exceptional window into Eocene ecosystems from Southeast Asia. *Zitteliana* A 53 121-167.

Garbin, R. C., Böhme, M., Joyce, W. G., 2019, A new testudinoid turtle from the middle to late Eocene of Vietnam. *Peer J*, DOI 10.7717/peerj.6280.

No. 6-6	Assessment of Loading Application on Sediment Material Properties in Downstream and Estuary at Bengawan Solo River		
Name	Toshifumi Mukunoki		
Affiliation	Faculty of Advanced Science and Technology Email: mukunoki@kumamoto-u.ac.jp	Title	Associate Professor
Research Field	Nanomaterial Science/ Green Energy/ Environmental Science/ Advanced Green Bio/ Other (Disaster prevention)		
Period of Travel	2019/8/7-10		
Visited Researcher	Dr. Ir. Ria Asih Aryani Soemitro,		
Affiliation	Institut Teknologi Sepuluh Nopember, Inonesia	Title	Senior Researcher

1. Overview and significance of the international research collaboration

Bengawan Solo River, which is a typical large ephemeral river in Indonesia, is facing stream problems induced by erosion and deposition of sediment. Imbalance between erosion and deposition on the riverbed can lead to excessive sedimentation, and increase risk of flooding and the formation of sandbar. One proposed solution to address this problem is dredging. However, dredging can have potential negative effects on the environment such as removal or destruction of the biota in the dredged materials, increase turbidity, as well as coverage of the benthos in the vicinity. Also, different dredging methods would suit to sediments with different properties. Therefore, knowledge of the properties of the deposited sediment is required so that appropriate dredging methods could be selected. The sediment properties were obtained by performing laboratory tests on physical and consolidation properties, also shear strength of soil sample.

2. Research achievements and progress of the international joint research

In order to make better solution to this issue, Dr. Ria Soemitro has contacted me and sent her master students in 2016 and then, we submitted one paper last year (2017). Finally, we just got acceptance letter from the editorial board of the international journal of river basin management as another attachment file. In order to have good collaboration, we also think that we should keep student exchange. So Dr. Ria Soemitro organized open seminar and I introduced Kumamoto University and my research topics to graduate students of ITS to encourage students of ITS to go abroad, especially, Kumamoto University.



Photo. 1 Class room during my lecture

3. Prospect for further research collaboration with the visited university/institution

Now we have two progressive research projects and two potential research projects as follows:

1） The impact of open dumping method in Ngipik landfill investigated with electrical resistivity tomography (ERT) and very low-frequency electromagnetic (VLF-EM) methods

(in print)

2） Sediment transport rate due to weir existence and river branches in the estuary of Bengawan Solo river, Indonesia (TBD in 2020)

3） Development of new landfill with excellent barrier system (Photo.2)

4） The development of new countermeasure technology using microorganism to liquefaction based on the experienced Palu Earthquake, 2018



Photo. 2 Site investigation of Landfill

4. Comments or suggestions for IROAST (programs).

I deeply appreciated IROAST to support funding to go to ITS in 2019. IROAST is doing very well organizing work so I don’t want to increase their tasks more. I just want to ask IROAST how long it can keep this program for us.

7. IROAST Young Internship Researchers

No.	Name	Project Title
7-1	**Andri Hardiansyah**	Proton transport number of graphene oxide/polyvinyl pyrrolidone /cerium membrane
7-2	**Yuliati Herbani**	Biocompatible plasmonic nanoparticle system in response to laser irradiation for antibacterial and photothermal applications
7-3	**Xia Zhiguo**	Study on the evolution law of dynamic disasters of faults result from the action of primary tectonic stress
7-4	**Jihoon Kim**	Establishment of Molecular Bio-Imaging guided Surgical Platform in Head and Neck Cancer based on Precision Medicine Biomarker
7-5	**Peng Kong**	Dynamic analysis of the rock burst potential induced by fault-slip
7-6	**Su-Bin Lee**	Treatment of A549 lung cancer cells using Albendazole and Fenbendazole
7-7	**Song Yeul Lee**	Near-infrared light-triggered bio-imaging and photodynamic therapy using upconversion nanoparticles
7-8	**Listiana Oktavia**	Isolation of Bioactive Natural Product Derived Compounds from Adina *sp*
7-9	**Mona Pakdel**	Protein-Nanoparticles as Drug Carriers for Prokaryotic Cells
7-10	**Sajjan Pokhrel**	Numerical study of a vertical closed loop double pipe geothermal heat exchange system
7-11	**Reetesh Tiwari**	Heat transfer enhancement in heat pipe using copper porous microstructure
7-12	**Reid William Wilson**	Chirality-driven photoelectrochemical reaction: Preparation of chiral systems and their properties
7-13	**Farzan Zare**	Pulsed Electromagnetic Field Excitation for Biological Applications

No. 7-1	Proton transport number of graphene oxide/polyvinyl pyrrolidone /cerium membrane		
Name	Andri Hardiansyah		
Affiliation	Research Center for Physics Indonesian Institute of Sciences, Indonesia Email: andri.hardiansyah@lipi.go.id	Title	Researcher
Research Field	Nanomaterial Science		
Period of Internship	January 6-February 28, 2020		
Host Professor	Tetsuya Kida		
Affiliation	Faculty of Advanced Science and Technology Email: tetsuya@kumamoto-u.ac.jp	Title	Professor

I did an internship at Prof. T. Kida Laboratory under International Research Organization for Advanced Science & Technology (IROAST) support from January until February 2020. Prof. Kida Laboratory covers research area including graphene oxide, perovskite material and quantum dot including the synthesis, characterization and its applications.

I work on an assignment project to investigate the characteristic and properties of graphene oxide membrane with the addition of cerium and water-soluble polymer (polyvinyl pyrrolidone, PVP). This topic suits my research background and current research that we have conducted in our institute at Research Center for Physics, Indonesian Institute of Sciences, Indonesia. Through the assignment, I did not only gain a lot of knowledge but more importantly, I also had a great chance to sharpen my skills in a professional laboratory working environment.

Research on proton conductivity is gaining interest due to their importance as a key role in various important process including electrochemical devices such as fuel cells, electrochemical sensor and electrochemical reactors. Thus, development of material that could exhibit selective and highly proton conductivity is in needed to achieve the optimum performance of electrochemical-based devices.

Graphene oxide (GO) is one of the graphene-based materials that consist of various oxygen-based functionality such as hydroxyl (-OH), carbonyl (-CO), and epoxy (C-O-C) and carboxyl (-COO) groups. Those functional groups exhibit an important role in the chemical reaction especially for the sites of reaction with other materials such as inorganic or organic material. The oxygen-based functional groups are also expected to displays a significant contribution to the proton conductivity performance of GO-based materials. Previous comprehensive research has been conducted in respect with the scope of proton conductivity in GO. Karim *et al.* reported the proton conductivity of bulk graphite oxide, a graphene oxide/proton hybrid and graphene oxide nanosheets at 100% humidity of ~10^{-4}, ~10^{-5}, and ~10^{-4} S cm^{-1}, respectively (Journal of the American Chemical Society 2013, 135, 8097-8100). Hatakeyama *et al.* reported the optimization of proton conductivity in GO by filling sulfate ions. The insertion of sulfate ions into intercalated GO (ratio of sulfur to carbon is 0.08, 0.16 and 0.41) could enhance the water content and flexibility, thus enhancing the conductivity of GO especially at above 40% relative humidity (Chemical Communications 2014, 50, 14527-14530). Hatakeyama *et al.* also reported that the proton conductivity of multilayer GO films is larger than single-layer films. This implies that proton could move easily in the inter layers than on the surfaces (Angew. Chem. Int. Ed, 2014, 53, 6997-7000). Hamidah *et al.* proposed the intercalation of cations (Al^{3+} and La^{3+}) in order to increase the proton conductivity (SN Appl. Sci. 1, 630, 2019). In this research, GO membrane with the addition of PVP and $CeSO_4.4H_2O$ was developed by using vacuum filtration technique. The innovative aspect of the proposed membrane lies in the utilization of water-soluble polymer (PVP) with GO in a simple preparation

technique, for the first time to best of our knowledge, in order to investigate their proton transport number characteristic. The membrane was characterized systematically by using XRD and cell membrane concentration experiment to evaluate the interlayer spacing distance and proton transport number, respectively. The potential application of membrane would be discussed.

Preparation of graphene oxide (GO). Firstly, we prepared the GO suspension by using modified Tour method. Modified Tour method has several advantages in compare with modified Hummers' method such as removing the release of toxic gasses such as NO_x due to the absence of nitrogen-based precursor such as nitric acid (HNO_3) and sodium nitrate ($NaNO_3$). In modified Tour method, the expandable graphite was used as the carbon precursor, meanwhile sulfuric acid (H_2SO_4)/phosphoric acid (H_3PO_4) and potassium permanganate ($KMnO_4$) were utilized as the oxidation agent and oxidator, respectively. The expanded graphite has a smaller lateral size and higher interlayer spacing distance compare to graphite. This characteristic would be benefit for the reducing time of reaction since the acids (H_2SO_4/H_3PO_4) would easily intercalate among the interlayer of expanded graphite. The resultant of GO could be evaluated from the visual observation and also through the analysis of interlayer spacing distance (*d*) value by x-ray diffraction (XRD) analysis. The GO has a brownish color suspension as the result of oxidation of graphite (black color) by strong acid. XRD result confirm the increasing of *d* value from of expanded graphite to GO of 4.3Å to 9.383 Å, respectively. Meanwhile, after the addition of PVP and Ce, the *d* value of the GO/PVP/Ce membrane enhanced to 11.13 Å.

Preparation of membrane. In this research, GO membrane was prepared by using vacuum filtration technique. Vacuum filtration technique is easy to conduct, by which the thickness of membrane could be control by adjusting the concentration of GO suspension. Vacuum filtration technique is filtering the GO suspension by means of a strong vacuum pressure and depositing freestanding GO membranes.



Figure. Membrane of GO prepared by vacuum filtration technique

Proton transport number (*t*). Proton transport number was evaluated through cell membrane concentration experiment. Briefly, the GO membrane was spray-coated by using the suspension of Pt/C. The membrane was placed to the apparatus consist of hydrogen gas flow. The flow rate of hydrogen gas was varied from 20 to 100 mL/min. Nerst Equation was used to calculated the proton transport number. Nernst Equation is a mathematical formula used to determine the equilibrium reduction potential of a half-cell in an electrochemical cell. Nernst equation relates the reduction potential of a half-cell at any point in time to the standard electrode potential, temperature, activity, and reaction quotient of the underlying reactions and species used. Proton transport number, *t* was measured by using the equation of $EMF = tRT/nF \ln(pH_2'/pH_2'')$, in which electromotive force (EMF) is correlated with the temperature (T, Kelvin), mol of electron involved in the balance reaction (n), and the pressure (*p*) of the system during the oxidation and reduction reaction. Membrane of GO/PVP/Ce display a proton transport number value of 1.63 at 40 ^oC. These results suggest that GO/PVP/Ce could conduct the proton moiety. This result implies the potential utilization of water-soluble polymer as a component for developing membrane with affordable proton conductivity characters. Eventually, the membrane is anticipated to be applied as an electrochemical device.

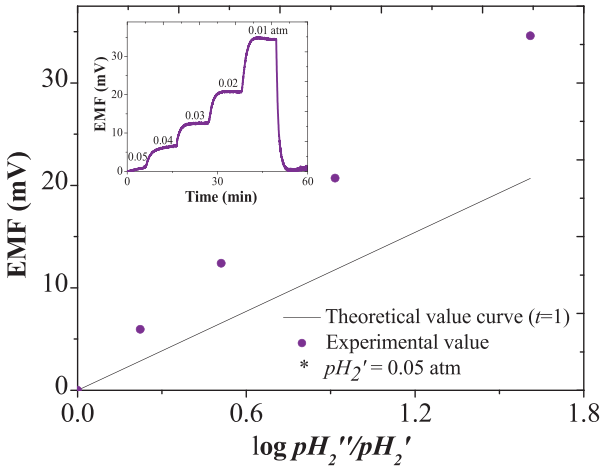


Figure. The electromotive force (EMF) of membrane as a function of hydrogen concentration

Moreover, there is still a room for improvement of this research including selection of polymer type and also controlling the polymer and cerium concentration to reach the optimum characteristic of proton conductivity of the membrane. In the near future, we would like to investigate the proton conductivity value through electrochemical impedance spectroscopy to quantify the proton conductivity value.

Eventually, I would also like to express my gratitude to Prof. Takashi Hiyama, the Director of the IROAST program, for giving me the opportunity to join the IROAST program in Kumamoto University. I am very appreciated to Prof. Tetsuya Kida, my supervisor and host professor at Department of Applied Chemistry and Biochemistry, Faculty of Advanced Science and Technology, Kumamoto University. Prof. Tetsuya Kida gave me very in-time valuable instructions and gave me extensive guidance regarding many practical issues in my research. He has given me all the freedom to pursue my research, while ensuring that I stay on course and do not deviate from the core of my research. Without his able guidance, this project would not have been possible and I shall eternally be grateful to him for his guidance. I have great pleasure in acknowledging my gratitude to my colleagues, Nur Laila Hamidah, Aynul Sakinah, Shota Kitamura, Masataka Shintani, Kanako, and all of the Lab members in ensuring that the fire keeps burning and being there at times when I required motivation and also for assisting me in collation of data for my research. Their support, encouragement and credible ideas have been great contributors in the completion of this project. Throughout the IROAST internship, I have also learnt many things about the Japanese culture whose benefits are far beyond what I could learn in a normal project.



Figure. Members of Prof. Kida Laboratory

No.7-2	Biocompatible plasmonic nanoparticle system in response to laser irradiation for antibacterial and photothermal applications		
Name	Yuliati Herbani		
Affiliation	Research Center for Physics Indonesian Institute of Sciences Email: yuliati.herbani@lipi.go.id	Status	Researcher
Research Field	Nanomaterial Science		
Period of Internship	January 6 – Feb 21, 2020		
Host Professor	Takuro Niidome		
Affiliation	Faculty of Advanced Science and Technology (FAST) Email: niidome@kumamoto-u.ac.jp	Title	Professor

Introduction

Over recent decades, noble metal nanostructure such as gold nanorods (AuNRs) and silver nanoplates (AgNPLs) have attracted an increasing attention due to their distinct NIR-SPR effects which possessed an extreme degree of anisotropy since their lateral dimension is larger than the thickness. This exquisite feature makes their SPR responses highly sensitive, strongly affected by the longitudinal or the sharp tip morphology, respectively. Many applications have been developed based on their strong shape-dependent optical properties, including photothermal therapy and antibacterial applications. Most cells or bacteria will be damaged or die at least at the temperature of 70°C (pasteurization temperature) for 30 min due to membrane rupture. Unlike Ag nanoparticles with all morphology possessing antibacterial nature, photothermal effect of Au nanoparticles (AuNPs) are not sufficiently kill bacteria or damage the cancer cells, even for the highest NIR responsive nanostructure such as Au nanotetrapods which give only 53°C in Luria Broth environment for its response to a CW laser at 808 nm. Therefore, to enhance its damaging power for microbes or tumor cells, Au nanoparticles needs to combine with chemical drugs in the form of nanocarriers. In the case of Ag, the enhancement can be done by simply using anisotrophic shaped nanoparticles which are responsive to NIR light irradiation to trigger Ag^+ ion release. In this internship program, I was assigned to both zprojects covering a series of tasks from synthesizing the system to the final applications on antibacterial activity. All the knowledge behind and the skills involved were the first time for me to experience. This internship has given me valuable yet basic understanding on a way to apply nanomaterial in the biomedical applications, which is one of I am dreamed for as engineering physicist.

Tasks

1. *Synthesis and characterization Ag nanoplates*

AgNPLs were prepared using seed growth protocol by Aherne et.al with some modification [1]. The modified preparation procedure was fully developed by Niidome lab and it has been published recently [2]. Typically, Ag seed were firstly synthesized by wet chemical reducing method using the strong $NaBH_4$ reducing agent in the presence of trisodium citrate as a capping molecule for [111] facet and polystyrene sulfonic acid as a defect controller. This seeding procedure resulted in Ag seed with a bright yellow color having an average particle size of around 10 nm. The seed were then slowly grown into AgNPLs in the growth solution within 100 hours at 30°C until a purple blue color appeared.

The UV-Vis spectra of Ag seed and AgNPLs were depicted in Fig. 1(a) and TEM image of the resulted AgNPLs was shown in Fig 1. (b). It can be seen that the morphology of the nanoplates were ranging from rounded-edged triangular to hexagonal nanoplates with an average size below 100 nm.

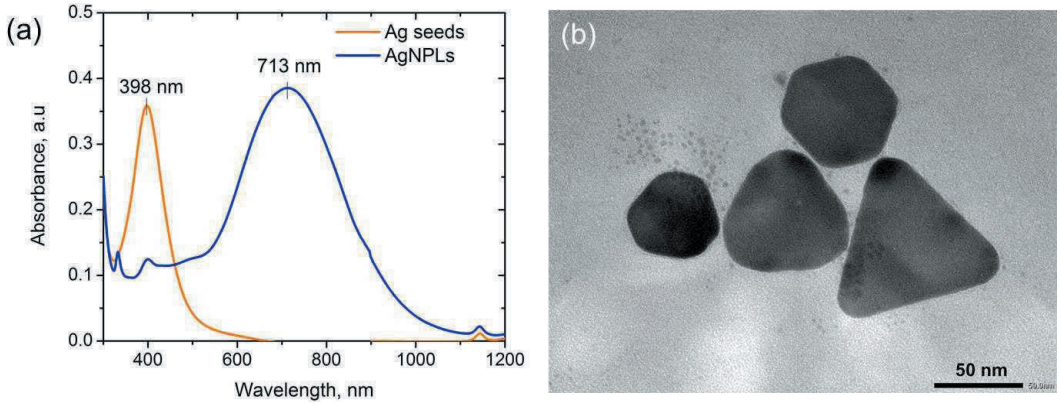


Figure 1. (a) UV-Vis spectra of Ag seed and Ag nanoplates. (b) A typical TEM image of Ag nanoplates developed in this internship.

Why bother to use AgNPLs rather than Ag nanosperes (AgNPs)? AgNPs were unstable and prone to the aggregation in the physicological conditions. In addition to that, AgNPs can only be activated at UV wavelength range (400 – 450 nm) which is dangerous for the health tissues. On the contrary, this AgNPLs have IR sensitivity at 700nm and thus can be activated at the resonance wavelength to release Ag^+ ions for antibacterial application. There are several on-going projects in Niidome lab related to this research, mostly for the sake of dispersability and Ag^+ ion release enhancement of AgNPLs simply by coating with Au, meso-silica or silica-hydrogel. Furthermore, I have been honored to witness and learn the performance of laser treated AgNPLs@SiO_2 nanoparticles by Ms Emi Takeda (B4 student) in inhibiting *Salmonella aureus*'s growth in a simple antibacterial application using turbidity method. I have documented the steps on how to perform this experiment and analyze the results. In the future, I will be able to use the learnt skill by myself.

2. PLGA-Cur-AuNRs Synthesis and its Antibacterial Activity

Recently, many kind of drug delivery system have been developed including liposomes and nanostructure consists of nanopore or biocompatible polymer nanoparticles [3]. Among all, drug loaded PLGA nanoparticles has become an attractive compartment for drug delivery due to their biocompatibility, capability to deliver hydrophobic compound and flexibility to adjust the drug release profile into the tissue. In this internship, we select curcumin as a release drug model, combine with AuNRs and aim to use this laser responsive PLGA nanocarrier as antibacterial agent.

The preparation of PLGA-Cur-AuNRs is quite simple, yet having long steps. Firstly, CTAB capped AuNRs were undergone the ligand exchange process into PEG-SH capped AuNRs. This process was carried out by centrifuging the CTAB-AuNRs several times and redispersed the clean precipitates with aqueous PEG-SH solution. The ligand exchange step is aimed for the easiness in the phase transfer of AuNRs for water to the organic medium such as chloroform. Then, PEG-SH capped AuNRs was phase transferred into DSF/chloroform phase using a shaker at 10,000 rpm overnight and resulted in DSF capped AuNRs in the chloroform phase. Finally, after mixing the PLGA and curcumin into DSF-AuNRs, nanoprecipitation of PLGA-Cur-AuNRs was done by sonicating the drops of DSF-AuNRs in 1% PVA ice-cold solution. After an overnight evaporation of chloroform and washing the remained solution 3 times, we finally got the PLGA-Cur-AuNRs nanocarrier.

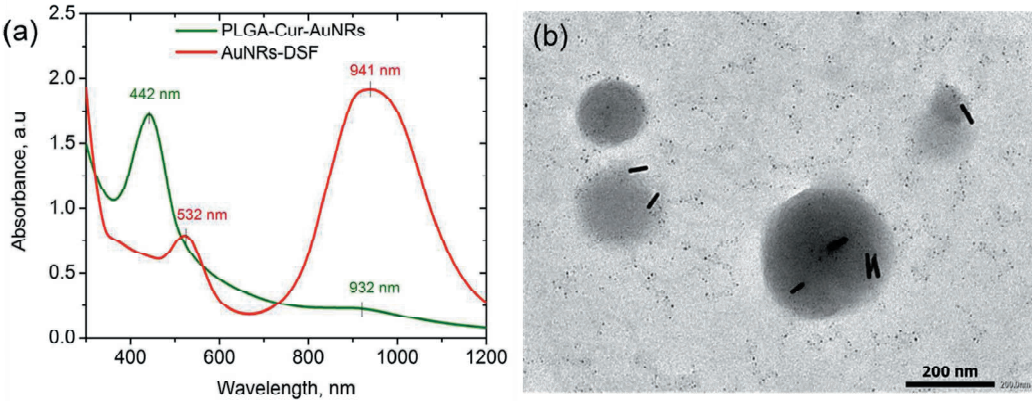


Figure 2. (a) UV-Vis spectra of DSF-AuNRs before (red) and after (green) incorporated with curcumin inside PLGA polymer. (b) TEM image of PLGA-Cur-AuNRs vesicle developed in this work.

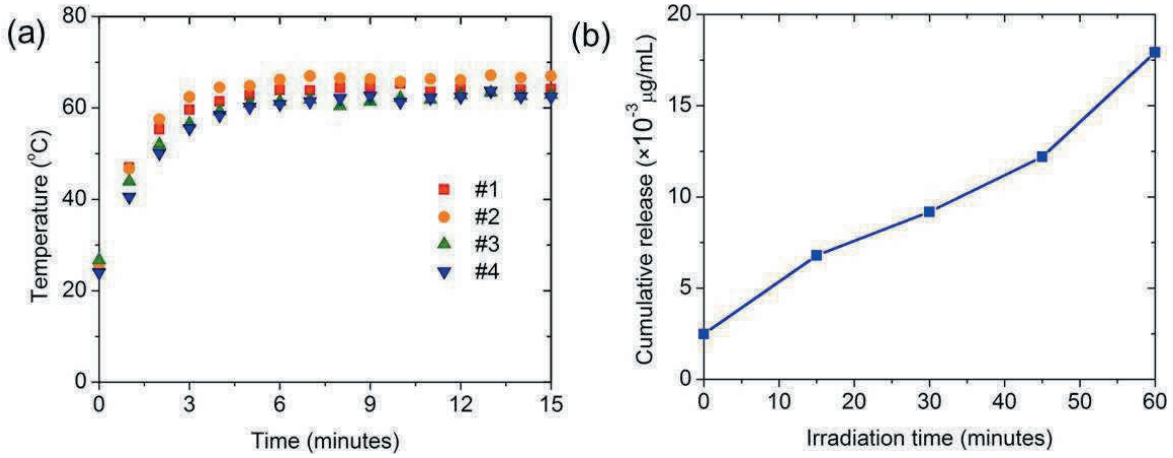


Figure 3. The profiles of (a) temperature increase and (b) curcumin release of PLGA-Cur-AuNRs in PBS after irradiation of CW laser (920nm, 400mW) for a total irradiation time of 60 min.

The UV-Vis spectra of DSF-AuNRs and the PLGA nanocarrier was shown in Fig. 2(a), while TEM image of the nanocarrier was depicted in Fig 2(b). UV-Vis spectra of PLGA nanocarrier showed the characteristic peak at 442 nm for curcumin and a small bump at 932 nm for AuNRs, indicating that the two components were successfully incorporated inside the PLGA compartment. This validated by the observed morphology of PLGA nanocarrier with an average size of ~500 nm as shown in the TEM image and from DLS measurement. All the experimental procedures were tutored by Mr. Ryu Yamashita, a Master student in the lab, as a part of his final project in the graduate program. He has also examined the efficiency encapsulation (EE) and loading efficiency (LE), which were 4.7% and 1.7% respectively [4].

We also assessed the photothermal and curcumin release profile in PBS to examine their feasibility use in the antibacterial activity. Both profiles were shown in Fig. 3. When a CW laser with a wavelength of 920 nm and power of 400 mW irradiated the PLGA nanocarrier for 15 min, the system temperature increased up to 65°C. Even when the carrier was irradiated consecutively up to 4 times, the temperature profiles did not significantly change. While the photothermal effect of the nanocarrier was good, we found that the cumulative release for curcumin was at a very low amount of 17.6 ng/mL for total 60 min irradiation. Most of literatures reported that at least 75 - 100 g/mL of curcumin molecules in was needed to inhibit the growth of *Staphylococcus aureus* [5, 6]. In fact, the release profile of curcumin in our case is very low in PBS even with the help of laser irradiation. Therefore we need to optimize the experimental parameters first such as drug load, composition of the organic

phase and volume ratio of water and organic phases, before we can apply to antibacterial activity. This optimization is set to be my main goal for the future research plan.

Future research plan

To enhance the drug loading efficiency and their profile release, we are encourage to optimize our nanocarrier system by varying 2 experimental parameters i.e. curcumin load and water to organic phase volume ratio. We also plan to explore another biodegradable aliphatic polymer which is more hydrophobic than PLGA especially poly(ε-caprolactose) (PCL) to increase the strong interaction with the hydrophobic curcumin [7]. With all the complexity of the works and the limited facilities in Indonesia, this future research will be much better to carry out in both Indonesia and Japan. I also plan to apply a research grant called "RisetPro Kolaborasi International" under The Indonesian Ministry of Research and Technology to cover the research expenses. Hopefully, the relationship between IROAST and my institution can be officially declared under a MoU in the near future to expand more and more collaborations between the two institutions.

References

1. Aherne et al. **2008.** Adv. Funct. Mater., 18, 2005 – 2016
2. Ichimaru et al. **2018**. Langmuir, 34, 10413 – 10418.
3. H. H. Arzani, et al. **2019**. Biointerface Research in applied Chemistry 9 (5), 4225 – 4231.
4. R. Yamashita, et.al. **2019**. Controlled drug release system from PLGA nanoparticles responding to NIR irradiation. Poster in Niidome lab.
5. M. Gao et al. **2020**. Food & Function 11, 448 – 455
6. Bhawana et. al. **2011**. Journal of Agricultural and Food Chemistry 59, 2056 – 2061.
7. N. Zs. Nagy et al. **2020**. eXPRESS Polymer Letters 14(1), 90–101

No. 7-3	Study on the evolution law of dynamic disasters of faults result from the action of primary tectonic stress		
Name	Xia Zhiguo		
Affiliation	Shandong University of Science and Technology Email: xzgyy88@163.com	Title	Graduate Student
Research Field	Green Energy		
Period of Internship	September 10, 2019-December 9, 2019		
Host Professor	Atsushi Sainoki		
Affiliation	IROAST Email: atsushi_sainoki@kumamoto-u.ac.jp	Title	Associate Professor

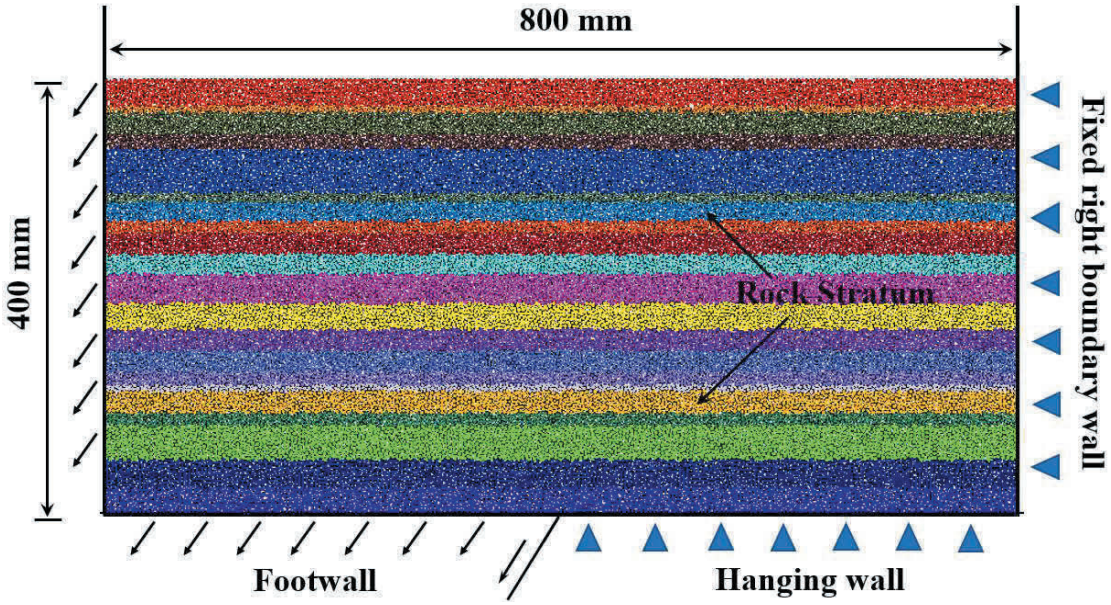
During these three months, I have lived and studied very happily. I am very honored to be an intern in a beautiful city and a university with a long history. When I first arrived at Kumamoto University, President Hiyama and Sainoki prof met me, and I feel very honored. During the internship, I received help and guidance from many teachers and classmates. Especially Professor Sainoki and Murao San, Your care and help made me feel warm at Kumamoto University, Thank you very much!

In academic research, I studied the formation process of the reverse fault and the tectonic stress distribution characteristics of primary rock during the formation process, I mainly use the method of combining physical and numerical simulation for research. The purpose of this research is to reveal the evolution characteristics of displacement field and stress field after the formation of the reverse fault, and the stress state near the fault, so as to provide ideas and help for the study of dynamic disaster in the fault area. During this time, Professor Sainoki had many discussions with me. He gave me a lot of useful advice.

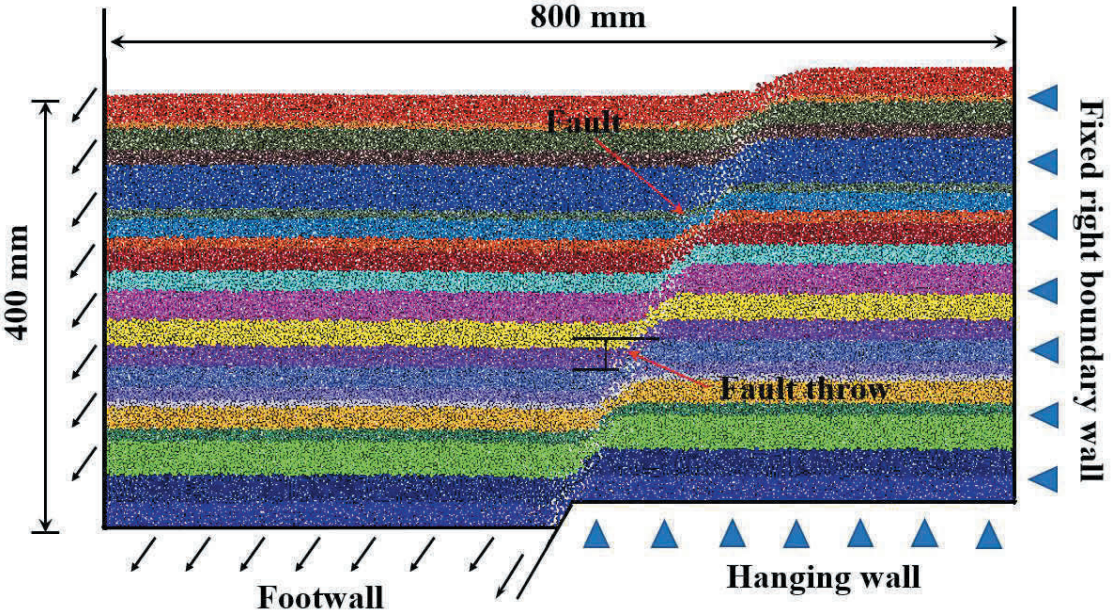
In the future, I will actively carry out further research by using the combination of Fault Formation-Dynamic Disaster Simulation Test System and numerical simulation, the establishment of a model for the distribution of primary rock stress and the prediction of tectonic stress in fault region can provide a reference for revealing the mechanical mechanism of fault formation and the study on the conduction mechanism of fault to mining-induced stress, and realize the analysis and accurate prediction of dynamic disasters of faults result from the action of primary tectonic stress. In addition, Due to the different formation mechanisms of normal faults and reverse faults, I will study the formation process of the reverse fault and the tectonic stress distribution characteristics of primary rock during the formation process.

Normal fault:

(1) Numerical modeling

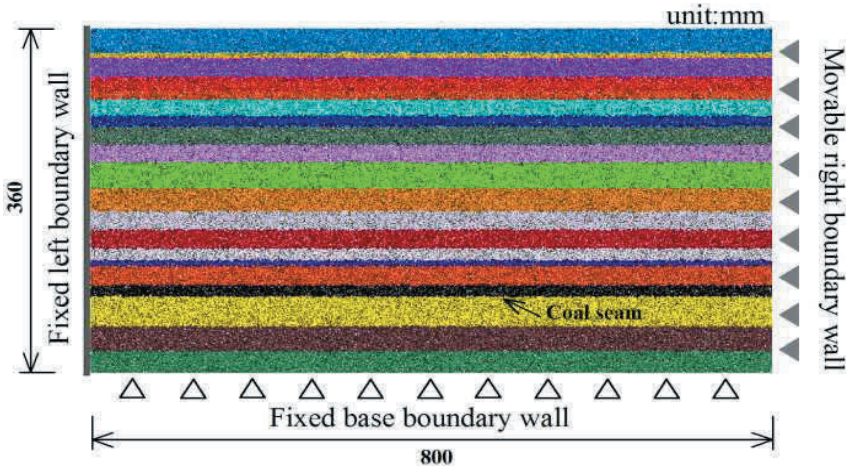


(2) Formation map of normal fault

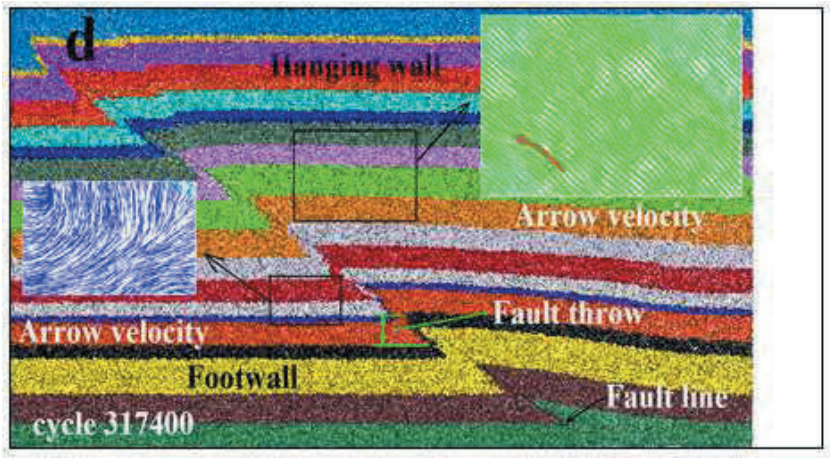


Reverse fault：

(1) Numerical modeling



(2) Formation map of reverse fault



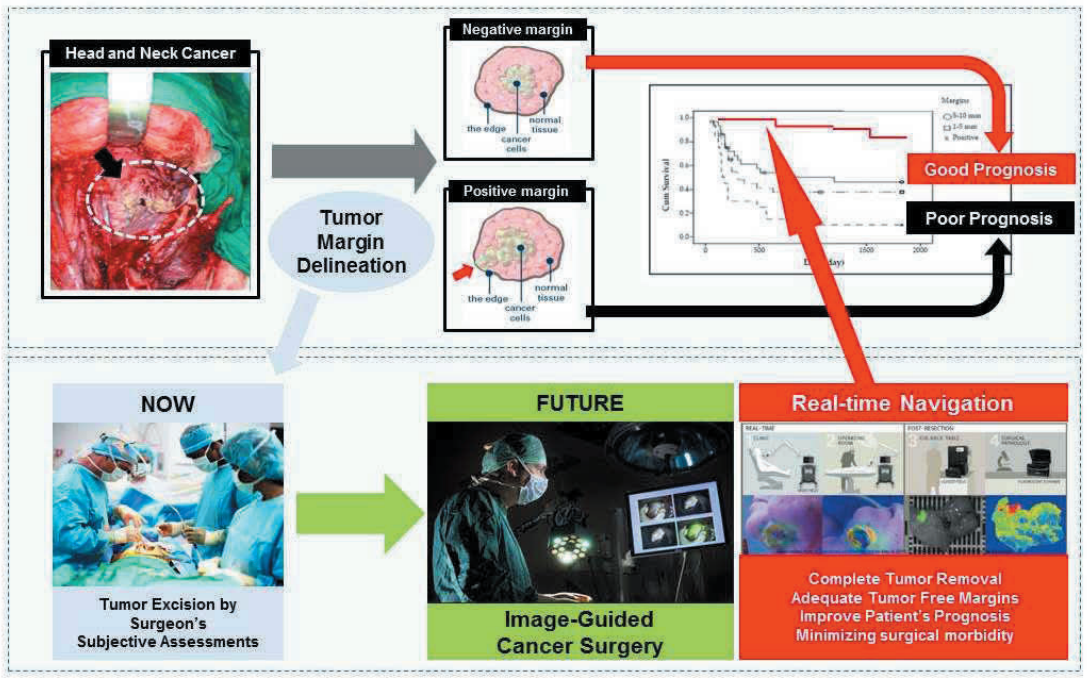


No. 7-4	Establishment of Molecular Bio-Imaging guided Surgical Platform in Head and Neck Cancer based on Precision Medicine Biomarker		
Name	Jihoon Kim (e-mail: jihoonkim0526@yonsei.ac.kr)		
Affiliation	Yonsei University Wonju College of Medicine, Department of Otorhinolaryngology	Title	Clinical Assistant Professor
Research Field	Head and Neck Cancer, Intraoperative imaging		
Period of Internship	September 9, 2019 ~ September 27, 2019		
Host Professor	Ruda Lee (e-mail: aeju-lee@kumamoto-u.ac.jp)		
Affiliation	IROAST	Title	Associate Professor

▸Basic Concepts of Project

- ✓ Head and neck cancer (HNC) is the 6th most common cancer with over 0.6 million newly-diagnosed patients every year worldwide. It is the most aggressive cancer with treatment rate of less than 40%. HNC are the most common cancers in developing countries, especially in Southeast Asia. This is mainly attributed to tobacco, areca nut, alcohol, etc. HNC in the developing world differ from those in the Western world in terms of age, site of disease, etiology, and especially molecular biology.
- ✓ In the head and neck region, there exists a complex network of vital neurovascular structures such as the carotid artery, jugular vein, and cranial nerves which make complete resection of the tumor with preservation of major functions very difficult even for utmost experienced surgeons. Also, in situations where an excessive resection is made, disabilities in vital functions are inevitable, thereby causing a rapid decline in patients' quality of life.
- ✓ If a HNC targeted nanoprobe could induce significant tumor-specific intensity in contrast to normal tissue particularly at the invasive fronts of the tumor, precision resection would be possible without leaving any remnant tumor since the tumor margins could be assessed real-time intraoperatively, thereby positively contributing to the improvement of patients' survival
- ✓ Despite great progress in developing the diagnostic tools to determine the tumor extent of the HNC, there is a lack of intraoperative real time imaging modality. Positive surgical margins have been associated with increased local recurrence and a poor prognosis. Defining the tumor margins is essential for complete removal of the tumor especially in solid tumor
- ✓ Currently, surgeons depend on subjective tactile sense and visual inspection to distinguish tumor margins from adjacent normal tissues, and have at their disposal a few fluorophores with non-targeting potential and unfavorable photophysical characteristics.
- ✓ With the use of fluorescence image-guided surgery, malignancies that evaded easy detection can be illuminated in real-time in the operating room. Robust detection of cancer tissue, directed by sensitive and specific HNC biomarkers, will eliminate reliance on nonspecific visual cues and tactile differences to distinguish malignant from normal tissues.
- ✓ With the development of fluorophores with improved physicochemical and HNC-targeting properties, surgeons could soon achieve sensitive and specific intraoperative cancer detection with improving patient's survival.
- ✓ Owing to the novelty of real-time fluorescent cancer detection strategies, many implementation barriers remain, including the feasibility of clinical applications, regulatory challenges, and considerations regarding clinical trial design. Thus, multidisciplinary collaboration between experts will be required to develop, translate, and realize the full clinical potential of fluorescent cancer detection.
- ✓ Bilateral collaboration between Korea and Japan as world leading countries in HNC research is very important to develop novel HNC biomarker targeted nano-sensors. When targeting a HNC specific biomarker, it has the potential to traverse the gap between preoperative radiology and surgery by providing real-time visualization of the tumor tissue. As a result, we are going to make a fluorescently labelled,

molecularly HNC targeted nano-sensor that would provide real-time, intra-operative distinction of the molecular edge between cancer and adjacent normal tissue.



▸Acknowledgements

First of all, I'd like to express my sincere thanks to my supervisor, Professor *Ruda Lee* for the significant support with the greatest care and valuable advice despite his busiest schedules. Her guidance provided me necessary insight into the research problem and paved the way for the meaningful ending the work in a short duration. I have no hesitation to say that, without her constant support and valuable advice from time-to-time, I would probably fail to complete the work in an appropriate manner.

My special gratitude goes to *Minwoo Kim* for his meticulous supervision to carry out the experiment. I respect and thank *Dr. Takashi HIYAMA*, Director of IROAST, for providing me an opportunity to do the project work in IROAST. I would also like to express my excessive thanks to *Shoko MURAO* for her excellent support and proper guidance in completing my internship program. I am also thankful all other departmental heads and office staffs of IROAST for their sincere co-operation and support for giving me the opportunity and always help and support me.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

Thanks for all your encouragement.

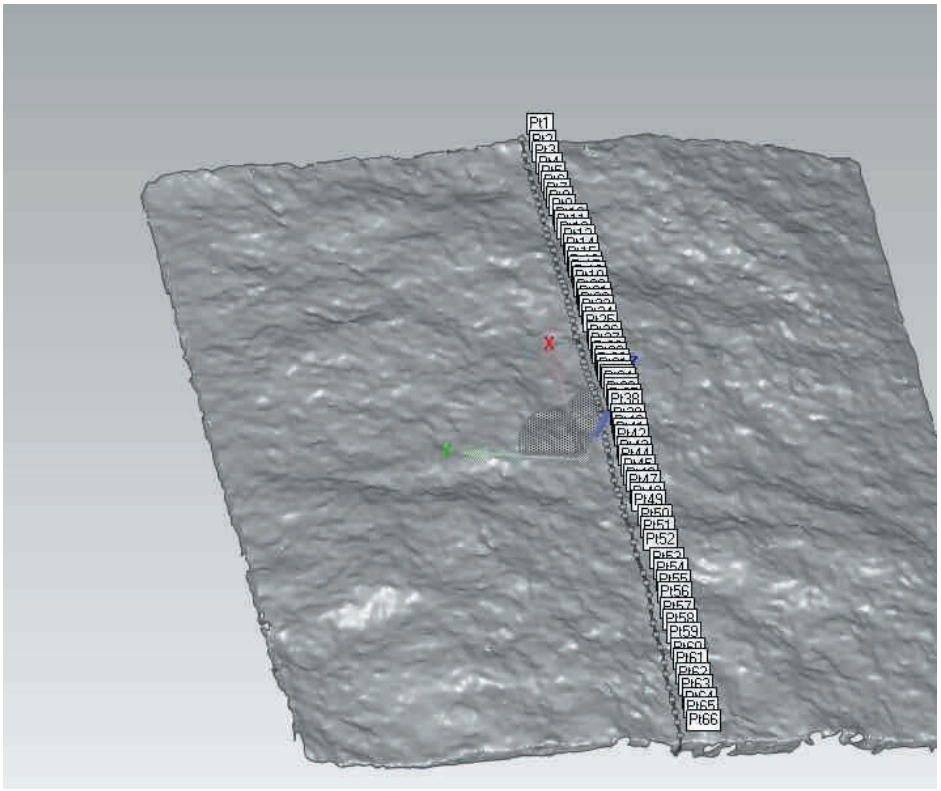
No. 7-5	Dynamic analysis of the rock burst potential induced by fault-slip		
Name	Peng Kong		
Affiliation	Shandong University of Science and Technology Email: 17854859770@163.com	Status	Graduate Student
Research Field	Green Energy		
Period of Internship	October 15, 2019-December 16, 2019		
Host Professor	Atsushi Sainoki		
Affiliation	IROAST Email: atsushi_sainoki@kumamoto-u.ac.jp	Title	Associate Professor

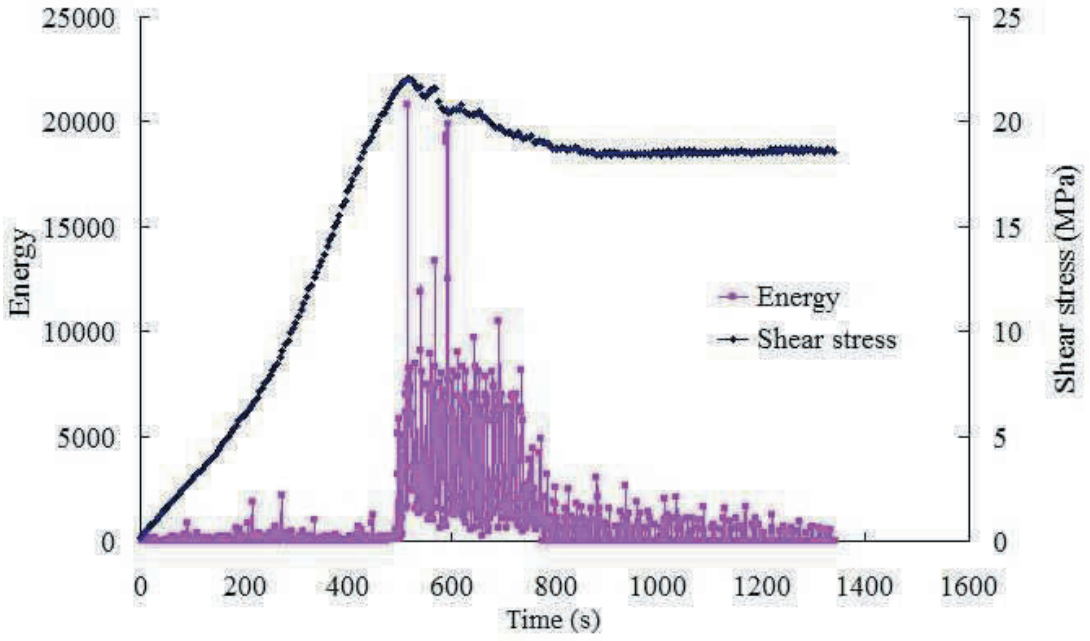
I am honored to be able to come to Kumamoto University for pursuing study from which I have learned a lot during this time not only the research skills but the Japanese culture. What's more important, I gradually realize what the significance of doing academic research is, so thank you very much to Kumamoto University teachers and lab classmates.

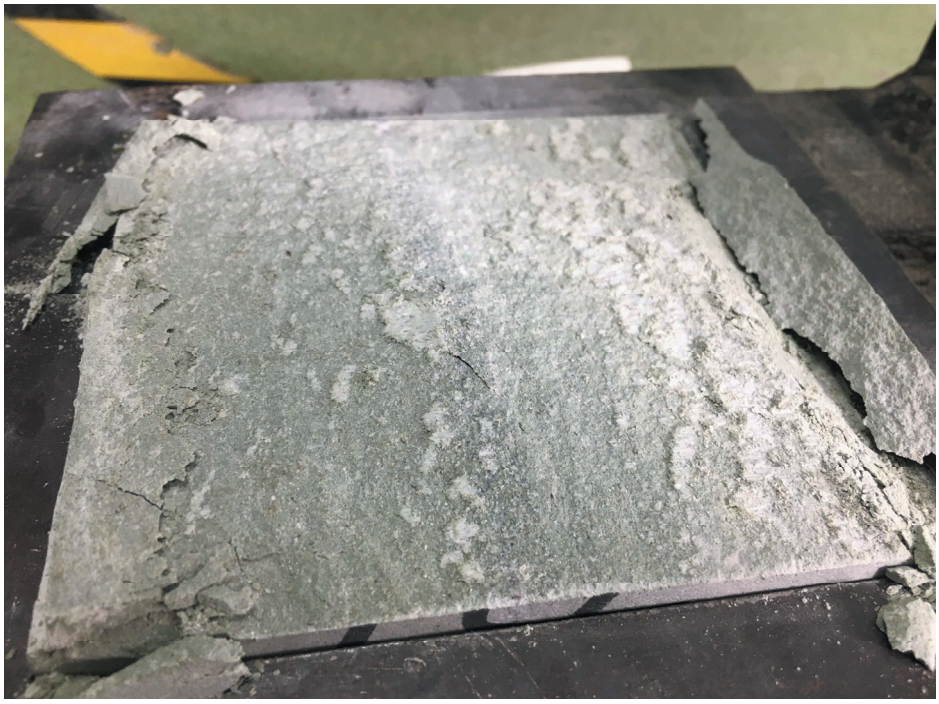
Under the guidance of Professor Atsushi, we have designed a specific test scheme for the direct shear test of prefabricated structural rock masses, taking the normal stress and shear rate on the structural surface damage, shear strength and acoustic emission in the direct shear test into account. The test results show that the normal stress and shear rate will significantly affect the shear strength of the structural surface, the morphological characteristics of the structural surface, and the acoustic emission characteristics. But the influence of shear rate is less than that of normal stress.

The 3D laser scanner was conducted to scan the morphological features before and after the shearing of the structural surface. The scanning results can provide a basis for quantitative study on the shear damage law of the structural surface under the influence of different roughness, normal stress and shear rate. The characteristics of acoustic emission changes under different normal stress and shear rate conditions have been analyzed. The results show that both normal stress and shear rate have a significant impact on the b value of the acoustic emission data. Therefore, the b value can be regarded as a structural surface warning for rock bursts, the research conclusions have great significance for early warning of ground pressure induced by mining-induced fault slip.

In the future time, I will conduct further research with Professor Atsushi on fault slip rock bursts. Three-dimensional laser scanning of prefabricated structural rock sample data can provide a basis for numerical simulation of the shear behavior characteristics of structural planes, thereby saving test costs and improving the stability and reliability of test data. Therefore, PFC software can be considered as an approach to carry out shear numerical simulation experiments on rough structural surfaces. The development of a numerical simulation calculation method considering the influence of the shear rate of the structural plane can simulate fault slip rock burst more reasonably.


Pt1
Pt66


25000
20000
15000
10000
5000
0
Energy
25
20
15
10
5
0
Shear stress (MPa)
0
200
400
600
800
1000
1200
1400
1600
Time (s)
Energy
Shear stress





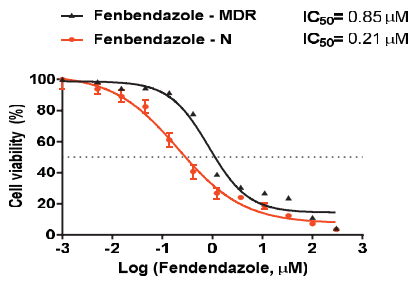
No. 7-6	Treatment of A549 lung cancer cells using Albendazole and Fenbendazole		
Name	Su-Bin Lee		
Affiliation	Technical University of Hamburg, Germany Email: subin424@aol.com	Status	Undergraduate Student
Research Field	Nanomaterial Science		
Period of Internship	January 6-February 28, 2020		
Host Professor	Ruda Lee		
Affiliation	IROAST Email: aeju-lee@kumamoto-u.ac.jp	Title	Professor

I want to thank Prof. Takashi Hiyama and Prof. Ruda Lee for giving me such a great opportunity. I also want to thank Doctor Minwoo Kim for teaching and working with me and all the IROAST staff for supporting me.

During this internship I learned the process of cell seeding, sub culturing and cell counting. These basics were necessary for the further experiments. I worked with A549 normal and multidrug resistant (MDR) lung cancer cells treating them with different drugs to find out which one is the most effective. We worked with Albendazole and Fenbendazole, used for the treatment of parasitic worm infections and also with the chemotherapy treatment Paclitaxel. We combined Fenbendazole with Paclitaxel to see if there is a synergistic effect, which we could proofed. I also learned how to measure cell activity using MTT assay.

As I am an undergraduate student, everything was new and exciting to me. I was able to improve my knowledge and skills. My time at Kumamoto University helped me to figure out what opportunities there are in the future. I also experienced the Japanese culture and met many great new people who made my time here more special.

Thank you very much for everything!



MTT assay – comparison of normal and MDR cells treated with Fenbendazole



Lee Lab

No. 7-7	Near-infrared light-triggered bio-imaging and photodynamic therapy using upconversion nanoparticles		
Name	Song Yeul Lee		
Affiliation	School of Chemical Engineering, Chonnam National University Email: lord_c@naver.com	Status	Graduate Student
Research Field	Advanced Green Bio		
Period of Internship	January 14-February 21, 2020		
Host Professor	Ruda Lee		
Affiliation	IROAST Email: aeju-lee@kumamoto-u.ac.jp	Title	Associate Professor

First of all, I would like to thank IROAST and Professor Ruda Lee for this special and valuable opportunity.

I have studied about synthesizing nanoparticle and its biomedical applications. In particular, I'm working on a dual model that combines the optical properties of upconverted nanoparticles synthesized in my lab with Professor Lee's research. I participated in the Research Internship Program with two research topics. One is to coat nanoparticles with polymer and the other is to coat nanoparticles with the cell membrane. I focused on determining experimental conditions during the internship because each experiment is in its infancy.

For polymer coating experiments, we selected specific solvents for the experiment from a variety of solvents and determined the temperature conditions for the experiment. Besides, experiments were conducted to control the number of nanoparticles contained in polymer particles made by adjusting the concentration of nanoparticles. Coating experiments with cell membranes were carried out using an extruder. The conditions of nanoparticles coated with membranes were examined by adjusting the pore size of the filter. During each experiment, I learned how to use the instrument to measure DLS and zeta potential and learned what each data means. Also, I had the opportunity to see the process of cell culture and cell viability tests. I had a meaningful time to discuss how the nanoparticles in the cell.

I plan to continue my experiment here in Korea. I will continue to discuss the experiment with Professor Ruda Lee and will proceed to in vivo experiments using the nanoparticles made. Finally, my goal is to obtain quality data and publish a paper in an international journal. It was a short time, but my experience at Kumamoto University was a good experience to refresh me.

No. 7-8	Isolation of Bioactive Natural Product Derived Compounds from Adina *sp*		
Name	Listiana Oktavia		
Affiliation	Research Center for Chemistry, Indonesian Institute of Sciences (LIPI) Email: oktavialisti@gmail.com/list004@lipi.go.id	Status	Junior Researcher
Research Field	Organic Chemistry		
Period of Internship	December 16, 2019-January 30, 2020		
Host Professor	Hayato Ishikawa		
Affiliation	Faculty of Advanced Science and Techonology Email: h_ishikawa@kumamoto-u.ac.jp	Title	Professor

1. Details of activities

The IROAST research internship program gives me a chance to have more experience in doing research on isolation of bio-active compound from natural resources. An Indonesian plant, *Adina sp* (rubiaceae family) was investigated for its content of indole-alkaloid and other bioactive compounds. The separations techniques such as open column chromatography, high performance chromatography and size exclusion chromatography with several mobile phase combination were applied to get the compound of interest. The NMR and ESI-MS analysis were used to confirm the structure of isolated compounds. After sequential separation processes, 2 pure compounds were isolated with the first isolated one is identified as sweroside (iridoids group compounds). The structure of later isolated one is still not fully understood. The detail of the research project established during my research internship period is described at the following session.

1. 1 Background of research

Natural products and their derivatives have been widely known for many years as a source of therapeutic agents representing a vast diversity of fascinating molecule configuration [1]. Natural product resources ranging from plants, animal and microorganism have been widely known to produce a large variety of biologically active compound[2]. One of source of bulk bioactive compounds is rubiaceae family. According to the previous reports[3–5], the rubiaceace family contains pharmacologically active compounds such as iridoids, indole alkaloids, anthraquinones, terpenoids (diterpenes and triterpenes), flavonoids and other phenolic derivatives. The exploration of chemical diversity in the rubiaceae family enables us to expand the chemical structure directory with hopefully can lead to discover a newly active compound. *Adina sp* is higher plant that belong to rubiaceae family. This plant was traditionally used as medicine for treatment of fever, febrility, ear pain, cold, bones and joints pain, joint pain and other conditions. The knowledge regarding the bioactive compound is interesting to be known for the further development.

1.2 Research methodology

1.2.1 Isolation procedure

The methanol extract of *Adina sp* (12.09) was fractionated sequentially by hexane, ethyl acetate, butanol and water resulting 4 fractions with mass 0.2269 mg, 1.9691mg, 3.891 mg and

2.9559 respectively. The butanol fraction (1.0359 g) was then picked for the further separation by reversed phase open Column Chromatography (CC) with C18 as a stationary phase and gradient solvent polarity from polar to the non-polar solvent (water : acetonitrile 4:1, 3:1 and methanol) were applied as the mobile phase. This separation resulted 4 fractions (B1-B4) which continued separation by the normal phase for the B1 fraction (0.28079 g). The normal phase CC was used silica as a stationary phase and chloroform: methanol with ratio of 10:1, 6:1 and 4:1. Six fractions (B11-B16) were produced during the later column. The pure sweroside was obtained after B14 fraction was separation by HPLC (CAPCELLPAK C18 (size 20 mm I.D x 250 mm) equipped with water:methanol in ratio 80:20; 60:40; and 0:100 as solvent system. The pure sweroside (14 mg) was obtained after removing solvent under reduced pressure.

The second pure compound was isolated from B16 fraction by reversed CC followed by preparative TLC using silica plate. The solvent system for the reversed CC was water: methanol 2:1 followed by washing with methanol. The preparative TLC was conducted by administering chloroform: water 5:2 as a mobile phase.

Thin layer chromatography (TLC) was performed to monitor the separation process and to preliminary confirm the purity of separated mixture.

1.2.2 Spectroscopic analysis

The H-NMR spectra of all fractions mixtures and pure compounds were recorded by JEOL NMR Spectrometer 500 MHz with CD_3OD was used as solvent. The pure compound was also analyzed by C13-NMR for the structure elucidation. The molecular weight data for the pure compounds were collected from LCMS-2020 (Shimadzu)

1.3 Result

The butanol fraction was chosen due to the appearance of interesting H-NMR spectra around 7-8 ppm that indicated the hydrogen attached to the aromatic compound. The H-NMR spectra of butanol and water phase showed a crowded chemical shifts around 4-5 ppm that associated with glycosilated compound. The reversed phase CC was subjected to the sample since the high polarity of butanol fraction. The selected mobile phase was chosen after solvent compatibility test for proper separation using TLC technique. The gradient solvent/mobile phase was established since the butanol fraction still contain many compounds. The isolation of natural product compounds requires several step separation techniques with particular mobile system due to narrow polarity properties. Combination of column chromatography followed by further purification led to the isolation of two glycosilated compounds

The structure elucidation of the pure compound was performed by investigating the spectral pattern of the H-NMR, C-NMR and MS analysis (figure 1-2). The experimental data was compared with the reference data. The NMR spectral revealed that the present of glicosidic moieties (δ ^{1}H-NMR 3-4 ppm and δ ^{13}C-NMR 60-70 ppm) and the present of carbon that attached to the ether moieties (105-106 ppm). The elucidation process concludes that the first isolated compound is established as an iridoid compound, ***sweroside*** ($C_{16}H_{22}O_9$) as the chemical structure is depicted in the figure 3. The structure of sweroside was later confirmed by the mass spectroscopy analysis. The [M^{+1}H] ion peak (m/z 359) in the positive ion FAB-MS supported this observation and the molecular mass was consistent with the molecular formula of Sweroside (358 g/mol).

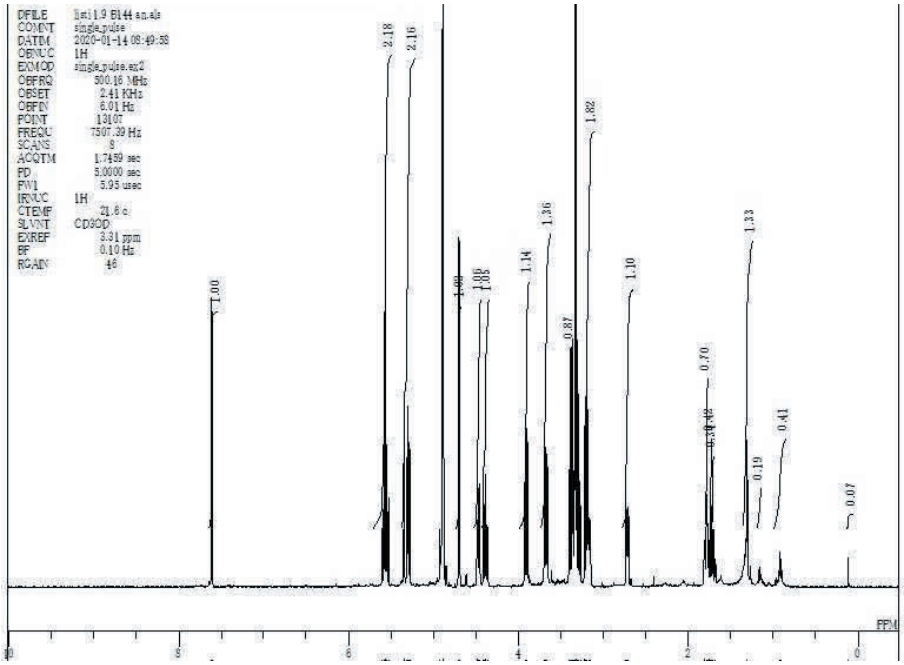


Figure 1. The H-NMR spectra for sweroside. ^{1}H NMR (500 MHZ, CD_3OD) δ 1.708, 1.73, 2.708, 3.177. 3.191, 3.273, 3.31, 3.366, 4.369, 4.459, 4.468, 5.282, 5.314, 5.535, 5.57, 7.612.

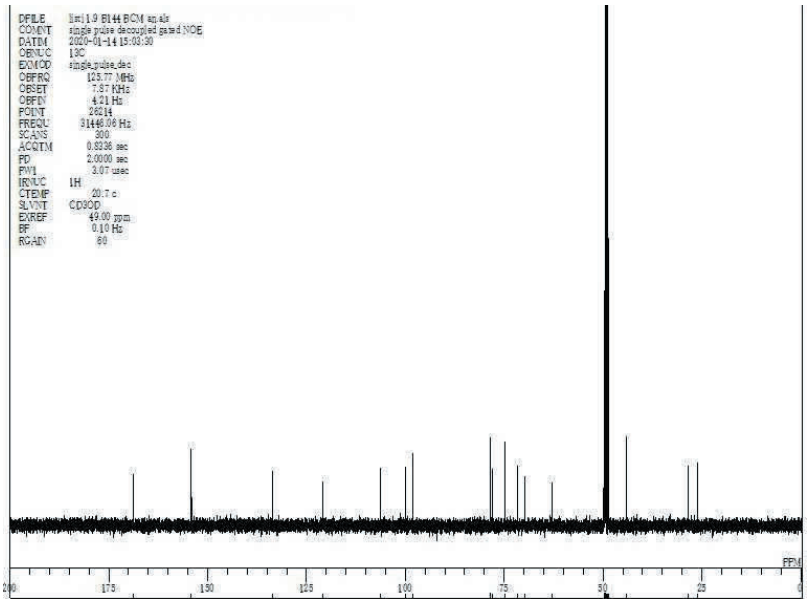


Figure 2. The C-NMR spectra for sweroside. ^{13}C NMR (500 MHZ, CD_3OD) δ 26.089, 28.597, 43.992, 62.821, 69.879, 71,682, 74.878, 78.035, 78,550, 98.122, 99.849, 106.192, 120.995, 133.150, 154.122, 168.687.

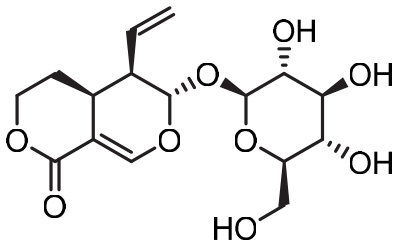


Figure 3. Sweroside structure. ($C_{16}H_{22}O_9$), Mr 358 g/mol.

The second isolated compound coded by B162-b is still under investigation for the chemical structure. The ^{1}H NMR and C^{13} NMR spectra showed the appearance of glycosylated compound. ^{13}C NMR revealed the 18 carbon peak is belong to the B162-b compound and the mass spectroscopy analysis revealed that this compound has molecular weight 486 g/mol.

1.4 Conclusion and Acknowledgement

Two glycosylated compounds were isolated from the methanol extract of Indonesian *Adina sp*. The isolation procedure was used the several chromatography techniques followed by purification method. The first isolated compound was identified as pharmacologically active compound, ***sweroside*** ***($C_{16}H_{22}O_9$)*** with molecular formula 358 mol/mg. The chemical structure was confirmed by the spectroscopy analysis ^{1}H-NMR, ^{13}C-NMR and mass spectroscopy.

This project is fully supported by IROAST program Kumamoto University. The awardee would like to thank to organizing committee of IROAST research internship program and Prof. Hayato Ishikawa that allowed the awardee to perform research training at the Department of Chemistry, Kumamoto University. The awardee would also like to extend the sincere thanks to all member of Organic Chemistry and Natural Product Laboratory for their help, guidance and intense discussion during the internship period.

1.5 References

1. Drahansky, M. *et al.*, Natural Products in Drug Discovery. *Intech open*. 13 (2016).
2. Park, M. N. *et al.* Review of natural product-derived compounds as potent antiglioblastoma drugs. *Biomed Res. Int.* **2017**, (2017).
3. Khazir, J., Mir, B. A., Mir, S. A. & Cowan, D. Natural products as lead compounds in drug discovery. *J. Asian Nat. Prod. Res.* **15**, 764–788 (2013).
4. Paul, J. H. A., Maxwell, A. R. & Reynolds, W. F. Novel bis(monoterpenoid) indole alkaloids from Psychotria bahiensis. *J. Nat. Prod.* **66**, 752–754 (2003).
5. Martins, D. & Nunez, C. V. Secondary metabolites from Rubiaceae species. *Molecules* **20**, 13422–13495 (2015).

1.6 Research experience

During my period of stay in Kumamoto University, I have learned many aspects ranging from the analytical chemistry research skills, the productive research habit, the tremendous discussion with fellow students and professor and obviously i can learn and enjoy the beauty of apanese culture. In term of research skill, during this program, I got the hand-on experience for trying some analytical instruments such us NMR, ESI-MS, HPLC and etc. In addition, this project also sharpen my critical thinking about research on natural product chemistry especially in the part of structure elucidation. The group discussions and work progress seminar held in my host laboratory is undoubtedly wider my perspective and knowledge about this field. Moreover, I am very grateful for having the chance to be supervised by the well-experienced researcher and teacher

in the field of organic chemistry, Prof. Hayato Ishikawa.



Figure 4. **Left:** Discussion session along with Professor H.Ishikawa and fellow students. **Right:** Instrument training session for LCMS and HPLC.

2. Future research plans

The nature constantly mesmerize us with many hidden treasures that remain unexplored. Isolation of bio-active compounds or particularly interested compounds from nature is always interesting as many commercially available biologically active compounds were inspired from the nature. The isolation process enables us to find and develop a complex and structurally engaging compound, therefore, in the future we hope we can build a constructive collaboration regarding exploring the bio-active natural derived compounds from both Japan and Indonesia natural products. In the future, we would like also to continue this research regarding the isolation of indole-alkaloid compounds from Indonesian *Adina sp.* The study of Structure Activity Relationship (SAR) from the isolated compounds are also interested to be explored for enabling us to modify and develop the structure for more versatile functions.

No. 7-9	Protein-Nanoparticles as Drug Carriers for Prokaryotic Cells		
Name	Mona Pakdel		
Affiliation	Alzahra University, Iran Email: m.pakdel@alzahra.ac.ir	Status	Graduate Student
Research Field	Nanomaterial Science		
Period of Internship	10, 08, 2019 - 11, 13, 2019		
Host Professor	Professor Hamid Hosano		
Affiliation	Institute of Pulsed Power Science Email: hamid@kumamoto-u.ac.jp	Title	Professor

From October 8 till November 13, 2019, I performed an IROAST internship at Kumamoto University. Although it was just 37 days, I could learn several things and made research progress during my stay. In my previous studies, I succeeded in producing a kind of protein nanoparticle from waste materials. After optimizing the nano-protein, I could do some more experiment on it during my internship in Kumamoto University. This experiments had been done with shock wave loading and then sequencing the nanoparticles by mass spectrometry.

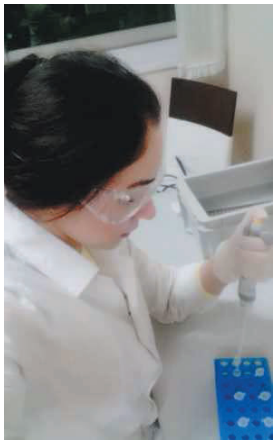
The laboratory where I was doing my experiments was in Bioelectrics Department, Institute of Pulsed Power Science. Since I needed a biochemistry laboratory for producing the nanoparticles, Professor Hamid Hosano and Doctor Nushin Hosano could manage all chemical materials and equipment needed for a biochemistry lab within a week. So I was able to produce the nano-protein with the same quality that I made before. Then we started the shock wave experiment to see the effect of the nano-protein on cancer cells. Besides that we could perform mass spectrometry analysis to obtain its sequence.

We are going to use the protein sequence in the bioinformatics pathway and by Molecular Dynamics (MD) simulation techniques and AGGRESCAN server, we will be able to study the physical movements of atoms and molecules and then design the nanoparticle as a drug deliver, especially for human cancer treatment.

While traveling to Japan, I was able to get acquainted with the beautiful culture and customs of this country in addition to progressing in the thesis. I think the most remarkable feature of Kumamoto city is its kind people. Moreover, I enjoyed glorious weather and delicious food. It was my pleasure to have the internship in Kumamoto University.



Ms. Pakdel, Prof. Hosano, Director Hiyama



No. 7-10	Numerical study of a vertical closed loop double pipe geothermal heat exchange system		
Name	Sajjan Pokhrel		
Affiliation	The University of British Columbia, Canada Email: sajjan.pokhrel@hotmail.com	Status	Graduate Student
Research Field	Green Energy		
Period of Internship	February 3-March 31, 2020		
Host Professor	Atsushi Sainoki		
Affiliation	IROAST Email: atsushi_sainoki@kumamoto-u.ac.jp	Title	Associate Professor

Research background and objectives

To decrease the dependency upon hazardous nuclear power plants as a source of electricity and to address the global warming concern, Japan is aiming to increase renewable energy generation up to 24 % of its total energy demand by 2030 [1]. Kumamoto prefecture is well poised to benefit from high quality geothermal energy – a stable and renewable source which could help the country to overcome this challenge. This research internship is about the numerical simulation of ground-coupled heat exchanger system for a novel geothermal power generation method. Closed-loop vertical double pipe ground heat exchanger is used for heat extraction from the ground. The proposed geothermal system is a recycling-type where surface water is used as a heat transfer fluid and is recycled continuously. Recycling type geothermal power generation is an eco-friendly system compared to conventional geothermal system which uses ground water to operate the power plant. A detailed numerical model to replicate the experimental set-up is developed which will be used in validating the experimental data and optimizing the system. Listed below are the specific objectives to accomplish this research task:

- To develop the accurate model of the vertical double pipe heat exchanger system followed by model discretization.
- To develop the numerical simulation of the fluid flow and heat transfer of the system and validate using experimental temperature data.
- To study the rate of heat extraction, outlet fluid temperature, thermal conductivity of ground, and their effect on the performance of the system.
- To simulate over different operating conditions to improve the effectiveness of heat exchanger.

Details of activities

Geometry generation

The first step in the numerical simulation is the geometry modeling. The real scale geometry is generated in SolidWorks based on the dimensions obtained from Obayashi Corporation's report. The depth of the borehole is 500m. To include the heat transfer effect of ground, depth of geometry is extended to 600m. Figure 1 gives the clear picture of the geometry and all the parts included in the geometry. The outermost part of the domain is rectangular in shape which constitutes all other parts at its center. Total of five different zones are present in the geometry. They are: ground, cement fillings, conductor pipe, insulator pipe, and fluid domain.

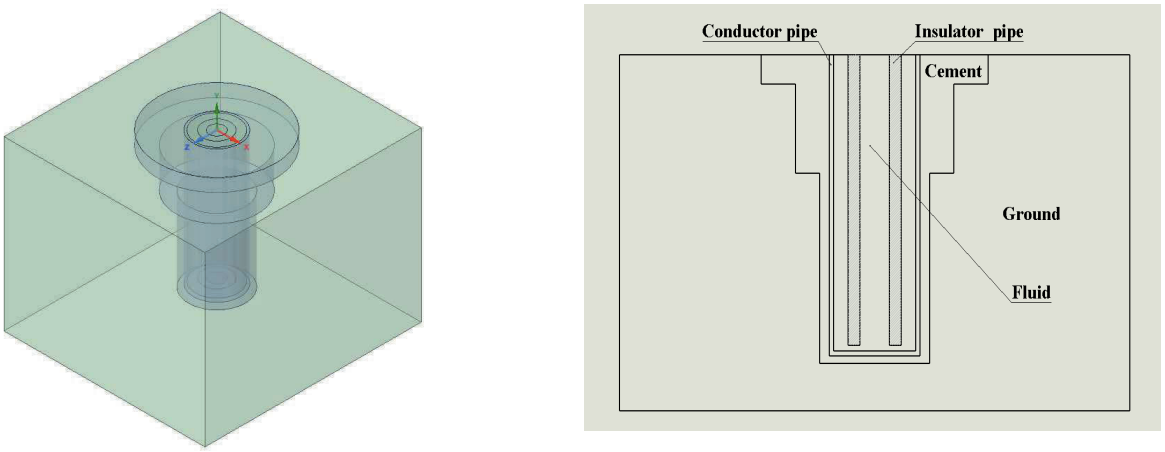


Figure 1: Isometric view and cross-sectional view of the geometry (not in scale)

Heat Transfer Fluid (HTF), water, is fed in from the insulator pipe and reaches to the bottom of the ground. After it reaches the bottom, it comes to the surface from the channel in between the insulator pipe and conductor pipe. Insulator pipe has low thermal conductivity while conductor pipe has high thermal conductivity via which thermal energy from ground is transferred to the HTF. Inlet and outlet temperature of the fluid are measured to observe the effectiveness of the system. In addition, temperature variation of the ground over time period illustrates the sustainability of the project.

Mesh generation

Next step is mesh generation where entire domain is split into smaller subdomains. Navier-Stokes equations along with energy equation will be discretized and solved inside each of these subdomains using finite volume numerical method. Before meshing, geometry is divided into two equal halves along the vertical axis. This would reduce the number of mesh element counts by half and also the corresponding computational time. ICEM CFD is used to generate hexahedral mesh using blocking technology. Figure 2 portrays the geometry and associated blocking image while figure 3 is the generated hexahedral mesh.

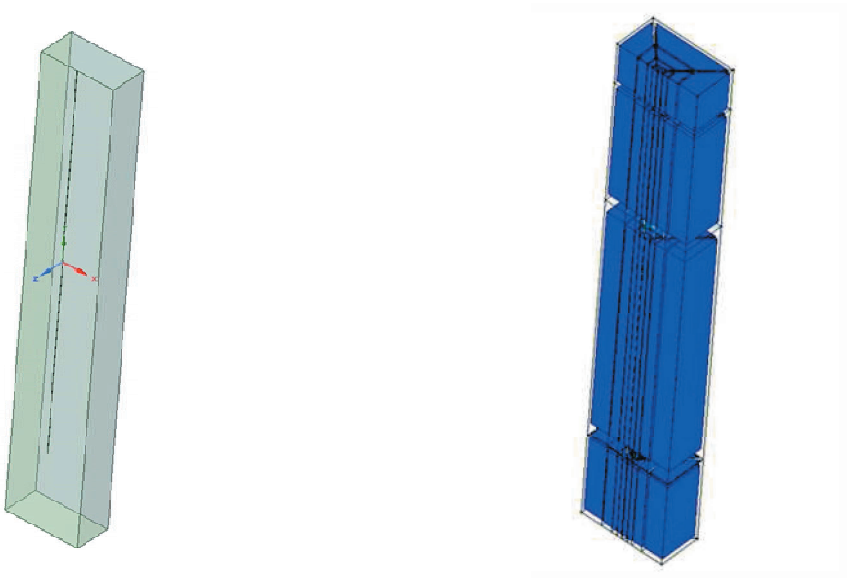


Figure 2: Full scale symmetric geometry and blocking in ICEM CFD

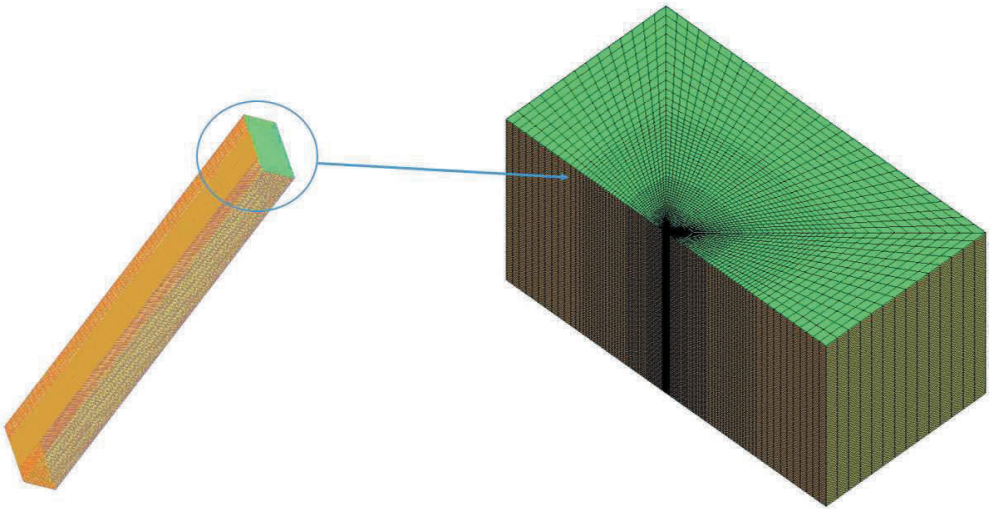


Figure 3: Generated hexahedral mesh

Simulation set up

After mesh generation is complete, it is imported to ANSYS Fluent for numerical set-up. Considering nature of incompressible flow, pressure-based solver is chosen along with transient formulation of time. For initial stage simulation, standard K-Epsilon model with enhanced wall function is selected to model the turbulence in the flow. Different cell-zones are defined for different materials are used. Different material properties of assigned material are listed in table 1. Temperature distribution profile obtained from experimental test is used as an initial condition temperature distribution profile. A User Defined Function (UDF) is written to implement this initial condition which is mentioned in the Appendix of this report.

Table 1: Material properties used in the simulation

S.N.	Cell zone name (Material)	Density	Specific heat	Thermal Conductivity	Data source
1	Water	-	-	-	Fluent library
2	Insulated inner pipe	5,240	310	0.05	Reference [2]
3	Conductor pipe	7,850	470	46.1	Standard Steel
4	Cement	1,830	1,900	0.99	Reference [3]
5	Ground	2,490	1,100	2.0	Volcanic rock [2]

Current status of research and future research plans

Currently, first numerical set-up is simulating and the results are yet to be obtained. At the same time multiple meshes of different mesh sizes are being generated to test the mesh independency of the domain. After mesh independency test, results from the simulation will be validated with

the experimental ones. To go further, parametric study will be done altering different parameters of the simulation to optimize the system.

Acknowledgement

I would like to thank IROAST and my host professor Atsushi Sainoki for providing me a wonderful opportunity to conduct research in Japan. I would like to extend my gratitude to Kumamoto University and its staffs for making my stay enjoyable and memorable. I would also like to thank my supervisor Ali G. Madiseh from UBC and Agus Sasmito for their valuable guidance during the period.

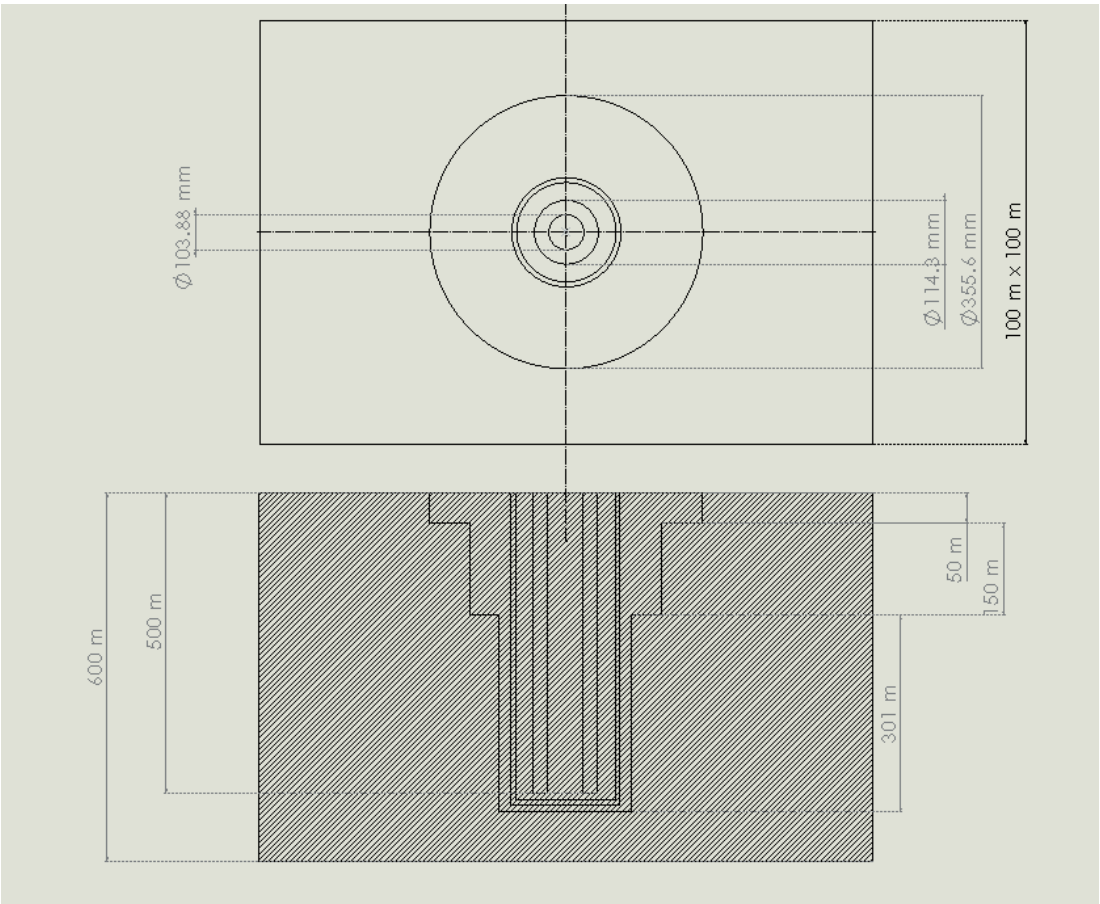
References

[1] T. Tosha, T. Yoshinaga, and M. Yokoya, "Current Geothermal Development in Kumamoto Prefecture , Central Kyushu Island , Japan," vol. 2030, no. March 2018, pp. 1–9, 2020.

[2] Obayashi Corporation, "Guided technology development and demonstration project to strengthen measures to reduce CO2 emissions: Demonstration of 'hydrothermal circulation power generation', a new geothermal power generation method," 2019.

[3] K. MORITA, F. MIZOGAMI, and W. S. BOLLMEIER, "Analysis of the Results from the Proof of Concept Experiment in Hawaii," *J. Geotherm. Res. Soc. Japan*, vol. 15, no. 3, pp. 275–303, 1993.

APPENDIX A: Geometry with dimensions



APPENDIX B: UDF to define initial temperature condition

```
#include "udf.h"
DEFINE_INIT(my_init_func, d)
```

```
{
        cell_t c;
        Thread *t;
        real xc[ND_ND]; /*location vector*/
        real x; /*depth*/
        thread_loop_c(t, d)
        {
          begin_c_loop(c, t)
                {
        if (THREAD_ID (t) == 44 || THREAD_ID (t) == 45 || THREAD_ID (t) == 46 )
                        {
                  C_CENTROID(xc, c, t); /*centroid of the cell*/
                        x = xc[1];
                        if(x>=100)
                                { C_T(c, t) = -0.0119 * pow(x,2) +3.3011 * x +251.51; }
                        else if (x>=0)
                                {C_T(c, t) = 0.0014 * pow(x,2) + 0.1061 * x + 448.06;}
                        else if (x>=-50)
                                {C_T(c, t) = 447.15;}
                        Else
                             {C_T(c, t) = 0.0003 * pow(x,2) - 0.1275 * x + 439.25;}
                          }
                      }
                end_c_loop(c, t)
        }
}
```

No. 7-11	Heat transfer enhancement in heat pipe using copper porous microstructure		
Name	Reetesh Tiwari		
Affiliation	Vel Tech Rangarajan & Dr. Sagunthala R&D Institute of Science & Technology, India Email: vtu7650@veltechuniv.edu.in	Status	Undergraduate Student
Research Field	Nanomaterial Science		
Period of Internship	December 2-March 27, 2020		
Host Professor	Shuichi Torii		
Affiliation	Faculty of Advanced Science and Technology Email: torii@mech.kumamoto-u.ac.jp	Title	Professor

Abstract

In this project, Heat transfer enhancement in heat pipe using copper porous microstructure is been carried out micro porous structure is made using electroplating the stainless-steel pipe 10 cm electroplating at the heating section is been done and the electroplating is very rough so that the heat transfer is very efficient.

Introduction

What is heat pipe? Heat pipe is a device that can transfer heat by phase change between two surfaces. At first, the evaporator section's working fluid absorbs heat and evaporate at the heater then, the vapor travels to the condenser section release heat and condense to liquid at last, they will return to the evaporator section by gravity or capillary force. This is the working cycle for heat pipe. The advantage of heat pipe is that it has high thermal conductivity, which was 250 times of copper. and that's why it was also called as the superconductor of heat. and then, heat pipe is also famous as its long life and it almost don't need any maintenance. It is also very light, cheap and easy to manufacture and at last, it doesn't need any power to keep it working Though heat pipe was invented in 1942, but it didn't use widely until the personal computer was invented. Because the heat generated from the chip are unable to dissipate by traditional way now, heat pipe has widely used in several electronic devices, such as cell phones, computers, air conditioner or many other electronic devices though it is already a superconductor of heat, as the advance of technology, we still need to enhance its thermal performance especially for the 5th generation mobile network 5th generation mobile network is almost 100 faster than the previous one, which also means that it will generate much more heat than the previous one

Literature Survey

In these 15 years, many researches have been done to apply nanofluid in a heat pipe. Many different kinds and sizes of nanofluid has been studied that if it is possible to replace water as working fluid lots of them reduce the resistance successfully but, many researches also realized that the main factor cause the decrease of heat pipe's thermal resistance is because of the nanoparticle deposition in the pipe. Nanoparticle deposition seems good for heat pipe's thermal performance, some research also found its disadvantage. If the heat pipe working for a long time with nanofluid as working fluid, the deposition inside the pipe will too much and increase the

thermal resistance of the heat pipe.

researcher	nanofluid	size	enhancement	year
S.W.Kang	Ag	10nm 35nm	52% 81%	2006
Kyu Hung Do	Al_2O_3	30nm	40%	2010
Madhusree.Kole	Cu	40nm	27%	2013
S.Venkatachalapathy	CuO	40nm	23.83%	2015
Kyung Mo Kim	GO	350nm	25%	2015

Methodology

The object of this experiment is to make another porous structure inside the heat pipe but without nanoparticle deposition. The method we choose in this experiment is hydrogen code position copper electroplating. the experiment material we used is a solution with 0.15M $CuSO_4$ and 1M H_2SO_4. Copper tube, stainless pipe and DC power supply. In this experiment, the electroplating length will be 10 cm which is also the evaporator section of this heat pipe. since the ionization constant will increase with temperature, if the solution temperature increased, the hydrogen ion in the solution will increase and cause more hydrogen to form during the electroplating process. so, in this experiment, we prepared two samples with different solution temperature the procedure of the electroplating is

First, plate the pipe with 0.5 voltage for 3 mins. The purpose of this step is to make a basement for step two to combine with Because of the force between copper and stainless is very weak, if we use the high voltage directly, the force will be too weak and the copper can't coat on the surface successfully.

Second, plate the pipe with 8 voltage for 20 mins. The purpose of this step is to make the porous structure. According to the previous research, the hydrogen will be generated with over 1.14 voltage. and it will be more with higher voltage.

Last, plate the pipe with 0.5 voltage for 3 mins. The purpose of this step is to make a cover for the second step. Because the porous structure made at the second step is very weak, we make this cover to protect the porous structure's surface from falling off. the experiment procedure is

Now, fill the uncoated pipe with 5ml distilled water as working fluid Reduce the pressure to 0.01Mpa Measure its surface temperature with 20W, 30W, 40W power input. Change the pipe to sample 1, 2 and redo the experiment.

Sample preparation:

Sample 1: Electroplating under 5°C

Sample 2: Electroplating under 18°C

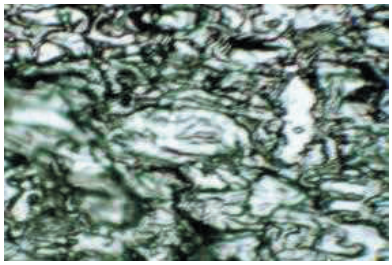
Experimental Condition

This is the experiment condition of the research. There are 9 K-type thermocouples attached on the heat pipe. 4 on evaporator section, 2 on adiabatic section and 3 on condenser section. The initial pressure is 0.01 Mpa. Power input is 20, 30, and 40W. the filling ratio is 26% which is 5ml. working fluid is distilled water. Heat pipe long: 300mm, material: stainless, diameter: 10mm. Evaporator Section (100mm) 4 thermocouple each at 20mm, Adiabatic Section (80mm) 2 thermocouples, Condenser Section (120mm) 3 thermocouples each at 50 mm.

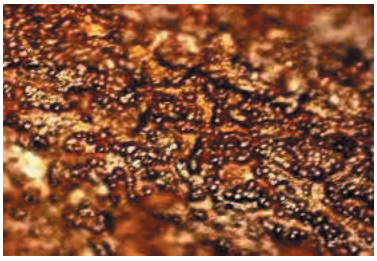
Parameter	Instruments	Uncertainties
Temperature	Thermocouples	1℃
Voltage	Voltmeter	0.3%
Current	Amperometry	0.3%

Result

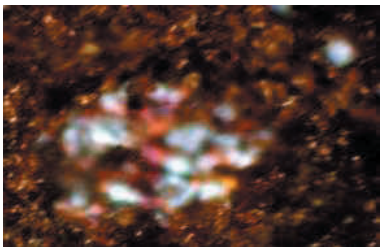
Inner surface optical microscope



Uncoated Pipe

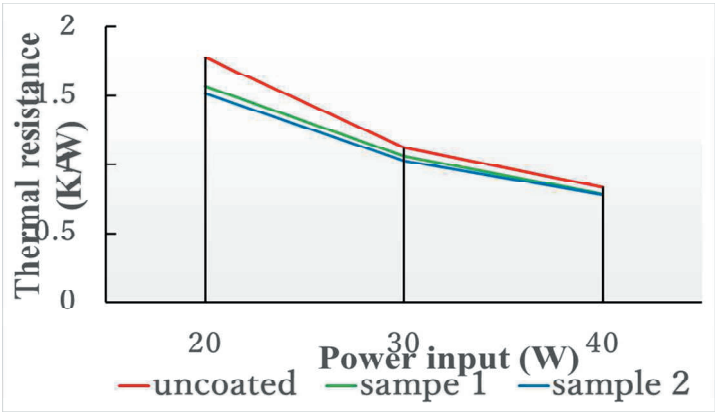


Sample 1



Sample 2

This is the experiment result. The thermal resistance of sample 2 are reduced from 6.4% to 14.6% compared with uncoated heat pipe.



Thermal Resistance

Thermal resistance: $R = \frac{\overline{T_{eva}} - \overline{T_{con}}}{Q}$

Watt	20	30	40
Uncoated	1.78	1.12	0.84
Sample 1	1.58	1.06	0.79
Sample 2	1.52	1.03	0.78

Conclusion

- The copper porous surface was formed inside the pipe by electroplating successfully.
- The thermal resistance of the heat pipes is improved from 5.4% to 11.7% for sample 1.
- The thermal resistance of the heat pipes is improved from 6.4% to 14.6% for sample 2.
- The surface electroplated in a higher solution temperature will have bigger and deeper porous structure.
- The surface with deeper and bigger porous structure will have better thermal performance.

- When the temperature of solution decreases the copper, deposition is in spherical shape but when the temperature increases the shape changes to flakes structure.

Future scopes

- To increase the numbers, depth, size of the nucleation sites on the surface, I need to enhance the hydrogen generated during the electroplating process.
- Increase solution temperature
- Enhance the circulation of the solution
- Increase the voltage of the electroplating
- Increase the time of the electroplating
- Implement this technique into a PTC absorber.

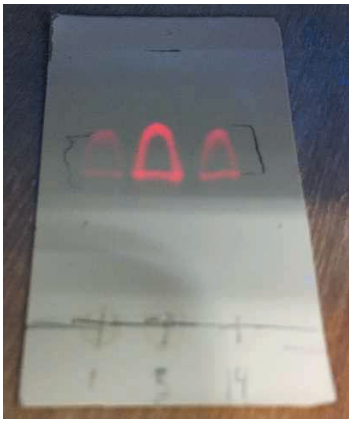
References

- Pool boiling heat transfer of porous structures with reentrant cavities. Daxiang Deng a,⇑, Junyuan Feng b, Qingsong Huang a, Yong Tang b, Yunsong Lian a
- An electroplated copper–silver alloy as antibacterial coating on stainless steel. Nicole Ciacotich, Rameez Ud Din, Jens J. Sloth, Per Møller, Lone Gram.
- Effect of electrolyte temperature on porous electrodeposited copper for pool boiling enhancement. A.M. Gheitaghy, H. Saffari ⇑, D. Ghasimi, A. Ghasemi.
- Enhancement of boiling heat transfer using hydrophilic-hydrophobic mixed surfaces: A lattice Boltzmann study. Q. Li, Y. Yu, P. Zhou, H.J. Yan
- Development of a two-step electrodeposition process for enhancing pool Boiling. Chinmay M. Patil a, K.S.V. Santhanam b, Satish G. Kandlikar a,⇑,1.
- Influence of helix twisted tape on heat transfer and friction factor in forced circulation V-trough solar water heater. A. Saravanan, J. S. Senthilkumaar, S. Jaisankar & J. Ananth.
- Wettability modification to further enhance the pool boiling performance of the micro nano bi-porous copper surface structure. Ya-Qiao Wang, Jia-Li Luo, Yi Heng, Dong-Chuan Mo⇑, Shu-Shen Lyu.

No. 7-12	Chirality-driven photoelectrochemical reaction: Preparation of chiral systems and their properties		
Name	Reid William Wilson		
Affiliation	University of Connecticut, USA Email: reid.wilson@uconn.edu	Status	Undergraduate Student
Research Field	Nanomaterial Science		
Period of Internship	January 7-February 27, 2020		
Host Professor	Yutaka Kuwahara		
Affiliation	Faculty of Advanced Science and Technology Email: kuwahara@kumamoto-u.ac.jp	Title	Assistant Professor

1. Project Overview and Research Achievements

The goal of this project was to prepare, using hydrocarbon chains developed by Kumamoto University, functionalized zinc (Zn)-inserted porphyrin molecular systems, similar to the ones utilized in a publication by Mtangi *et al.*[1] They could control (and prevent) the formation of hydrogen peroxide during water splitting by utilizing chiral active photoelectrochemical Zn-porphyrin systems that highly selective in forming same-spin superoxide radicals.[1] Same-spin radicals are generally unable to react, preventing the formation of hydrogen peroxide. We wanted to observe this phenomena in the hopes of expanding on the idea with alternatively functionalized Zn-porphyrins.



The porphyrin precursor, purchased from Sigma Aldrich, was first purified as there was a significant presence of reaction byproducts that remained in the sample as shipped. Reverse-phase flash chromatography was used to purify over six batches of porphyrin. In total, pure precursor porphyrin was collected from crude porphyrin, confirmed with ^{1}H nuclear magnetic resonance (NMR) spectroscopy. This was the first time I used reverse-phase chromatography to purify a compound.

Following purification, precursor porphyrin was reacted with excess hydrocarbon-chained molecules developed by Kumamoto Univ. to form the similar functionalized porphyrin as used in the study by Mtangi *et al.*[1] The reaction was monitored using thin-layer chromagraph-flame ionization detector (TLC-FID), using a mixture of chloroform ($CHCl_3$), methanol (MeOH) and triethylamine (TEA) as TLC solvent. Here, we took reaction samples over the course of a week and analytically observed the formation of the product. This was the first time I used TLC-FID to monitor a reaction.

A chloroform extraction was then performed. Due to difficulty purifying the porphyrin at this stage (neither normal phase or reverse phase chromatography were suitable), we went ahead to perform the metalation reaction that inserted the zinc atom into the porphyrin center, which reduced the polarity of the porphyrin system further. After purification, the porphyrin would be ready for photoelectrochemical experimentation. The preparation of this porphyrin compound was the first critical step in the overall project.

2. Significance of Research Collaboration with Kumamoto University

Kumamoto University, in Japan, and the University of Connecticut, in the United States, are both global innovators in the area of nanomaterials and share unique research connections. As an undergraduate student at the University of Connecticut, I was introduced to this project by my research professor there, Assistant Professor Tomoyasu Mani. Assistant Professor Mani introduced me to his collaborator Assistant Professor Yutaka Kuwahara of Kumamoto University. Their collaboration introduced a unique opportunity for me to contribute to this project through the generous support of IROAST. This research experience allowed me to learn new chemistry techniques that I've never used before, such as reverse-phase chromatography, TLC-FID and various synthetic techniques, which greatly aided in my preparation to start graduate school in physical chemistry in the United States in the Fall of 2020.

3. Impressions of Kumamoto University and Japan

Throughout the two months I've spent at Kumamoto University, I've been very generously welcomed and helped every step of the way, especially by Assistant Professor Kuwahara. All members of the University have been a great pleasure to work with, including all of the graduate students. This was the first time I visited Japan and I'll leave with a fantastic impression of the country. I was able to explore Kyushu, notably Mt. Aso National Park, the Beppu hot springs, and the great nightlife of Kumamoto City. When I arrive back home in the United States, I'll surely keep Japan close in my continued celebration and respect for their culture, passion for science, and enjoyment of Japanese cuisine.

References:

1) Mtangi, W.; Tassinari, F.; Vankayala, K.; Jentzsch, A.V.; Adelizzi, B.; Palmans, A.R.A.; Fontanesi, C.; Meijer, E.W.; Naaman, R. Control of Electrons' Spin Eliminates Hydrogen Peroxide Formation During Water Splitting. *Journal of American Chemical Society* **2017**, *139*, 2794-2798.

No. 7-13	Pulsed Electromagnetic Field Excitation for Biological Applications		
Name	Zare Farzan		
Affiliation	The University of Queensland, Australia Email: f.zare@uq.net.au	Status	Undergraduate Student
Research Field	Nanomaterial Science/ Green Energy/ Advanced Green Bio		
Period of Internship	December 1, 2019 - January 31, 2020		
Host Professor	Hosano Hamid		
Affiliation	Institute of Pulsed Power Science Email: hosseini@kumamoto-u.ac.jp	Title	Professor

I have been a part of the IROAST internship program from the 2nd of December 2019 until the 31st of January 2020. My research interests and passion are in the field of bioelectrics, specifically how we can improve the quality of life for humans. Within the field, my specialization interests are improved drug delivery to cells, improving the yield of filamentous fungi, and triggering the apoptotic pathway of cancer cells. Under the supervision of Professor Hosano at the institute of pulsed power science (IPPS), I was involved in numerous experiments ranging from recycling of materials, optical test setups using lasers, and synchronization of combinatory pulsed modalities.

With collaboration with Prof. Hosano and my home university, we submitted a paper titled "Increasing the production yield of white oyster mushrooms with pulsed electromagnetic fields" to the *Innovative Food Science and Emerging Technologies* journal and it is currently under review.

Throughout the internship I have also learned to use and setup new devices such as a digital-to-time converter, high power RF generator and amplifier. Moreover, in collaboration with other labs at IPPS, we visited the agricultural PEF lab where I learned about some of the innovative advanced generator designs being employed for various agricultural applications.

To all future IROAST young internship researchers, I advise you to be a part of as many international events as possible and to quickly incorporate yourself into the social culture. I have made some lifelong friends from my stay in Kumamoto and am looking forward to meeting all of them in their home countries.



Future research plans

From what I have learned during my IROAST research internship, my future plan is to apply for the October 2020 or April 2021 Masters and PhD admissions at Kumamoto University. My research interests will be to use pulsed treatment modalities on various cell lines (i.e. HeLa or Jurkat T Lymphocyte) with an accompanying high-speed imaging system. Furthermore, in collaboration with other groups at IPPS and my home university (University of Queensland), I wish to conduct further investigations on the secondary effects of pulsed power on filamentous fungi. I am grateful for the experiences and supervision of my mentor Prof. Hosano and would like to thank the director Prof. Hiyama and all IROAST helpful and accommodating staff for allowing me to be a part of this internship program.

IROAST Symposiums

No.	Title	Organizer	Date
1	5th IROAST Symposium – International Symposium on Strategies on mechanical optimization in plants	**Shinichiro Sawa**	12/05/2019
2	6th IROAST Symposium – 1st Pan Pacific Reverse Monte Carlo Conference	**Shinya Hosokawa** **László Pusztai**	02/20/2020- 02/21/2020

KU-KAIST Joint Symposium

No.	Title	Organizer	Date
1	3rd KU-KAIST Joint Symposium – 6th IRCMS&IROAST Joint Seminar	**Toshio Suda** **Takashi Hiyama**	11/11/2019

IRCMS: International Research Center for Medical Sciences, Kumamoto University

IROAST Symposium Report 1

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Shinichiro Sawa</td></tr>
<tr><td>Affiliation</td><td>Graduate school of Science and Technology</td><td>Title</td><td>Professor</td></tr>
<tr><td>Symposium Title</td><td colspan="4">5th IROAST Symposium – International symposium on Strategies of mechanical optimization in plants</td></tr>
<tr><td>Venue</td><td colspan="4">Rm226, Bldg Science#1</td></tr>
<tr><td>Time & Date</td><td colspan="4">13:45-17:30, December, 5, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Olivier Hamant (ENS Lyon)
Takumi Higaki (Kumamoto Univ.) / Kunita Itsuki (Ryukyu Univ.)
Yoichiro Hosokawa (NAIST)
Haruka Tomobe (Kyoto Univ.)
Masatsugu Toyota (Saitama Univ.)
Yusuke Onoda (Kyoto Univ.)
Ali Ferjani (University of Tokyo)</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 11 (Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">38</td></tr>
<tr><td>Students: 21 (Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 5 (Int'l participants: 1)</td></tr>
<tr><td>Students: 1 (Int'l participants: 0)</td></tr>
</table>

1. Symposium Overview

As environmental and population issues are worsening at the global level, efforts to build up a sustainable society are accelerating. The creation of a sustainable living space, in harmony with the surrounding environment, is one of society's most important endeavors, even in the fields of manufacturing, architectural design, and urban planning.

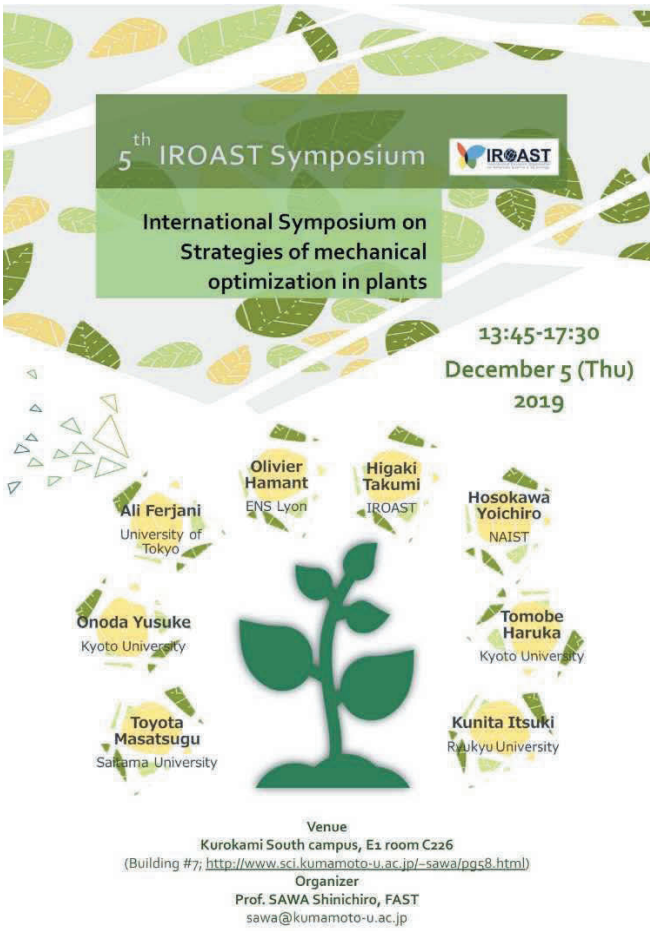
In recent years, approaches in engineering using biomimetics have been pursued. Additionally, studies on plant cell walls have demonstrated that plants are excellent structural systems that autonomously optimize their mechanical properties in response to various environmental factors.

Based on the above background, in this seminar, we discussed to understand the mechanical optimization of plants on a multi-scale (molecular, celluler, tissue, and individual) level.

2. Symposium Outcomes and Future Plan

We could contribute to sublimate the mechanical optimization strategy of plants into new material models, and to create a base for the next-generation of sustainable structural systems.




5th IROAST Symposium
IROAST
International Symposium on Strategies of mechanical optimization in plants
13:45-17:30
December 5 (Thu)
2019
Olivier Hamant
ENS Lyon
Higaki Takumi
IROAST
Ali Ferjani
University of Tokyo
Hosokawa Yoichiro
NAIST
Onoda Yusuke
Kyoto University
Tomobe Haruka
Kyoto University
Toyota Masatsugu
Saitama University
Kunita Itsuki
Ryukyu University
Venue
Kurokami South campus, E1 room C226
(Building #7; http://www.sci.kumamoto-u.ac.jp/~sawa/pg58.html)
Organizer
Prof. SAWA Shinichiro, FAST
sawa@kumamoto-u.ac.jp

IROAST Symposium Report 2

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">HOSOKAWA Shinya</td></tr>
<tr><td>Affiliation</td><td>KU, FAST</td><td>Title</td><td>Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">PUSZTAI László</td></tr>
<tr><td>Affiliation</td><td>IROAST & Wigner RCP, HU</td><td>Title</td><td>Distinguished professor</td></tr>
<tr><td>Symposium Title</td><td colspan="4">6th IROAST Symposium – 1st PanPacific Reverse Monte Carlo Conference</td></tr>
<tr><td>Venue</td><td colspan="4">Rm212, Bldg C8 (20 Februry 2020); 100th Anniversary Hall (21 February)</td></tr>
<tr><td>Time & Date</td><td colspan="4">09:00-18:30, February 20, 2020; 09:00-16:45, February 21, 2020</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation (The names of invited speakers are <u>underlined</u>.)</td><td colspan="4">09:00 Welcome (Professor Takashi HIYAMA, Director, IROAST, Kumamoto University)
09:15 <u>David KEEN</u> (STFC ISIS & Oxford University, UK; !! VIA THE INTERNET !!): Thirty-two years of reverse Monte Carlo (RMC): An introduction and discussion of current practice
09:55 <u>Shinji KOHARA</u> (NIMS, Japan): Understanding diffraction patterns of disordered materials via persistent homology analyses
10:35 Wolf-Christian PILGRIM (Marburg University, Germany): A new highly efficient amorphous molecular white light emitter
11:15 <u>Matthew TUCKER</u> (SNS/ORNL, USA): RMCProfile: RMC for disordered crystalline materials – Difficulties and solutions
11:55 Johnathan BULLED (University of Oxford, UK): Refinement of Nuclear Diffuse Scattering from Short Range Order in Frustrated Binary Alloys using a Heavily Confined RMC approach
12:15 Benjamin KLEE (Marburg University, Germany): Molecular Reverse Monte-Carlo Simulations on Amorphous White-Light Emitting Materials
12:35 Shinya HOSOKAWA (Kumamoto University, Japan): Local structures of chalcogenide glasses investigated by anomalous x-ray scattering and reverse Monte Carlo modeling
14:15 <u>Alexei KUZMIN</u> (University of Latvia): X-ray absorption spectroscopy of functional materials, aided by atomistic simulations
14:55 Fabio IESARI (Saga Light Source, Japan): Analysis of EXAFS by RMC and Sparse Modeling
15:25 Szilvia POTHOCZKI (Wigner Research Centre, Hungary): Limitations of fixed neighbour constraints
15:45 Imre BAKÓ (Research Centre for Natural Sciences, Hungary): Uncertainty in evaluating results of neutron diffraction experiments with isotopic substitution
16:30 Yukinobu KAWAKITA (J-PARC, Japan): Time-space correlation function of liquid metals from coherent quasi-elastic neutron scattering
16:50 Robert McGREEVY (ISIS, STFC, UK; !! VIA THE INTERNET !!): Imaging <–> Modelling
17:10 László PUSZTAI (Kumamoto University, Japan & Wigner Research Centre, Hungary): Consistency checks between results of computer simulations and diffraction experiments
17:45 Posters
19:00 Social Event (FORICO cafeteria)</td></tr>
</table>

21 February (Friday) ***'100th Anniversary' Hall))***

09:00 ***Andrew GOODWIN*** (Oxford University, UK): *(R)MC analysis of 3D diffuse scattering: opportunities and challenges*

09:40 ***Martin DOVE*** (Queen Mary University of London, UK) *RMC studies of orientational disorder in molecular crystals from neutron scattering data*

10:20 ***Ella SCHMIDT*** (Oxford University, UK): *Exploring possibilities for RMC modelling for single crystal diffuse scattering in molecular materials*

10:40 ***Philip WELCH*** (Oxford University, UK): *Using reverse and direct Monte Carlo to study frustration effects in triangular Ising antiferromagnets*

11:20 ***Pál JÓVÁRI*** (Wigner Research Centre, Hungary): *Difficulties in structure determination of metallic glasses: the case of $Pd_{40}Ni_{40}P_{20}$*

12:00 ***Yohei ONODERA*** (Kyoto University, Japan): *Extraction of structural features for mixed alkali effect in silicate glas s*

12:20 ***Jens STELLHORN*** (Hiroshima University, Japan): *RMC modeling of the exotic phase change material Cu_2GeTe_3*

12:40 ***Akihide KOURA*** (Kumamoto University) *Ab initio molecular dynamics study of the structure of amorphous Mg-Zn-Y alloy*

14:00 ***László TEMLEITNER*** (Wigner Research Centre, Hungary): *Atomistic modeling of disorder in crystalline systems using the RMCPOW method*

14:40 ***Hiroko YOKOTA*** (Chiba University, Japan): *Combined local and average structural analysis on piezoelectric $PbZr_{(1-x)}Ti_xO_3$*

15:40 ***Osamu YAMAMURO*** (Tokyo University, Japan): *Glass transition of simple molecular liquids and related local structural development studied by X-ray diffraction*

16:00 ***Masanori INUI*** (Hiroshima University): *Large and Small Angle X-ray Scattering Measurements for fluid Se at high temperatures and high pressures and reverse Monte Carlo modeling*

16:25 ***Martin DOVE*** (QMUL, UK): *Closing remarks*

Number of Participants	From KU	Faculty: 5 (Int'l participants: 1)	Total	38
		Students: 4 (Int'l participants: 0)		
	From outside KU	Faculty: 18 (Int'l participants: 11)		
		Students: 11 (Int'l participants: 5)		

1. Symposium Overview

The main purpose was: discussing current issues concerning the Reverse Monte Carlo (MC) method of structural modeling. The method is applicable to liquids, amorphous materials and (disordered) crystals (including nanocrystals).

There were 8 invited talks (40 mins), and an additional 19 contributed talks (20 mins). A poster session was also held (8 posters were presented).

There is a sizeable community in Japan (certainly more than 100 researchers) who use this (and/or one of the closely related) computational method(s). The symposium therefore provided a unique opportunity for them to meet each other, as well as world leading experts.

The Reverse Monte Carlo method of structural modeling (McGreevy&Pusztai, Molecular Simulation 1, 359 (1988)) has become a rather widely used method for the determination of the atomic level structure of liquids, amorphous materials and realistic (i.e., non-perfect) crystals, including

nanocrystals. As for the impact of the development, the original publication has received 1200+ independent citations, and already 7 RMC conferences have been organized (6 of which by L. Pusztai in Budapest, Hungary), in which events Japanese participation has always been significant.

In these 'traditional' RMC meetings (the last of which, RMC-7, took place between 20-22 September, 2018, see https://www.szfki.hu/~nphys/rmc7/), presenters usually report their successful applications of the method. This time, presenters were asked to report on the 'dark side' of Reverse Monte Carlo modeling.

The main scientific purpose was therefore to identify where the Reverse Monte Carlo algorithm, and the software tools connected to it, have difficulties, problems, shortcomings, deficiencies – symptoms that are not frequently mentioned in 'normal' publications. In order to facilitate this process, and to provide quick feedback to software developers, representatives of the two main software packages, RMCProfile and RMC++/RMC_POT, have been invited (Dove, Tucker, Jóvári, Temleitner). All of them have come and presented their thoughts concerning the software tools just mentioned.

2. Symposium Outcomes and Future Plan

Quite a few (MSc and PhD) students have come and bravely presented their results from their 'early researcher' carriers. Many participants expressed their wish that the '2nd Pan Pacific Reverse Monte Carlo Conference' would also be held some time in the future.
Interestingly, quite a few future international research collaborations seemed to have been forming during the meeting, e.g.: 'Japan-USA-Hungary', 'Japan-Latvia', UK-USA', 'Latvia-Hungary-Japan', Japan-Germany-Hungary'

3. Others

Despite the fact that the shadow of a possible COVID-19 virus pandemic has been cast over the meeting (so that two key speakers from the UK were only able to deliver their presentations via 'videoconferencing'), quite many researchers were brave enough and come. The organizers very much hope that the very warm reception of the conference by the participants (expressed explicitly and at length by, e.g., Prof. M. Dove in his closing remarks) have not only been just words out of politeness.

Hopefully, the photos taken during the conference (see below) would be able to reflect the (as we think, very friendly) atmosphere of the meeting.



Prof. Hiyama opens the symposium



Professor Hosokawa (KU FAST) chairing the first session



The audience during the second session



Group photo taken on Day 2



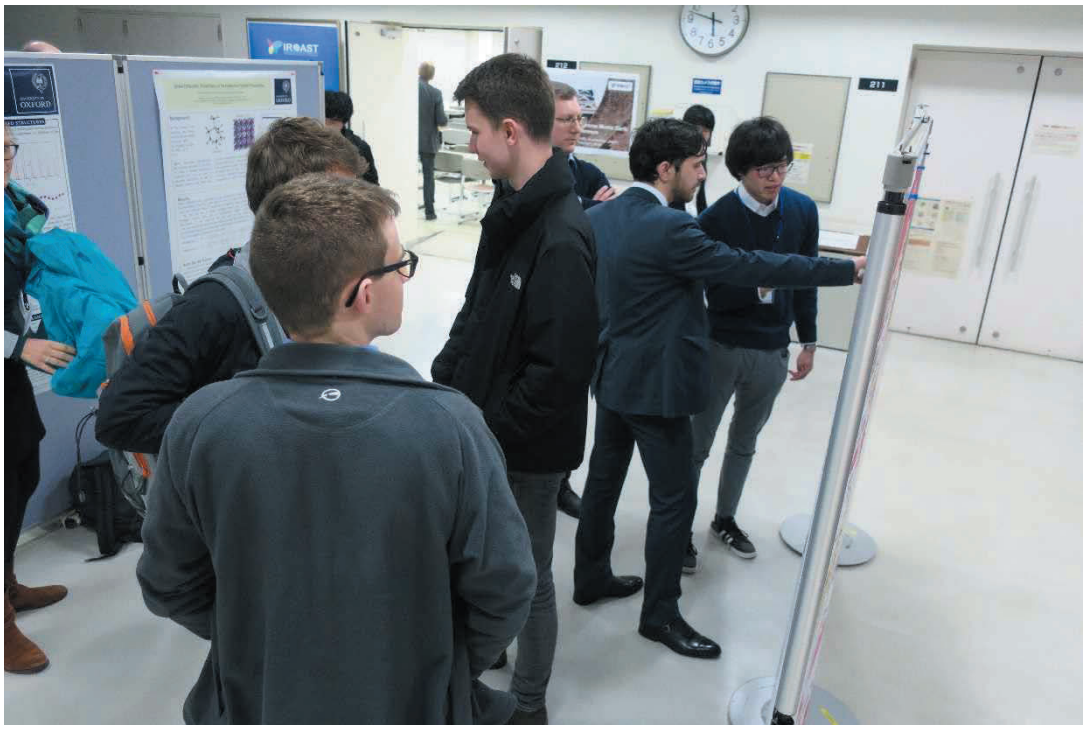
Conference banquet in FORICO



Prof. McGreevy delivering his presentation from the UK



Organizers' discussion



Poster session



Closing remarks by Prof. Dove



From Invited Researcher

Name: Wolf-Christian Pilgrim

1. Research achievements

Professor Wolf-Christian Pilgrim is a professor of Department of Chemistry, Philipps University of Marburg, Germany, who is an expert of experimental studies of atomic structures and dynamics of non-crystalline materials by X-ray and neutron scattering techniques He mainly carried out these experiments at European Synchrotron Radiation Facility (ESRF) and Institut Laue-Langevin (ILL) at Grenoble, France, and published a significant number of scientific papers. He is a member of International Proposal Selection Committee of J-PARC neutron facility at Tokai, Japan.

During the present visit, Professor Pilgrim gave a talk titled “A new highly efficient amorphous

molecular white light emitter" in the IROAST Seminar / 1st Pan Pacific Reverse Monte Carlo Conference held on 20-21 of February, 2020 at Kumamoto University. See the photograph in Fig. 1. In his presentation, he introduced his recent topics on the atomic structures of a new highly efficient amorphous molecular white light emitter investigated by X-ray diffraction combined with reverse Monte Carlo (RMC) calculations.



Fig. 1. Talk of Prof. Pilgrim in the IROAST seminar

2. Overview and significance of the research collaboration with Kumamoto University

We have a longstanding collaboration with Prof. Hosokawa whereby we have developed specific x-ray and neutron techniques, sample environments and data analysis procedures over the last twenty years. Recently, we have started a new project which is extensively funded by the German government through the German Research Society (DFG). There, we are exploring a new group of amorphous materials which convert light from a commercially available inexpensive IR-laser-diode into brilliant white light with high directionality similar as in a laser application. Such materials could become very valuable for many technical and medical applications, where intense illumination from mobile sources are required. We are currently aiming to understand the microscopic structural implications in the material responsible for the white-Light-Emission (WLE) effect. Prof. Hosokawa is an internationally highly renowned scientist in the field of structure determination in disordered matter and we see a high potential in a close collaboration to succeed in our efforts understanding the structural cause for the WLE. Therefore, Prof. Hosokawa has been awarded a Mercator-Professor by the DFG for our research project. Within this collaboration we are performing a number of synchrotron and neutron experiments on the WLE-samples and are analyzing the resulting data with specific computer simulation techniques. Prof. Hosokawa is an experienced scientist in this field too and we strongly rely on his advices and his input. The collaboration with Kumamoto University and with Prof. Hosokawa is therefore of fundamental importance for our research and the success of this research is visible by the large number of common publications over the last twenty years.

It must additionally be mentioned that we are also developing specific computer code for simulations needed to analyze our scattering data. In this field we are also in close contact with Prof. Pusztai and his research group who is a current IROAST Professor at Kumamoto University. It is a fortunate constellation for us, to have these two scientists in one place which we hope might have fundamental impact on our current work.

3. Comments or suggestions for IROAST/Kumamoto University

My impression about the IROAST-efforts to promote collaboration science and exchange of knowledge was very good. I strongly appreciate these efforts. During my visit, everything went fine and was absolutely satisfactorily.

4. Prospect for further research collaboration with Kumamoto University

As mentioned above, we have great expectations for the collaboration with Kumamoto University and the scientists working there. This cooperation will certainly take place at a very close level in the coming years and we are currently convinced that this cooperation will be very fruitful. We assume that

the cooperation will lead to a deeper understanding of the structural cause of the WLE effect. This would contribute to a development of this material to application-maturity, so that it will be available for technology and medicine in the future.

5. Impressions of Kumamoto University/Kumamoto

Very beautiful impressions of Kumamoto and the campus. Very friendly and effective administration/management. The guest house is really great. Unfortunately, to less time to learn more about the university.

KU-KAIST Joint Symposium Report 1

Organizer 1	Name	Toshio Suda		
	Affiliation	IRCMS, Kumamoto University	Title	Director
Organizer 2	Name	Takashi Hiyama		
	Affiliation	IROAST, Kumamoto University	Title	Director
Symposium Title	3rd KU-KAIST Joint Symposium–6th IRCMS & IROAST Joint Seminar			
Venue	Matrix Hall, KI Bldg.(E4), KAIST/ Emerald Hall, Ramada Hotel Daejeon, Korea			
Time & Date	9:30-18:30, November 11, 2019 10:00-12:00, November 12, 2019			
Speaker's Name/ Title/Affiliation	Young Seok Ju, KAIST Ishimoto Takatsugu, IRCMS, Kumamoto University (KU) Inkyung Jung, KAIST Ruda Lee, IROAST, KU Umemoto Terumasa, IRCMS, KU You-Me Kim, KAIST Hayashi Yoshikazu, IRCMS, KU Sada Aiko, IRCMS, KU Jinju Han, KAIST Mizuno Hidenobu, IRCMS, KU Ki-Jun Yoon, KAIST Jae-Byum Chang, KAIST Taeyun Ku, KAIST Nishiyama Koichi, IRCMS, KU Jae Myung Suh, KAIST Arima Yuichiro, IRCMS, KU Jee Myung Yang, KAIST Yokomizo Tomomasa, IRCMS, KU Ryul Kim, KAIST Hanada Sanshiro, IRCMS, KU Jingu Lee, KAIST Minwoo Kim, IROAST, KU Kwang-eun Kim, KAIST			

Number of Participants	From KU	Faculty: 12 (Int'l participants: 2)	Total	71
		Students/Staff: 2 (Int'l participants: 0)		
	From outside KU	Faculty/Students: 57 (Int'l participants:-)		
		Students: - (Int'l participants: -)		

(Written by Ruda Lee, IROAST Associate Professor)

The 3rd KU-KAIST joint symposium was held on November 11 and 12, 2019 at Matrix hall, KAIST, Korea. The first day, the Symposium started with the opening marks by Prof. Yong-Mahn Han, the dean of the College of Life Science & Bioengineering, KAIST. The symposium was organized 4 different sessions, which was “Genomics and Epigenomic”, “Stem Cells and Inflammation”, “New Avenues for Biomedical Science” and “Tissue Formation and Maintenance”. Eight PIs from KAIST and 8 PIs from KU introduced their research. The second day, 4 students from KAIST and 3 researchers from KU introduced their main theme for 10 min each.

The aim of this symposium was to introduce and match a potential research collaboration between KAIST and KU PI researchers as well as young researchers. Compare to the previous KAIST-KU symposium, it mainly focused on the young researcher’s research on the second day. It was a good chance to explain the young researcher's projects by themselves.



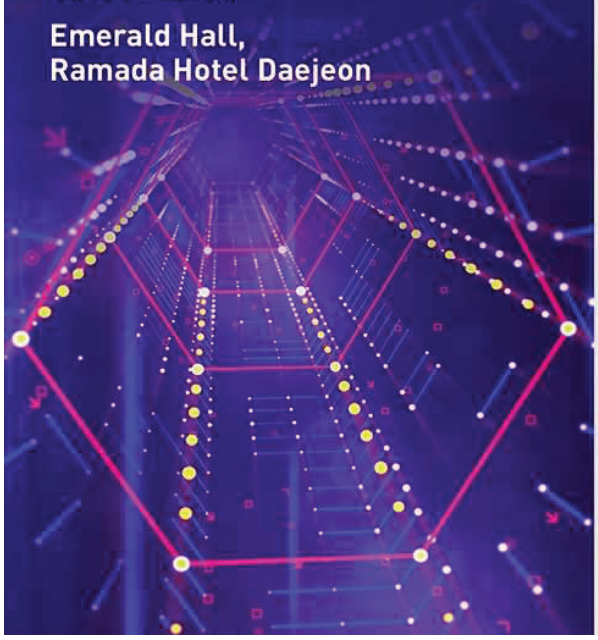
KAIST Kumamoto University

KAIST-KU Joint Symposium

The 6th IROAST/IRCMS Joint Seminar

Nov 11(Mon.), 2019
09:30-18:30
Matrix Hall, KI Bldg.(E4), KAIST

Nov 12(Tue.), 2019
10:00-12:00
Emerald Hall, Ramada Hotel Daejeon



Nov 11(Mon.), 2019 Matrix Hall, KI Bldg.(E4), KAIST

Session I 10:00~ *Genomics and Epigenomics*

Young Seok Ju Korea Advanced Institute of Science and Technology	Single genome sequencing of normal cells reveals developmental trees of early human embryogenesis
Takatsugu Ishimoto IRCMS, Kumamoto University	Gastric CAFs maintain SASP through epigenetic histone modification and enhance peritoneal metastasis
Inkyung Jung Korea Advanced Institute of Science and Technology	3D chromatin structure in complex human disease
Ruda Lee IROAST, Kumamoto University	Target Specific Delivery of miRNA nanocargo for EGFR triple positive breast cancer

Session II 13:00~ *Stem Cells and Inflammation*

Terumasa Umemoto IRCMS, Kumamoto University	Aspartate synthesis pathways in hematopoietic stem cell divisions
You-Me Kim Korea Advanced Institute of Science and Technology	Intestinal Immune System, Microbiota and Metabolic Homeostasis
Yoshikazu Hayashi IRCMS, Kumamoto University	Microbial signal regulates crosstalk between bone marrow and other organs in early hematopoiesis
Aiko Sada IRCMS, Kumamoto University	Elucidating the cellular and molecular regulation of epidermal stem cell dynamics: from homeostasis to aging

Session III 14:55~ *New Avenues for Biomedical Science*

Jinju Han Korea Advanced Institute of Science and Technology	Study on neuronal development using human pluripotent stem cells
Hidenobu Mizuno IRCMS, Kumamoto University	Activity-dependent neuronal circuit formation in the cerebral cortex
Ki-Jun Yoon Korea Advanced Institute of Science and Technology	Deciphering the neural epitranscriptome using mouse and human organoid models
Jae-Byum Chang Korea Advanced Institute of Science and Technology	Expansion microscopy and related techniques: principles and applications
Taeyun Ku Korea Advanced Institute of Science and Technology	Engineering mechanical properties of biological tissues for large-scale molecular phenotyping

Session IV 17:00~ *Tissue Formation and Maintenance*

Koichi Nishiyama IRCMS, Kumamoto University	Blood flow-dependent biomechanical control of angiogenesis
Jae Myoung Suh Korea Advanced Institute of Science and Technology	Adipose tissue maintenance and dedifferentiation
Yuichiro Arima IRCMS, Kumamoto University	Ketone body metabolism - it's relation to health and disease -

Nov 12(Tue.), 2019 Emerald Hall, Ramada Hotel Daejeon

Session V 10:00~ *Young Scientists Session*

Jee Myung Yang(KAIST), **Tomomasa Yokomizo**(IRCMS)
Ryul Kim(KAIST), **Sanshiro Hanada**(IRCMS), **Jingu Lee**(KAIST)
Minwoo Kim(IROAST), **Kwang-eun Kim**(KAIST)

KAIST GSMSE IRCMS IROAST

문의 : pilhan.kim@kaist.ac.kr

IROAST Seminars

No.	Title	IROAST Speaker (Organizer)	Date
1	57th IROAST Seminar – Carbon Dioxide Removal: Costs, potentials and side effects	**Jens Hartmann** IROAST Visiting Professor (**Takahiro Hosono**)	04/12/2019
2	58th IROAST Seminar – CSIRO Australia: Global Collaboration between Science and Industry – Additive manufacturing research in CSIRO	**Shirley Shen** IROAST Visiting Professor (**Kazuki Takashima**)	07/04/2019
3	59th IROAST Seminar – Data mining techniques in Medical Informatics	**U Rajendra Acharya** IROAST Visiting Professor (**Makiko Kobayashi**)	09/03/2019
4	60th IROAST Seminar – 5th IRCMS & IROAST Joint Seminar/ 59th IRCMS Seminar	**Takumi Higaki** IROAST Associate Professor (**Jun Otani** / **Hitoshi Takizawa**)	10/29/2019
5	61st IROAST Seminar – Additive Manufacturing Center and the Nondestructive Evaluation Activities	**Che-Hua Yang** (**Makiko Kobayashi**)	10/23/2019
6	62nd IROAST Seminar – Pan Pacific International Symposium on Chalcogenide Functional Materials	**László Pusztai** IROAST Distinguished Professor **Matthiew Micoulaut** IROAST Visiting Professor (**Shinya Hosokawa**)	11/10/2019-11/11/2019
7	63rd IROAST Seminar – The physics of animal groups - using remote sensing technologies to understand behavior and ecology of penguins and whales	**Daniel P. Zitterbart** IROAST Visiting Associate Professor (**Kei Toda**)	11/11/2019
8	64th IROAST Seminar – Passive and Active Vehicle Safety -Technologies towards Autonomous Driving-	**Tomonari Furukawa** IROAST Visiting Professor (**Makoto Kumon**)	11/13/2019
9	65th IROAST Seminar – Lignin Biorefinery: Processes and Products	**Maria Jose Cocero** IROAST Visiting Professor (**Tetsuya Kida/ Armando T. Quitain**)	11/25/2019

10	66th IROAST Seminar – Technoscience. Risks & opportunities of a social revolution	**Josep-Lluis Barona Vilar** IROAST Visiting Professor (**Makoto Takafuji/ Yutaka Kuwahara**)	11/25/2019
11	67th IROAST Seminar – IPPS Lecture & Seminar No. 50	**Konstantinos Kontis** IROAST Distinguished Professor (**Hamid Hosano**)	12/03/2019
12	68th IROAST Seminar – Our Investigations of CO_2 reduction: Past and Present	**Etsuko Fujita** IROAST Visiting Professor (**Yutaka Kuwahara**)	12/12/2019
13	69th IROAST Seminar – Deep Learning & Image Processing for CT data analysis of morphometric parameters in soil	**Alfonso Gastelm Strozzi** **Patrice Delmas** IROAST Visiting Professor **Trevor Gee** (**Toshifumi Mukunoki/ Patrice Delmas**)	12/13/2019
14	70th IROAST Seminar – Chemical modifications of RNA in control of mammalian gene expression	**Ramesh Shanmughom Pillai** IROAST Visiting Professor (**Tokio Tani**)	12/18/2019
15	71st IROAST Seminar – IPPS Lecture & Seminar No. 52	**Hamid Ghandehari** IROAST Visiting Professor (**Hamid Hosano**)	12/18/2019
16	72nd IROAST Seminar –Waste treatment in high-temperature and high-pressure water: from fundamentals to applications	**Olivier Boutin** IROAST Visiting Professor (**Mitsuru Sasaki**)	01/29/2020
17	73rd IROAST Seminar – Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules	**Mani Tomoyasu** IROAST Visiting Associate Professor (**Yutaka Kuwahara**)	02/06/2020
18	74th IROAST Seminar – Nanoscopic Inorganic Structures – A New Class of Materials for Sustainability	**Parasuraman Selvam** (**Shinya Hayami**)	03/13/2020

IROAST Seminar Report 1

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Dr. Takahiro Hosono</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Associate Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">Dr. Jens Hartmann</td></tr>
<tr><td>Affiliation</td><td>Institute for Geology, Universität Hamburg</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">57th IROAST Seminar – Carbon Dioxide Removal: Costs, potentials and side effects</td></tr>
<tr><td>Venue</td><td colspan="4">Rm#201, 2F, Faculty of Science Bldg. 3</td></tr>
<tr><td>Time & Date</td><td colspan="4">16:30-17:30, April 12th, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Jens Hartmann/ Professor/ Institute for Geology, Universität Hamburg</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 2 (Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">87</td></tr>
<tr><td>Students: 83 (Int'l participants: 10)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 2 (Int'l participants: 1)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

Following matters are discussed in the seminar: The most recent IPCC assessment has shown an important role for negative emissions technologies (NETs) in limiting global warming to 2°C cost-effectively. However, a bottom-up, systematic, reproducible, and transparent literature assessment of the different options to remove CO_2 from the atmosphere was until last year missing. A comprehensive set of the relevant literature so far published, focusing on seven technologies was analysed by a team of specialists: bioenergy with carbon capture and storage (BECCS), afforestation and reforestation, direct air carbon capture and storage (DACCS), enhanced weathering, ocean fertilisation, biochar, and soil carbon sequestration. I present estimates of costs, potentials, and side-effects for these technologies based on our recent review Fuss et al. (2018) which triggered also an inquiry in the German parliament about the German strategy. Based on a systematic review of the literature, our best estimates for sustainable global NET potentials in 2050 are 0.5–3.6 Gt CO_2 yr^{-1} for afforestation and reforestation, 0.5–5 Gt CO_2 yr^{-1} for BECCS, 0.5–2 Gt CO_2 yr^{-1} for biochar, 2–4 Gt CO_2 yr^{-1} for enhanced weathering, 0.5–5 Gt CO_2 yr^{-1} for DACCS, and up to 5 Gt CO_2 yr^{-1} for soil carbon sequestration. Costs vary widely across the technologies, as do their permanency and cumulative potentials beyond 2050. It is unlikely that a single NET will be able to sustainably meet the rates of carbon uptake described in integrated assessment pathways consistent with Paris 1.5°C target of global warming. The presentation will provide an overview from our review on the suggested methods and an outlook.

2. Seminar Outcomes and Future Plan

We have already conducted collaboration field surveys with many young researchers from both laboratories. We have published one paper in Scientific Reports and are about submitting more research articles for publications in international journals. However, the authors strongly require financial supports for publications.

3. Others





April 12th (Fri) 16:30-17:30

The 57th IROAST Seminar

Carbon Dioxide Removal: Costs, potentials and side effects

Prof. Dr. Jens Hartmann

Institute for Geology, Universität Hamburg, Germany
IROAST Visiting Professor

Venue: Auditorium #D201, 2F, Faculty of Science Bldg.3
Organizer: Assoc. Prof. Takahiro Hosono, FAST
hosono@kumamoto-u.ac.jp

IROAST Seminar Report 2

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Kazuki Takashima</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Engineering</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">58th IROAST Seminar – CSIRO Australia: Global Collaboration Between Science and Industry – Additive Manufacturing Research in CSIRO</td></tr>
<tr><td>Venue</td><td colspan="4">I-308, Faculty of Engineering Bldg. I (Kurokami South C3)</td></tr>
<tr><td>Time & Date</td><td colspan="4">10:30-12:00, July 4, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Shirley Shen
Principal Research Scientist,
CSIRO Manufacturing</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 3
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">32</td></tr>
<tr><td>Students: 28
(Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 1)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

CSIRO Manufacturing, one of the nine business units, develops industry-driven scientific and engineering innovations to catalyse the transition of Australian manufacturing into a globally connected, economically viable, high-technology sector with our scientific capabilities from biomedical materials and devices, advanced fibre and chemical industries, metal and industrial innovation. The CSIRO Manufacturing (1) helps existing firms make the transition to become more sustainable and remain competitive in an increasingly competitive, resource constrained world, (2) supports the development of new businesses and industry supply chains, and (3) positions CSIRO as a global R&D provider by applying Australian science and technological capabilities in international markets.

Among their capabilities and research activities, this seminar focused on the additive manufacturing research in CSIRO Manufacturing, including polymer 3D printing for biomedical applications and metal 3D printing in our Lab 22. CSIRO national open laboratory of Lab 22 is building an Australian additive manufacturing community. Since Sept of 2012, Lab 22 has 3D printed over 900 pieces in titanium from over 200 files for 75 entities in 180 total Arcam EBM builds. That is an average ~ 1.5 builds per week. Of these, 54% have been for industry, 21% have been for R&D, and 25% have been for marketing, media, and education. CSIRO have hosted more than 3000 visitors so far.

Through this seminar, we were able to learn about the detail of CSIRO's research activities. CSIRO is active in collaborative research with overseas institutions, and hopes to deepen cooperation with Kumamoto University in the future. This seminar was a good opportunity for the activation of international collaborative research.





58th IROAST Seminar

CSIRO AUSTRALIA: GLOBAL COLLABORATION BETWEEN SCIENCE AND INDUSTRY
– ADDITIVE MANUFACTURING RESEARCH IN CSIRO

Dr Shirley Shen

Principal Research Scientist,
Commonwealth Scientific and Industrial
Research Organisation(CSIRO), Australia

July 4(Thu), 2019
10:30～12:00

@308, 3F,
Faculty of
Engineering Bldg. I

Organizer: Prof. Kazuki Takashima, FAST
takashik@gpo.kumamoto-u.ac.jp

IROAST

IROAST Seminar Report 3

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Makiko Kobayashi</td></tr>
<tr><td>Affiliation</td><td>FAST</td><td>Title</td><td>Assoc. Prof.</td></tr>
<tr><td>Seminar Title</td><td colspan="4">59th IROAST Seminar – Data mining techniques in Medical Informatics</td></tr>
<tr><td>Venue</td><td colspan="4">Rm#204, 2F, Kurokami South W2 General Research Bldg.</td></tr>
<tr><td>Time & Date</td><td colspan="4">16:25-17:25, Sep. 3, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr U Rajendra Acharya
Senior faculty member/ Ngee Ann Polytechnic, Singapore</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 5 (Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">40</td></tr>
<tr><td>Students: 31 (Int'l participants: 5)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 4 (Int'l participants: 4)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview: Automatic medical evaluations by deep learning/AI

2. Seminar Outcomes and Future Plan

It is an initiation of international collaborative research. Discussion was made for joint publication and provisional patent in US. Many KU students listen with high motivation and it helps to stimulate their passion for their research area of information science.

3. Others




September 3 (Tue) 16:25-
59th IROAST Seminar
Data mining techniques in Medical Informatics
Prof. U Rajendra Acharya
Ngee Ann Polytechnic, Singapore
IROAST Visiting Professor
Venue: #204, 2F, Kurokami South W2 General Research Bldg.
Organizer: Assoc. Prof. Makiko Kobayashi, FAST
kobayashi@cs.kumamoto-u.ac.jp
IROAST

IROAST Seminar Report 4

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Jun Otani</td></tr>
<tr><td>Affiliation</td><td>IROAST/
FAST</td><td>Title</td><td>Vice Director/
Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">Hitoshi Takizawa</td></tr>
<tr><td>Affiliation</td><td>IRCMS</td><td>Title</td><td>Vice Director</td></tr>
<tr><td>Seminar Title</td><td colspan="4">60th IROAST Seminar –
5th IRCMS & IROAST Joint Seminar/ 59th IRCMS Seminar</td></tr>
<tr><td>Venue</td><td colspan="4">Meeting Room B, 2F, Faculty of Engineering Building 1</td></tr>
<tr><td>Time & Date</td><td colspan="4">13:30-16:45, October 29, 2019</td></tr>
<tr><td>Speaker’s Name/
Title/Affiliation</td><td colspan="4">Hitoshi Takizawa, Vice Director, IRCMS
Hidenobu Mizuno, Associate Professor, IRCMS
Takumi Higaki, Associate Professor, IRCMS
Takatsugu Ishimoto, Associate Professor, IRCMS</td></tr>
<tr><td rowspan="4">Number of
Participants</td><td rowspan="2">From KU</td><td>Faculty: 23
(Int'l participants: 16)</td><td rowspan="4">Total</td><td rowspan="4">49</td></tr>
<tr><td>Students: 26
(Int'l participants: 7)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 0
(Int'l participants: 0)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

IROAST and IRCMS are research associations at Kumamoto University and the aims are not only to enhance the advanced researches but also its international collaborations. Recently, joint activity has been conducted between IROAST and IRCMS and under this frame, we had a presidential budgets last year and then, three of joint research groups under this frame had financial support for their activities. The idea of this time of seminar was

1) to have the activities reports of three jointed groups,
2) to look for the next jointed group, and
3) of course, to discuss about recent topics in IROAST and IRCMS and to exchange the ideas.

The program of this seminar was as follows:
Date: October 29th, 2019 13:30~16:45
Place: Meeting Room B, 2F, Faculty of Engineering Building 1
Organizer: Prof. Jun Otani, Vice Director, IROAST, Professor, FAST
Prof. Hitoshi Takizawa, Vice Director, IRCMS
MC: Prof. Otani
Agenda:
1. Progress Report of IRCMS-IROAST Research Collaboration Group
- results of study (Introduction, Method, Results and discussion, and so on)
- next step of the study - suggestion to a new possible group

For this agenda, following three groups presented their activities:

◆Assoc. Prof. Takatsugu Ishimoto from IRCMS

◆Assoc. Prof. Toshifumi Mukunoki from FAST

◆Prof. Jun Otani from IROAST/FAST

MicroCT-based quantification of fibrosis and stiffness of tumor microenvironment

◆Assoc. Prof. Hidenobu Mizuno from IRCMS

◆Assoc. Prof. Takumi Higaki from IROAST

Quantitative bioimage analysis to elucidate dynamics of stem cells in living animals

◆Prof. Hitoshi Takizawa from IRCMS

◆Prof. Yorifumi Satou from IRCMS

◆~~Prof. Yasushi Sakurai from FAST~~

Bioinformatics analysis of single cell transcriptome and proteome data

2. Discussion -About feasibility of collaborative research with IRCMS-IROAST and future plans, etc.

2. Seminar Out comes and future plan

In the discussion session, there are two steps of discussion in which are 1) total discussion (all the participants) and group discussion (depending on the interest topics). Both were very active discussion and especially, in the group discussion, not only research topics but also the tools and the method were discussed and those seems to have the next potential joint group. Some of the photos are shown as follows:

Finally, both IROAST and IRCMS agreed that we continue our collaboration and we are going to have another new joint research group in this year. And we also agreed that we will give the financial support for those new group.



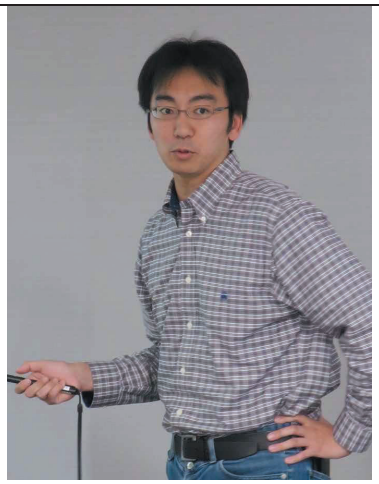
Participants



Opening address
IROAST Director Hiyama



Talk 1
Dr. Takizawa



Talk 2
Dr. Mizuno



Talk 2
Dr. Higaki



Talk 3
Dr. Ishimoto



MC&Discussion Facilitator
IROAST Vice Director Otani



Closing address
IRCMS Director Suda



Social gathering



5th IRCMS & IROAST Joint Seminar

-59th IRCMS Seminar/ 60th IROAST Seminar-

October 29, 2019/ 13:30-16:45

Place Meeting Room B, 2F, Faculty of Engineering Building 1
Organizer Prof. Jun Otani, Vice Director, IROAST; Professor, FAST
Prof. Hitoshi Takizawa, Vice Director, IRCMS

Progress Reports by IRCMS-IROAST Research Collaboration Groups

MicroCT-based quantification of fibrosis and stiffness of tumor microenvironment

Takatsugu Ishimoto, IRCMS; Toshifumi Mukunoki, FAST; Jun Otani, IROAST/FAST

Quantitative bioimage analysis to elucidate dynamics of stem cells in living animals

Hidenobu Mizuno, IRCMS; Takumi Higaki, IROAST

Bioinformatics analysis of single cell transcriptome and proteome data

Hitoshi Takizawa, IRCMS; Yorifumi Sato, IRCMS

IRCMS International Research Center for Medical Sciences

IROAST International Research Organization for Advanced Science & Technology

IROAST Seminar Report 5

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Makiko Kobayashi</td></tr>
<tr><td>Affiliation</td><td>FAST</td><td>Title</td><td>Assoc. Prof.</td></tr>
<tr><td>Seminar Title</td><td colspan="4">61st IROAST Seminar – Additive Manufacturing Center and the Nondestructive Evaluation Activities (Ultrasonic Sensors for the Applications in Nondestructive Testing and Photoacoustic Imaging)</td></tr>
<tr><td>Venue</td><td colspan="4">Kurokami South Campus, Densu Lecture Room, 1F, Kurokami South C3</td></tr>
<tr><td>Time & Date</td><td colspan="4">October 23(Wed), 2019, 14:40-16:00</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Che-Hua Yang
Professor
National Taipei University of Technology</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 1
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">12</td></tr>
<tr><td>Students: 10
(Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 1)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

Additive manufacturing center (AMC) for customized mass production is a featured national research center founded for higher education sprout program (HESP) supported by Ministry of Education (MOE) in Taiwan. AMC aims at research, development, and integration of manufacturing and production techniques towards commercial industrial products. For customized production, researches in AMC cover a wide spectrum including measurement techniques, analysis and modeling, material development, additive manufacturing process and equipment, validation and industrial total solutions. The final goal is to bring digital values of AM to product values and building the ecosystems of new AM applications. One of the important tasks in developing AM product is quality assurance where nondestructive testing/evaluation (NDT/E) serve as the key role. In this talk, several developed NDT/E research activities were presented and future research directions was outlined.

2. Seminar Outcomes and Future Plan

We learned about additive manufacturing and discussed about possible applications for KU sensors. In addition, projects regarding structural health monitoring (SHM) based on KU sensors and laser generated ultrasounds, and a special wedge transducer with KU sensor designed by Taipei tech were discussed.

3. Others



October 23 (Wed) 14:40-16:00

61st IROAST Seminar

Additive Manufacturing Center and the Nondestructive Evaluation Activities

Prof. Che-Hua Yang

Director, Additive Manufacturing Center for Customized Mass Production
Professor, Graduate Institute of Manufacturing Technology
National Taipei University of Technology, Taiwan

Place Densu Lecture Room, 1F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)

Organizer Assoc. Prof. Makiko Kobayashi, FAST
kobayashi@cs.kumamoto-u.ac.jp

From Invited Researcher

Name: Che-Hua Yang

1. Research achievements

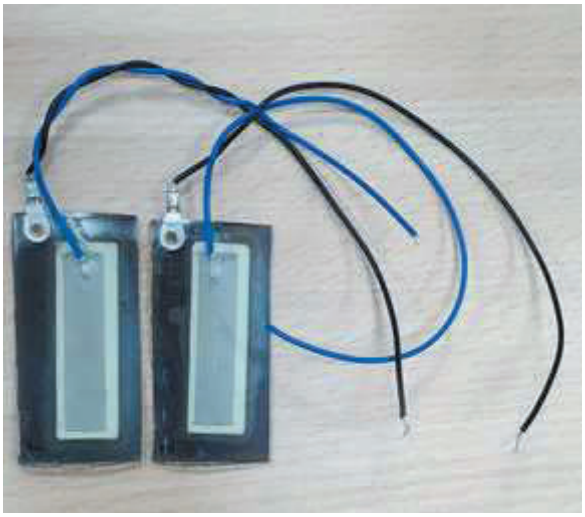
(a) Conducted a research in laser ultrasound with flexible transducer detection for curved surface at high temperature

(b) Conducted a jointed research in photoacoustic imaging in biological tissue based on the newly developed focused PZT transducer.

(c) A seminar was delivered on Oct. 23 on the topic of "Additive manufacturing center for mass production and nondestructive evaluation research activities."

(d) Discussions in depth about 3 research topics: (1) Flexible PZT ultrasound transducer for the applications of petrochemical industries, (2) Structural health monitoring (SHM) based on flexible PZT transducer and laser generated ultrasounds, and (3) A special wedge transducer by using spray coated PZT acting element.

(e) A pair of flexible PZT transducer were fabricated during the visiting period. These transducers will be applied for the detection of defects in petrochemical equipment.



2. Overview and significance of the research collaboration with Kumamoto University

The collaboration between NTUT and KU is in the area of ultrasound/sensor technology. With unique and conjugate technologies in both sides, the collaboration becomes a featured and completive team in the research community around the world. KU team have been working in the area of flexible

ultrasound transducer capable of working at elevated temperatures for a long time. NTUT team have been working the area of laser ultrasound and nondestructive testing areas for more than 25 years. With these two teams working together, unique and competitive researches have been achieved and now working towards more practical applications.

3. Comments or suggestions for IROAST/Kumamoto University

I would like to thanks for IROAST/Kumamoto University for providing the opportunity of visiting KU with that good communications were achieved for more advanced research activities.

4. Prospect for further research collaboration with Kumamoto University

Researches will keep going along the line of PZT sensors continuously developed KU in conjunction with laser-based ultrasonics, structural heath monitoring and photoacoustic imaging in Taipei Tech.

5. Impressions of Kumamoto University/Kumamoto

Visiting to KU was very impressive. KU has a good history of more than 100 years within that good reputation and faculties were established and expanded. Very good research actives are been developed with good atmosphere. People here including professors, students and staff are friendly and good for exchange of ideas.

IROAST Seminar Report 6

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Shinya Hosokawa</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">62nd IROAST Seminar – Pan Pacific International Symposium on Chalcogenide Functional Materials</td></tr>
<tr><td>Venue</td><td colspan="4">D201, Kurokami South E3 Building</td></tr>
<tr><td>Time & Date</td><td colspan="4">09:30, November 10, 2019-13:00, November 11, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Prof. Kazutaka Kudo (Okayama University)
Dr. Yoichi Nakajima (Kumamoto University)
Dr. Koji Kimura (Nagoya Institute of Technology)
Dr. Akihide Koura (Kumamoto University)
Dr. Yoshifumi Sakaguchi (CROSS, J-PARC)
Dr. Adam Lőrinczi (National Institute of Materials Physics, Bucharest, Romania)
Prof. László Pusztai (IROAST, Kumamoto University and Hungarian Academy of Science)
Dr. Shinji Kohara (NIMS/JASRI)
Prof. Anita Zeidler (University of Bath)
Prof. Alexander V. Kolobov (Herzen University and AIST)
Prof. Punit Boolchand (University of Cincinnati)
Prof. Matthieu Micoulaut (Sorbonne Université)
Dr. Jens Rüdiger Stellhorn (Hiroshima University)</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 8 (Int'l participants: 1)</td><td rowspan="4">Total</td><td rowspan="4">35</td></tr>
<tr><td>Students: 10 (Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 17 (Int'l participants: 7)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

International conferences, the main topics of which include “Chalcocenides”, were held nine times at Romania or surrounding countries named “International Conference on Amorphous and Nanostructured Chalcogenides” from 2001 to 2019. The organizer of this symposium, SH, was invited by this conference three times, and the hospitalities by the meeting were excellent. Unfortunately, the chief steering committee member of this meeting, Prof. Mihai A. POPESCU, passed away on 14th of July, 2019.

Although many researchers investigating chalcogenide materials in Japan, such as glasses, phase-change materials (DVD), topological insulators, high-temperature superconductors and so on, only a very few Japanese scientists can join such a meeting, and thus, SH has discussed with a Romanian scientist for the future meeting on chalcogenide sciences. In this symposium, we invited seven foreign and six inland distinguished researchers who are investigating several chalcogenide functional materials with excellent and advanced ideas for the research.

The list of the invited speakers and titles of the presentations are as follows.

Prof. Kazutaka Kudo (Okayama University)
“Superconductivity induced by breaking dimers of $IrTe_2$ and $AuTe_2$”
Dr. Yoichi Nakajima (Kumamoto University)
“Inelastic X-ray scattering measurements on liquid Fe-S alloys under high pressures”
Dr. Koji Kimura (Nagoya Institute of Technology)
“*Local structure of In-doped Bi_2Se_3 topological insulator studied by x-ray fluorescence holography*”

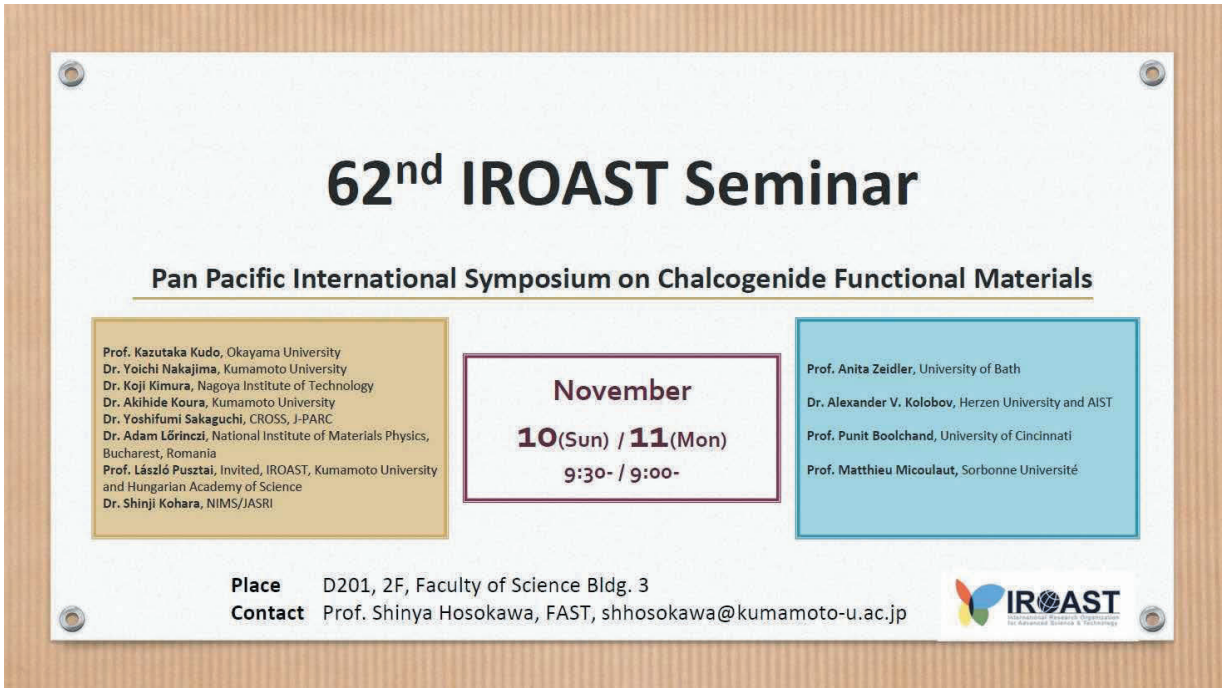
Dr. Akihide Koura (Kumamoto University)
"*Ab initio molecular dynamics study of amorphous Cu_2GeTe_3*"
Dr. Yoshifumi Sakaguchi (CROSS, J-PARC)
"*Kinetics of silver photodiffusion into amorphous germanium sulfide probed by in situ neutron reflectivity measurement"*
Dr. Adam Lőrinczi (National Institute of Materials Physics, Bucharest, Romania)
"*Chalcogenide science in Romania"*
Prof. László Pusztai (IROAST, Kumamoto University and Hungarian Academy of Science)
"*Reverse Monte Carlo modeling: potentialities for chalcogenide glasses"*
Dr. Shinji Kohara (NIMS/JASRI)
"*Understanding Diffraction Patterns of Disordered Materials via Persistent Homology Analyses*"
Prof. Anita Zeidler (University of Bath)
"*The structure of Ge-Se glasses"*
Dr. Alexander V. Kolobov (Herzen University and AIST)
"Photo-induced phenomena in amorphous chalcogenides"
Prof. Punit Boolchand (University of Cincinnati)
"*Progress and challenges in probing melt dynamics, configurational entropy change and topological phases of chalcogenide glasses*"
Prof. Matthieu Micoulaut (Sorbonne Université)
"*Structure and dynamics of chalcogenides*"
Dr. Jens Rüdiger Stellhorn (Hiroshima University)
"*A combination of anomalous x-ray scattering and x-ray absorption fine structure experiments for the characterization of amorphous Cu_2GeTe_3*"

The topics covers a variety of materials, such as superconductors (Kudo), liquids (Nakajima), topological insulators (Kimura), chalcogenide glasses (Zeidler, Micoulaut, and others), and analytical technique (Pusztai), and intensive discussion was made by the topical experts as well as scientists in the different field, which is very different from usual conferences or symposium. I heard from many participants that the symposium was well organized and they leaned many things with high interests.

Although a special announcement was not performed, many graduate school students participated by their own interests of the topics of the symposium as seen in the Fig. 1 together with the most of the invited speakers, which is a strong indication of the promising future of the scientific level in Kumamoto University. We would like to continue this series of symposium to effectively improve our scientific level for materials science.



Fig. 1 The main participants of the symposium.


62nd IROAST Seminar
Pan Pacific International Symposium on Chalcogenide Functional Materials
Prof. Kazutaka Kudo, Okayama University
Dr. Yoichi Nakajima, Kumamoto University
Dr. Koji Kimura, Nagoya Institute of Technology
Dr. Akihide Koura, Kumamoto University
Dr. Yoshifumi Sakaguchi, CROSS, J-PARC
Dr. Adam Lőrinczi, National Institute of Materials Physics, Bucharest, Romania
Prof. László Pusztai, Invited, IROAST, Kumamoto University and Hungarian Academy of Science
Dr. Shinji Kohara, NIMS/JASRI
November
10(Sun) / 11(Mon)
9:30- / 9:00-
Prof. Anita Zeidler, University of Bath
Dr. Alexander V. Kolobov, Herzen University and AIST
Prof. Punit Boolchand, University of Cincinnati
Prof. Matthieu Micoulaut, Sorbonne Université
Place D201, 2F, Faculty of Science Bldg. 3
Contact Prof. Shinya Hosokawa, FAST, shhosokawa@kumamoto-u.ac.jp
IROAST

IROAST Seminar Report 7

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Kei Toda</td></tr>
<tr><td>Affiliation</td><td>Department of Chemistry</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">63rd IROAST Seminar – The physics of animal groups - using remote sensing technologies to understand behavior and ecology of penguins and whales</td></tr>
<tr><td>Venue</td><td colspan="4">C227, 2F, Science Faculty Building</td></tr>
<tr><td>Time & Date</td><td colspan="4">14:40 – 16:10, November 11, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Daniel P. Zitterbart
Assistant Scientist
Woods Hole Oceanographic Institution</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 6
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">28</td></tr>
<tr><td>Students: 20
(Int'l participants: 3)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 2
(Int'l participants: 1)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

There were two stories: one was about observations of penguin colonies and individual penguin’s behavior, the other was how to monitor whale’s behaviors. Dr. Zitterbart talk was very impressive and audiences were grabbed by his talk. The behaviors were explained with many interesting and beautiful videos and his lecture was like a BBC’s scientific TV program. The all audiences enjoyed very much. He also showed results of our collaborative research held in the last June.

2. Seminar Outcomes and Future Plan

The young students received strong impression about the researches regarding oceanic animal behaviors. The many behaviors, especially feeding, are triggered by some chemicals naturally produced by prey etc. KU develops monitoring devices for these compounds and may measure on site where penguins and whales are foraging. Young students, who have willing to go, may work in US and Antarctic in the coming future. That was a very special topics for KU as well.

A part of topics Dr. Zitterbart presented is now considered to be in a manuscript and we are preparing it for submission.

3. Others





November 11 (Mon)
14:40-16:10



63rd IROAST Seminar

Dr. Daniel P. Zitterbart

Woods Hole Oceanographic Institution
USA

The physics of animal groups - using remote sensing technologies to understand behavior and ecology of penguins and whales

Place C227, 2F, Faculty of Science Bldg.
Organizer Prof. Kei Toda, FAST
todakei@kumamoto-u.ac.jp

IROAST

IROAST Seminar Report 8

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Makoto Kumon</td></tr>
<tr><td>Affiliation</td><td>FAST</td><td>Title</td><td>Associate Prof.</td></tr>
<tr><td>Seminar Title</td><td colspan="4">64th IROAST Seminar – Passive and Active Vehicle Safety
- Technologies towards Autonomous Driving -</td></tr>
<tr><td>Venue</td><td colspan="4">Rm309, Faculty of Engineering Research Bldg. I</td></tr>
<tr><td>Time & Date</td><td colspan="4">14:40-15:40, Nov. 13, 2019</td></tr>
<tr><td>Speaker’s Name/
Title/Affiliation</td><td colspan="4">Tomonari Furukawa / Professor / Department of Mechanical and Aerospace Engineering, University of Virginia, Virginia, USA</td></tr>
<tr><td rowspan="4">Number of
Participants</td><td rowspan="2">From KU</td><td>Faculty: 3
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">21</td></tr>
<tr><td>Students: 17
(Int'l participants: 4)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 1)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

The seminar was about the measurement technology for automobile crash based on Recursive Bayesian Estimation that was proposed by Prof. Furukawa; numerical prediction and sensor fusion to estimate dynamical deformation of car components.

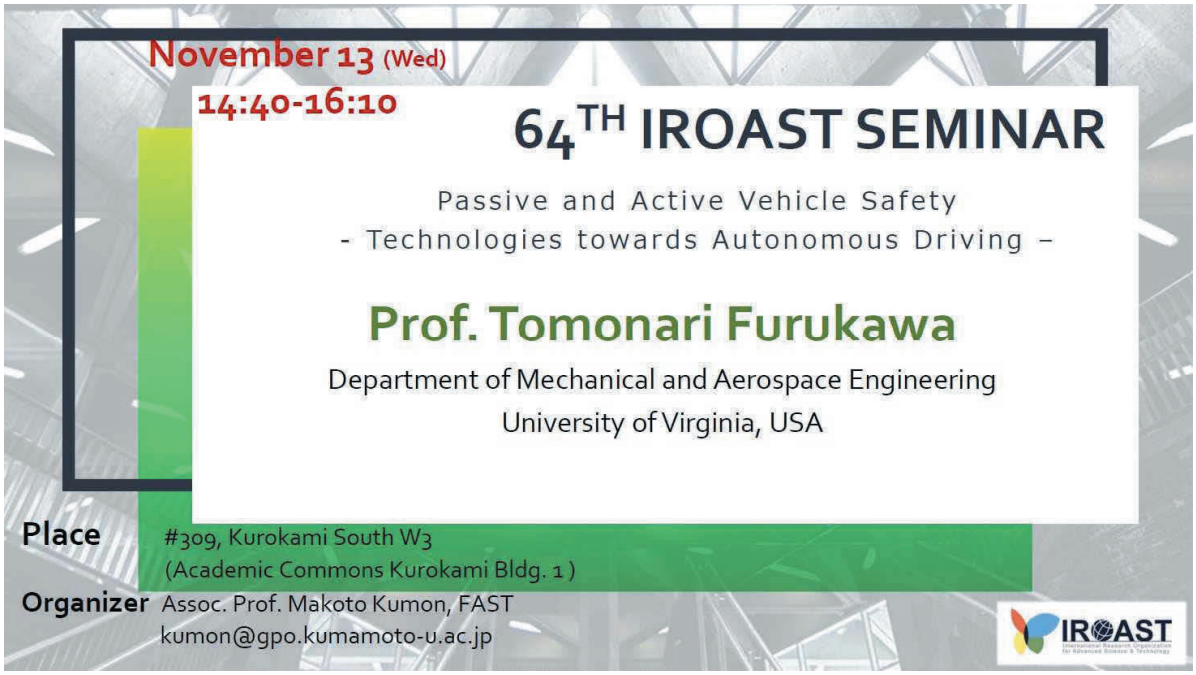
2. Seminar Outcomes and Future Plan

Seminar attracted graduate students and they joined discussion after the presentation by Prof. Furukawa.
As adaptive RBE is currently studied at VT/UVA where the host researcher of KU is now with, the method will be tested if it can improve the car clash investigation.

3. Others






November 13 (Wed)
14:40-16:10
64TH IROAST SEMINAR
Passive and Active Vehicle Safety
- Technologies towards Autonomous Driving –
Prof. Tomonari Furukawa
Department of Mechanical and Aerospace Engineering
University of Virginia, USA
Place
#309, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)
Organizer
Assoc. Prof. Makoto Kumon, FAST
kumon@gpo.kumamoto-u.ac.jp
IROAST

IROAST Seminar Report 9

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Tetsuya KIDA</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">Armando T. QUITAIN</td></tr>
<tr><td>Affiliation</td><td>College of Cross-Cultural and Multidisciplinary Studies</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">65th IROAST Seminar – Lignin Biorefinery: Processes and Products</td></tr>
<tr><td>Venue</td><td colspan="4">Lecture Room 203, Applied Chemistry and Biochemsitry Building</td></tr>
<tr><td>Time & Date</td><td colspan="4">November 25, 2019 (10:30-11:30)</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Maria Jose COCERO
Professor
High Pressure Research Group/Department of Chemical Engineering and Environmental Technology, Valladolid University (Spain)
Email: mjcocero@iq.uva.es</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 4
(Int'l participants: 1)</td><td rowspan="4">Total</td><td rowspan="4">41</td></tr>
<tr><td>Students: 35
(Int'l participants: 10)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 2
(Int'l participants: 2)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

In this international seminar, Prof. Maria Jose COCERO talked about biorefining processes of lignin, a biopolymer derived from lignocellulosic biomass, into value-added products and commodities. This seminar highlighted the technology that Prof. Cocero has been working with for over 3 decades, and were well attended by both undergraduate and graduate students from the Department of Applied Chemistry and Biochemistry. Participants from other laboratories were also present, and showed interests in the current trends in the biomass utilization technologies.

2. Seminar Outcomes and Future Plan

This seminar and lecture broadened the perspective of the participating students to the science and technology of this promising green environmental technology for biomass utilization. Possibility for future collaboration and joint international publication was also discussed after the seminar.

3. Others







November 25 (Mon)
10:30-11:30

Nano-Organics and Nano Hybrids Research Unit

65th IROAST Seminar

Lignin Biorefinery: Processes and Products

Prof. Maria Jose Cocero

The University of Valladolid, Spain

Place #203 Lecture Room, 2F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)

Organizers **Prof. Tetsuya Kida**, FAST, tetsuya@kumamoto-u.ac.jp
Prof. Armando T. Quitain, College of Cross-Cultural and Multidisciplinary Studies, quitain@kumamoto-u.ac.jp

IROAST

IROAST Seminar Report 10

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Makoto Takafuji</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">Yutaka Kuwahara</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Assistant Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">66th IROAST Seminar – Technoscience. Risks & opportunities of a social revoluation</td></tr>
<tr><td>Venue</td><td colspan="4">#203 Lecture room, 2F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)</td></tr>
<tr><td>Time & Date</td><td colspan="4">11:30-12:30, November 25, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Josep L.Barona / Professor (History of Science)
Catedràtic d'Història de la Ciència
Universitat de València (University of Valencia)</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 4
(Int'l participants: 1)</td><td rowspan="4">Total</td><td rowspan="4">41</td></tr>
<tr><td>Students: 35
(Int'l participants: 10)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 2
(Int'l participants: 2)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

The 66th IROAST seminar was held on 25 November, 2019. Prof. Josep Barona who is the guest professor of IROAST from the University of Valencia presented the origins of the "big science” after World War II and its importance for social change, daily life and the economy. It highlighted changes in the organization of research and innovation, discussing a few cases in the domain of biomedical sciences. Nearly 40 audiences including graduate and undergraduate students from applied chemistry department joined his seminar and listened attentively his lecture.

2. Seminar Outcomes and Future Plan

The host professors are now collaborating on the chiroptical properties of supramolecular assemblies with the scientific research group at the University of Valencia. Prof. Josep Barona is one of the members of the Spanish team. We had discussions on our collaboration, exchange and future plan, particularly for the exchange of young researchers. At this time, we decided to send one young post-doc to the University of Valencia in this year for research exchange. We hope her visit will open new collaboration between young researchers in the near future.

3. Others







November 25 (Mon)
11:30-

Nano-Organics and Nano Hybrids Research Unit

66th IROAST Seminar

Technoscience. Risks & opportunities of a social revolution

Dr. Josep-Lluis Barona-Vilar

Universidad de Valencia, Spain

Place #203 Lecture Room, 2F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)

Organizer Prof. Makoto Takafuji, FAST
takafuji@kumamoto-u.ac.jp

IROAST Seminar Report 11

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Hamid Hosano</td></tr>
<tr><td>Affiliation</td><td>IPPS</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">The 67th IROAST Seminar - IPPS Lecture & Seminar No. 50
Going Interstellar</td></tr>
<tr><td>Venue</td><td colspan="4">#516, Common Building 3</td></tr>
<tr><td>Time & Date</td><td colspan="4">14:30-16:00, December 3, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Prof. Konstantinos Kontis
Dean for Global Engagement–East Asia & China, Head of Aerospace Sciences Division, University of Glasgow, UK
IROAST Distinguished Professor</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 3 (Int'l participants: 2)</td><td rowspan="4">Total</td><td rowspan="4">10</td></tr>
<tr><td>Students: 6 (Int'l participants: 3)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1 (Int'l participants: 1)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

1.Seminar Overview

Title: Going Interstellar

Research enablers were highlighted, focused on future aerospace vehicles to be lighter and greener, and also to achieve optimal shape, performance, and system robustness throughout the flight envelope. Some thoughts were given to current blue-sky technologies that may have a dramatic effect upon future aerospace designs, and how Nature can be a source of inspiration. The lecture was also emphasized research or engineering issues for space travel and exploration, and other aerospace issues such as ensuring a diverse and robust engineering community.

2. Future Prospects

The lecture to the students enabled fruitful discussions about the potential of plasma systems and energy deposition in applications outside the traditional areas of IROAST, which opens up vast opportunities for multidisciplinary collaboration, knowledge transfer activities and impact generation.

3. Others

The unique technologies of IROAST can be married with a range of engineering applications opening up multidisciplinary opportunities. The seminar can set the foundations for future research activities and attracting potential students for joint research activities and staff exchanges/





IROAST
International Research Organization for Advanced Science & Technology

Kumamoto University
IPPS
Institute of Pulsed Power Science

- The 67th IROAST Seminar -
IPPS Lecture & Seminar No. 50

Title: **Going Interstellar**

Lecturer: Prof. Konstantinos Kontis
(Dean for Global Engagement – East Asia & China,
Head of Aerospace Sciences Division, University of Glasgow)
IROAST Distinguished Professor, Kumamoto Univ.

Date & Time: Dec. 3, 2019 (Tue.) 14:30～16:00

Venue: Common Building 3, 5th Floor, 516 (Seminar room)

Abstract: Research enablers will be highlighted, focussed on future aerospace vehicles to be lighter and greener, and also to achieve optimal shape, performance, and system robustness throughout the flight envelope. Some thoughts will be given to current blue-sky technologies that may have a dramatic effect upon future aerospace designs, and how Nature can be a source of inspiration. The lecture will also emphasise research or engineering issues for space travel and exploration, and other aerospace issues such as ensuring a diverse and robust engineering community.

Supported by Intentional Research Organization for Advanced Science and Technology (IROAST)

Organizer: Hamid Hosano (IPPS)

IROAST Seminar Report 12

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Yutaka Kuwahara</td></tr>
<tr><td>Affiliation</td><td>FAST
Nano-Organics and Nano-Hybrids Research Unit</td><td>Title</td><td>Assistant Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">68th IROAST Seminar – Our Investigations of CO_2 reduction: Past and Present</td></tr>
<tr><td>Venue</td><td colspan="4">203, 2F, Bldg. W3</td></tr>
<tr><td>Time & Date</td><td colspan="4">11:30 – 12:30, December 12, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Etsuko Fujita / Senior Chemist / Brookhaven National Laboratory, USA</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 4
(Int'l participants: 3)</td><td rowspan="4">Total</td><td rowspan="4">26</td></tr>
<tr><td>Students: 21
(Int'l participants: 3)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 0)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

We invited Dr. Etsuko Fujita, who was a senior chemist of Brookhaven National Laboratory, USA, and the 68nd IROAST seminar was held on December 12, 2019. The presenter, Prof. Fujita, is also a collaborator based on a KAKEN project and an “Open Partnership Joint Research Projects” with USA, JSPS. 25 of students and faculty members joined the seminar and had discussion about her talk entitled “Our Investigations of CO_2 reduction: Past and Present”.

The concentration of CO_2 in the atmosphere continues to increase due to fossil fuel combustion. To suppress that increasing, the recycling of carbon dioxide by chemical reduction is important. Dr. Fujita have studied photochemical CO_2 reduction for over 30 years, focusing on improvement of the catalytic performance for metal complexes.

Her talk in this seminar strongly impressed young students and researches, and the audience would understand the research field are important for resolving global problems like global warming. New research project and unit could be organized in near future with Fujita’s group of the Brookhaven National Laboratory.





At the seminar


Date December 12 (Thu) 10:30-11:30
Place #203 Lecture Room, 2F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)
Organizer Assistant Prof. Yutaka Kuwahara, FAST
kuwahara@kumamoto-u.ac.jp
IROAST
Dr. Etsuko Fujita
Senior Chemist
Brookhaven National Laboratory, USA
68TH IROAST SEMINAR
Our Investigations of CO_2 Reduction: Past and Present

IROAST Seminar Report 13

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Toshifumi Mukunoki</td></tr>
<tr><td>Affiliation</td><td>Department of Civil Engineering</td><td>Title</td><td>Associate Professor</td></tr>
<tr><td rowspan="2">Organizer 2</td><td>Name</td><td colspan="3">Patrice Delmas</td></tr>
<tr><td>Affiliation</td><td>The University of Auckland</td><td>Title</td><td>Associate Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">69th IROAST Seminar – Deep Learning & Image Processing for CT data analysis of morphometric parameters in soil</td></tr>
<tr><td>Venue</td><td colspan="4">Kurokami South Campus, 905, 9F, Faculty of Engineering Research Bldg. 1</td></tr>
<tr><td>Time & Date</td><td colspan="4">December 13 (Fri), 2019, 13:00-17:00</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Alfonso Gastelum Strozzi
(National Autonomous University of Mexico, Mexico)
Dr. Patrice Delmas
(The University of Auckland, New Zealand)
Dr. Trevor Gee
(The University of Auckland, New Zealand)</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 6
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">25</td></tr>
<tr><td>Students: 16
(Int'l participants: 4)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 3
(Int'l participants: 3)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

The workshop investigated the potential of machine learning and most specifically deep learning techniques to the understanding of soils characteristics and behavior from various scales and horizons (above -aerial, and inside -CT-scan). The attendees provided several perspectives of deep learning techniques applications to a range of problems and images notably:

Opening address by Dr. Toshifumi Mukunoki

i) In marine, forestry and farming environment from aerial perspective
ii) for CT-scan image segmentation of brain images; in a multi-scale sensing and image analysis point of view; by Dr. Patrice Delmas
iii) 3D morphological and textural analysis of voxels datasets
iv) Micro-Macro scale issue and its modeling by Dr. Alfonso Gastelum Strozzi
v) Deep learning + Computer Vision in the context of New Zealand environment
vi) Multi-Scale UAV Mapping of surface topographies by Dr. Trevor Gee

Each lecture had 1 hour with Q&A.

2. Seminar Outcomes and Future Plan

The young students received strong impression about the researches regarding basics of deep learning. Nowadays, AI is very popular so many people are using without deep understanding. For general users, it is OK because AI technology is very convenient. However, Dr. Delmas left strong message to students if you did not understand what you were doing, you should not use it as your research tool. But, indeed application of deep learning is very useful so try to understand machine learning first and then, study about deep learning. After seminar, some technician and PhD candidates contacted them and discussed their own research how to use image analysis with deep learning to their own research. Dr. Delmas will come back to Kumamoto this summer as adjunctive professor to give a series lecture

about Deep learning and Image analysis.

Dr. Gee is a specialist of Deep learning to Image analysis so now Dr. Mukunoki, Dr. Delmas and Dr. Gee have stared collaborate research with respect to monitoring large area with respect to natural disaster like flood and landslides. Deep learning uses large capacity of calculation so Dr. Strozzi will contribute knowledge of CUDA for our project.

3. Others



Associate Prof. Mukunoki



Dr. Alfonso Gastelum Strozzi



Dr. Trevor Gee



Associate Prof. Patrice Delmas



Group Photo after seminar



IROAST Seminar Report 14

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Tokio Tani</td></tr>
<tr><td>Affiliation</td><td>FAST, Department of Biology</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">70th IROAST Seminar – Chemical modifications of RNA in control of mammalian gene expression</td></tr>
<tr><td>Venue</td><td colspan="4">Rm C329, Rigakubu Bldg 1</td></tr>
<tr><td>Time & Date</td><td colspan="4">16:00-17:00, December 18, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Ramesh Pillai
Professor
Department of Molecular Biology
University of Geneva, Switzerland</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 10 (Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">53</td></tr>
<tr><td>Students: 41 (Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 2 (Int'l participants: 1)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

Dr. Ramesh Pillai is a professor in University of Geneva, Department of Molecular Biology, Switzerland. He has been working on the small functional noncoding RNAs, microRNAs and piRNAs, and came to Kumamoto University to discuss ongoing collaborative research project. Prof. Pillai and Tani, an organizer of the seminar, have been conducting a collaborative research on the cellular structure, called Nuage, which relates to the piRNA biogenesis, for 6 years. The organizer Prof. Tani went to University of Geneva this September and exchanged the information on the project. In this IROAST seminar, Prof. Pillai talked about his study on RNA modification that controls gene expression in mammalian cells. The research on RNA modification has recently developed as one of very “hot” fields in molecular biology. By chance, Prof. Haruhiko Shiomi in Medical Department, Keio University, who is also famous for working on the piRNA, came to Kumamoto to give a seminar in IMEG at the same day. He attended the Pillai’s seminar and did discussion after the seminar. The seminar was very exciting, and attractive to the participants, including young students in GSST.





December 18 (Wed) 16:00-17:00

IROAST

Dr. Ramesh S. Pillai

Department of Molecular Biology, University of Geneva, Switzerland
IROAST Visiting Professor

70th IROAST Seminar

CHEMICAL MODIFICATIONS OF RNA IN CONTROL OF MAMMALIAN GENE EXPRESSION

Place C329, 3F, Faculty of Science Bldg. 2
Organizer Prof. Tokio Tani, FAST, ttani@kumamoto-u.ac.jp

IROAST Seminar Report 15

<table>
<tr><td rowspan="2">Organizer 1</td><td>Name</td><td colspan="3">Hamid Hosano</td></tr>
<tr><td>Affiliation</td><td>IPPS</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">The 71st IROAST Seminar, IPPS Lecture & Seminar No. 52
Biomaterials for Localized Delivery: Design and Safety Considerations</td></tr>
<tr><td>Venue</td><td colspan="4">#516, Common Building 3</td></tr>
<tr><td>Time & Date</td><td colspan="4">13:00-14:30, December 18, 2019</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Prof. Hamid Ghandehari
Director of Utah Center for Nanomedicine, Professor of Department of Pharmaceutics and Pharmaceutical Chemistry and Bioengineering, University of Utah, USA
Editor in Chief, Advanced Drug Delivery Reviews
IROAST Visiting Professor, Kumamoto Univ.</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 5
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">20</td></tr>
<tr><td>Students: 12
(Int'l participants: 5)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 3
(Int'l participants: 3)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1.Seminar Overview

Title: Biomaterials for Localized Delivery: Design and Safety Considerations.

Engineered nanomaterials provide fundamental building blocks in nanomedicine applications such as biosensing, drug delivery, imaging and detection of circulating tumor cells. Successful clinical translation of these constructs requires a detailed understanding of the influence of their physicochemical properties on their biological fate. During the lecture, Prof. Ghandehari’s lab efforts on the investigation of the nano-biomaterials for localized delivery and their design and safety considerations were presented.

2. Future Prospects

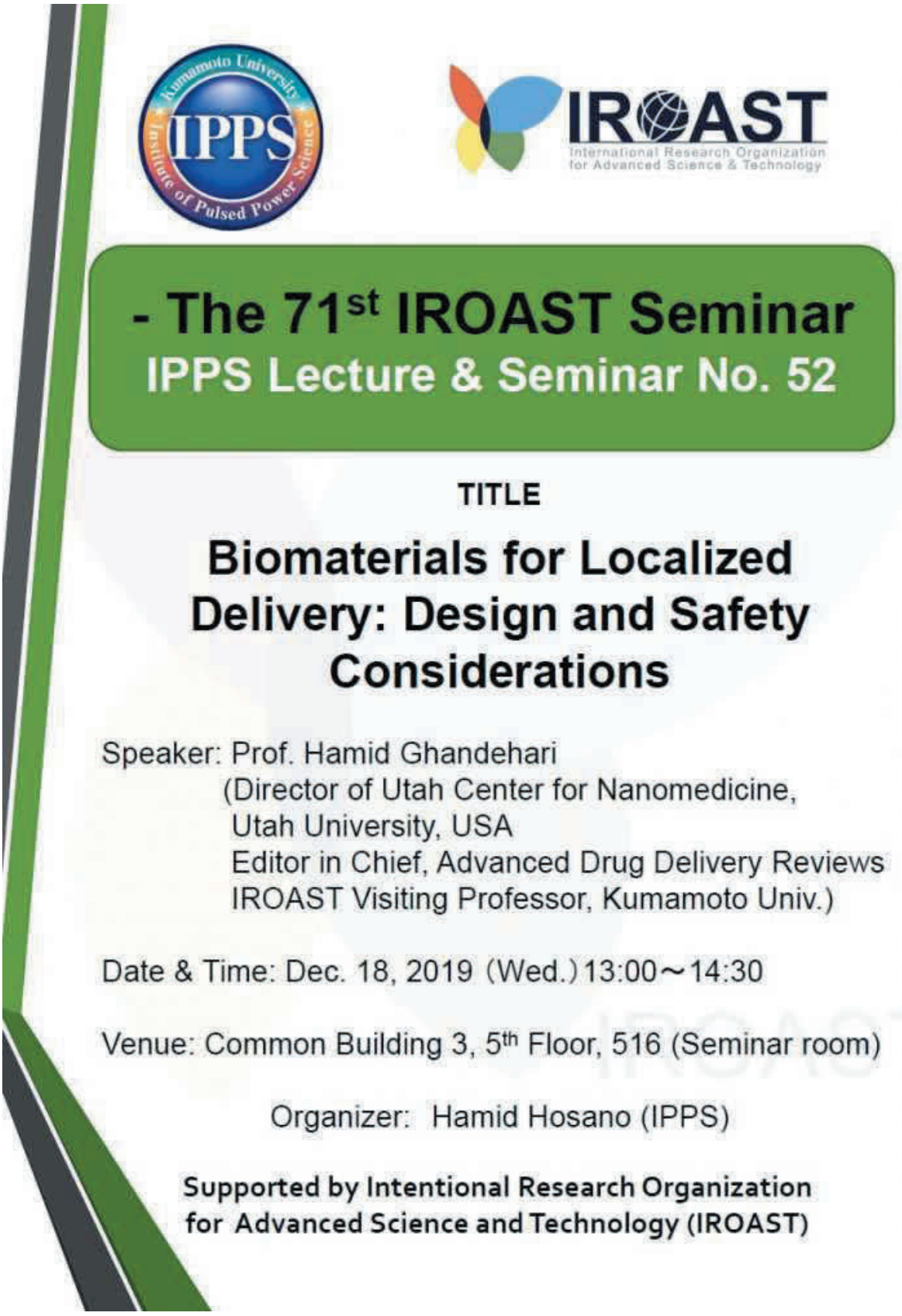
This lecture provided opportunities for IROAST colleagues and students at Kumamoto University to explore application of nano-biomaterials for localized delivery and their design and safety considerations as well as utility of nano-biomaterials for potential collaborative projects.

3. Others

Interdisciplinary research at the interface of engineering and medicine using nanoparticulate carriers was discussed.






Kumamoto University
IPPS
Institute of Pulsed Power Science
IROAST
International Research Organization for Advanced Science & Technology
- The 71st IROAST Seminar
IPPS Lecture & Seminar No. 52
TITLE
Biomaterials for Localized Delivery: Design and Safety Considerations
Speaker: Prof. Hamid Ghandehari
(Director of Utah Center for Nanomedicine,
Utah University, USA
Editor in Chief, Advanced Drug Delivery Reviews
IROAST Visiting Professor, Kumamoto Univ.)
Date & Time: Dec. 18, 2019 (Wed.) 13:00～14:30
Venue: Common Building 3, 5th Floor, 516 (Seminar room)
Organizer: Hamid Hosano (IPPS)
Supported by Intentional Research Organization for Advanced Science and Technology (IROAST)

IROAST Seminar Report 16

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Mitsuru Sasaki</td></tr>
<tr><td>Affiliation</td><td>Institute of Pulsed Power Science</td><td>Title</td><td>Assoc. Prof.</td></tr>
<tr><td>Seminar Title</td><td colspan="4">72nd IROAST Seminar – Waste treatment in high-temperature and high-pressure water: from fundamentals to applications</td></tr>
<tr><td>Venue</td><td colspan="4">Rm#203, 203, Kurokami South W4, Faculty of Engineering Bldg. II</td></tr>
<tr><td>Time & Date</td><td colspan="4">13:00-14:00, January 29, 2020</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Olivier Boutin
Professor, Aix-Marseille University (France)</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 2 (Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">13</td></tr>
<tr><td>Students: 10 (Int'l participants: 5)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1 (Int'l participants: 1)</td></tr>
<tr><td>Students: 0 (Int'l participants: 0)</td></tr>
</table>

1.Seminar Overview

In this seminar, the organizer aimed researchers and students to learn fundamental physical properties and characteristics of subcritical and supercritical water" called the fourth state, which is the second state after solid, liquid and gas. Secondly, I aimed to allow audiences to understand that various harmful species can be decomposed by using subcritical water in the presence of oxygen, both of which are environmentally friendly chemicals.

2. Seminar Outcomes and Future Plan

Through this seminar, I believe that the following results were obtained.

(1) Participants were able to acquire knowledge on basic physical properties and characteristics of subcritical and supercritical water.

(2) We were able to learn practical processes using sub- and supercritical water in the worldwide.

(3) Some students were able to obtain knowledge that can solve the problems in the research they are currently carrying out.

With this interaction as a trigger, we will start international collaborative research, and we will try to activate exchange through dispatch or acceptance of students. For research subjects that are already conducting joint research, we aim to contribute co-authored international peer-review papers.

3. Others

Prof. Olivier Boutin was obtained the FY2019 IROAST Visiting Professor position and he will apply for the Call for the FY2020 IROAST Visiting Professor.



Prof. Olivier



Snapshot of the seminar



IROAST Seminar Report 17

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Yutaka Kuwahara</td></tr>
<tr><td>Affiliation</td><td>FAST
Nano-Organics and Nano-Hybrids Research Unit</td><td>Title</td><td>Assistant Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">73rd IROAST Seminar – Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules</td></tr>
<tr><td>Venue</td><td colspan="4">203, 2F, Bldg. W3</td></tr>
<tr><td>Time & Date</td><td colspan="4">15:00 – 16:00, February 06, 2020</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Dr. Tomoyasu Mani / Assist. Professor / University of Connecticut, USA</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 4
(Int'l participants: 0)</td><td rowspan="4">Total</td><td rowspan="4">29</td></tr>
<tr><td>Students: 23
(Int'l participants: 3)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 1)</td></tr>
<tr><td>Students: 1
(Int'l participants: 1)</td></tr>
</table>

We invited Dr. Tomoyasu Mani, who was an assistant professor, University of Connecticut, USA, and the 73nd IROAST seminar was held on February 6, 2020. The presenter, Prof. Mani, is also a collaborator based on the “Open Partnership Joint Research Projects” in a Japan-USA Bilateral Program of JSPS. About 30 students and faculty members joined the seminar and had discussion about his talk entitled “Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules”. Conjugated organic molecules are a candidate material for functional organic device and “molecular wires” consist of chains of the conjugated molecules have the potential to be employed for various applications and technologies, for example, organic solar cells, catalysis and molecular electronics. In this seminar, Dr. Mani showed what was vibrational probes and how the probes could report behaviors of electrons in the conjugated molecules.

His talk strongly impressed young students and researches who weren’t familiar with scientific fields associated with the talk. I believe audience could recognize importance of our collaboration. New research project and unit can be organized in near future by the continuous collaboration with Dr. Mani.





February 6(Thu), 2020 15:00-16:00

73RD IROAST SEMINAR

Power of Vibrational Probes to Study Electrons in π-Conjugated Organic Molecules

Dr. Tomoyasu Mani

Assistant Professor
University of Connecticut, USA

Place #203 Lecture Room, 2F, Kurokami South W3
(Academic Commons Kurokami Bldg. 1)

Organizer Assistant Prof. Yutaka Kuwahara, FAST
kuwahara@kumamoto-u.ac.jp

IROAST Seminar Report 18

<table>
<tr><td rowspan="2">Organizer</td><td>Name</td><td colspan="3">Shinya Hayami</td></tr>
<tr><td>Affiliation</td><td>Faculty of Advanced Science and Technology</td><td>Title</td><td>Professor</td></tr>
<tr><td>Seminar Title</td><td colspan="4">74th IROAST Seminar
Nanoscopic Inorganic Structures–A New Class of Materials for Sustainability</td></tr>
<tr><td>Venue</td><td colspan="4">C122, Faculty of Science Building 2</td></tr>
<tr><td>Time & Date</td><td colspan="4">15:00-16:30, March 13th, 2020</td></tr>
<tr><td>Speaker’s Name/ Title/Affiliation</td><td colspan="4">Selvam Parasuraman
Professor
National Centre for Catalysis Research
Indian Institute of Technology-Madras</td></tr>
<tr><td rowspan="4">Number of Participants</td><td rowspan="2">From KU</td><td>Faculty: 4
(Int'l participants: 2)</td><td rowspan="4">Total</td><td rowspan="4">30</td></tr>
<tr><td>Students: 25
(Int'l participants: 0)</td></tr>
<tr><td rowspan="2">From outside KU</td><td>Faculty: 1
(Int'l participants: 1)</td></tr>
<tr><td>Students: 0
(Int'l participants: 0)</td></tr>
</table>

1. Seminar Overview

The discovery and development of periodic porous materials of well-defined pore geometry with precise and easily controllable pore shape and size is of great importance in many areas of modern science and technology. In this regard, mesoporous and hierarchical (micro-meso-macro) molecular sieves including zeolite-like metal-organic framework structures (MOFs) are the new generation ordered porous solids, analogous to conventional microporous (zeolitic) materials, with high surface area, large pore opening and huge pore volumes. On the one hand, the unique flexibility of these materials, in terms of synthetic conditions, pore size tuning, high surface area, large internal hydroxyl groups, framework substitution, etc., have created new avenues not only in catalysis but also in the areas of advanced energy materials and environmental pollution control strategies. On the other hand, the preparation and characterization of high quality materials with well-defined pore characteristics is of paramount importance for many applications in areas including nanomaterials, catalysis, adsorption and separation. In designing such materials, several characteristics of pore structure may be addressed, which include their shape, size, pore interconnectivity, etc. Likewise, traditional preparation methods of supported catalyst systems are neither efficient in generating/dispersing uniform sized clusters nor chemically inert towards the guest molecules. Nevertheless, the confinement of nanoclusters/nanofilaments/enzymes in the cavities/voids/pores of nanostructured matrices is attracting much attention as a way to stabilize highly dispersed materials in the form of atoms, clusters, colloids or filaments, and prevent their coalescence into to larger, ill-defined aggregates. In this context, self-assembly of nanoparticles into ordered pore structures, i.e., encapsulation of the nanosized materials in zeolitic-pores, is considered as one of the promising options. Therefore, in this presentation, the recent progress on the development of numerous nanoscale materials and their applications in catalysis will be discussed.

2. Seminar Outcomes and Future Plan

Prof. Selvam Parasuraman research about catalyst materials, and he is a world-leading researcher in the research area. And he stayed in Kumamoto University for 2 weeks, and we could discuss about catalyst materials by using our GO and 2D materials. Furthermore, he has many ideas, we also discussed about nitrogen doped carbon research. We will start a collaboration about GO hybrid catalyst. Our collaboration is very strong society and each researcher is also very high level in the world. For some our results, we have submitted and published in top class journals. We will also collaborate in this project each other from now.

3. Others



Finally, I would like to thank IROST support for our research collaborations.



From Invited Researcher

Name: Parasuraman Selvam

1. Research achievements

- Initiated research collaboration on the synthesis of novel iron-binuclear complexes for the oxidation of methane to methanol.
- Initiated research collaboration on the study of luminescence properties of ordered mesoporous titania and coloured titania.

2. Overview and significance of the research collaboration with Kumamoto University

While collaboration has been an integral part of research, the nature of collaboration appears to be evolving from interdisciplinary approach and encouraged the development of innovative and path-breaking strategies in investigating increasingly novel and complex areas. There are a number of factors driving the trend toward increased collaboration that include the ability to share resources, exchange students, opportunity to learn from other disciplines, etc. In this way, Indian Institute of Technology-Madras (IIT-Madras) and Kumamoto University can benefit each other.

3. Comments or suggestions for IROAST/Kumamoto University

Modern research requires a great deal of collaboration among academicians, scientists, engineers and technologists. Collaboration can address the demand for expanded capacity that is required of research projects demonstrating proper scope and complexity. In fact, breakthroughs are often more likely to come from collaboration across disciplines. Thus, collaboration can facilitate conducting research with a greater scope, invite experts from diverse yet relevant disciplines, handle larger number of study subjects and permit research to be conducted at different locations both at nationally or internationally.

4. Prospect for further research collaboration with Kumamoto University

Different forms of partnership beyond the school are having an impact on the work of research leads. The mutual topic of interest provides an excellent opportunity to integrate the individual research expertise of the groups in India and Japan to work effectively addressing global challenges.

5. Impressions of Kumamoto University/Kumamoto

Students and researchers will find Kumamoto University as an attractive place for carrying out their study under the guidance of experienced and highly helpful faculty. They would also greatly benefited from the modern equipment and infrastructure available in the campus. Kumamoto is one of the beautifully cities in Japan and also a very safe place for living and studying especially for young international students.

Agreement

No.	Kumamoto University	Partner University/Institute	Date of Conclusion
1	FAST IROAST	The Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	05/27/2019

Memorandum of Understanding

No.	Kumamoto University	Partner University/Institute	Date of Conclusion
2	**Toshifumi Komatsu** GSST/ FAST	**Doan Dinh Hung** The laboratory of Doan Dinh Hung in Vietnam National Museum of Nature (VNMN), Vietnam Academy of Science and Technology (VAST), Socialist Republic of Vietnam	02/29/2020

GSST: Graduate School of Science and Technology, Kumamoto University

*The conclusion of the MOU was supported by the IROAST International Joint Research Travel Support Program.

Kumamoto University

Memorandum of Understanding

Between

Kumamoto University (KU)

Faculty of Advanced Science and Technology, and

International Research Organization for Advanced Science and Technology

of Kurokami, Chuo-ku, Kumamoto, 860-8555, Japan

and

The Commonwealth Scientific and Industrial Research Organisation (CSIRO),

of Limestone Avenue, Campbell, ACT 2612, Australia

for

Academic Exchange and Engagement Cooperation

---

1. KU and CSIRO (hereinafter referred to as the Parties) enter into this Memorandum of Understanding (MOU) to encourage collaboration in areas of mutual interest and benefit to both Parties. Based on the principles of equality and reciprocity, this MOU serves as a general framework for cooperation between the two Parties and is intended to facilitate discussions for more specific programs of collaboration. Any specific program of collaboration or sharing of confidential information will be subject to formal agreement. The key focus of this MOU is to:

   i. Encourage academic exchange and collaboration in the areas of engineering, advanced science and technology, education and research;

   ii. Encourage CSIRO staff to go to KU to promote CSIRO technologies and research and to build up academic collaborations with KU;

   iii. Encourage KU professors, researchers and postgraduate students to go to CSIRO to promote friendship and academic exchanges;

   iv. Encourage the exchange of information, demonstration materials and use of equipment and facilities under separate legally enforceable arrangements; and identify other areas of possible interest and collaboration.

2. A designated person at each Party will oversee and facilitate implementation of this MOU in cooperation with other appropriate administrators at the respective institutions. The Commonwealth Scientific and Industrial Research Organisation designates Dr Shirley Shen (Engagement Manager, CSIRO Manufacturing). The Kumamoto University designates Prof. Yoji Mine (Professor, Faculty of Advanced Science and

Technology) and Prof. Takashi Hiyama (Director, International Research Organisation for Advanced Science and Technology).

3. The scope of activities under this MOU will be determined by funds regularly available at both institutions for the types of collaboration undertaken and by such other financial assistance as may be obtained by either institution from external sources.
4. Notwithstanding anything contained in this MOU, each Party retains its autonomy to conduct research independently of this MOU.
5. Each Party's rights, title and interest in its intellectual property and confidential information remains unaffected by the existence of this MOU. For the avoidance of doubt, neither Party is obliged to disclose any confidential information to the other Party. Any disclosure or exchange of confidential information must be covered by an appropriate confidentiality agreement.
6. Upon signature by each Party, this MOU will be in effect for a period of five years or until otherwise terminated earlier in writing by either Party, who will give the other Party at least six month in advance notice of intention to terminate. Termination will incur no liability on either Party, and will not affect any agreements or other legally-binding arrangements in place between the two Parties.
7. This MOU is not governed by international or domestic law and does not constitute, nor is it intended to be a legally binding arrangement or contract. It does not create any legally binding or enforceable obligations, express or implied. It serves only as a record of each Party's separate intention pending execution of specific agreements governing the undertaking of activities as contemplated by this document.
8. Nothing in this MOU is to be treated as creating a partnership, agency, trust, joint venture or otherwise.
9. Any dispute, controversy or difference as to the interpretation of this MOU will be settled amicably by mutual consent between the Parties.

For Faculty of Advanced Science and Technology, Kumamoto University

Name: Prof. Tsuyoshi Usagawa, Ph.D.; Dean

(Signature)

Tsuyoshi Usagawa

Date April 12, 2019

International Research Organization for Advanced Science and Technology, Kumamoto University

Name: Prof. Takashi Hiyama, Ph.D.; Director

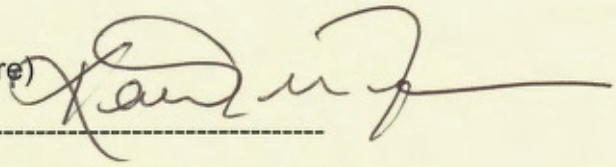
(Signature)

Takashi Hiyama

Date April 12, 2019

For The Commonwealth Scientific and Industrial Research Organisation, Australia

Name: Dr. Keith McLean; Director – CSIRO Manufacturing

(Signature) 

Date 27 MAY 2019

Memorandum of Understanding (MOU)
between
the laboratory of Doan Dinh Hung
in Vietnam National Museum of Nature (VNMN)
Vietnam Academy of Science and Technology (VAST)
and
the laboratory of Toshifumi Komatsu
in Faculty of Advanced Science and Technology (FAST),
Kumamoto University

The laboratory of Doan Dinh Hung in Vietnam National Museum of Nature, Vietnam Academy of Science and Technology, Socialist Republic of Vietnam, and the laboratory of Toshifumi Komatsu in Graduate School of Science and Technology, and Faculty of Advanced Science and Technology, Kumamoto University, Japan, agree to conclude the following Memorandum of Understanding (hereinafter referred to as "MOU") on academic cooperation. All activities under the framework of this MOU must be followed the laws of Socialist Republic of Vietnam and Japan.

1. Objective of cooperation

Promote cooperation in various areas of education and scientific research (Reconstructions of the Mesozoic biofacies in Vietnam and Reconstructions of the Cenozoic non-marine biofacies in northern Vietnam).

2. Content of cooperation

(1) Co-organize the exchanging professors, professional personnel and students, and also exchanging research materials and data that should have permission from Vietnam relevant agencies.

(2) Co-ordinate in postgraduate training

(3) Hold joint workshops and seminars.

(4) Co-organize the research courses, field work. sample analysis, joint publication of research results.

(5) Exchange specimens

(6) Other areas that both parties take interest in.

3. Financial obligation

This MOU does not regulate specific in finance. The financial regulations will be reflected in specific projects. We will apply Bilateral Programs Joint Research Projects/Seminars between Vietnam and Japan, JSPS

4. Ownership

- The parties will jointly publish the research results
- The parties will jointly hold the ownership of patents (if any).

5. Duration of MOU

This MOU is valid for 3 years and may be extended by the written agreement between the parties.

6. Effectiveness and termination of MOU

This MOU takes effect after its signing date. This MOU may be amended or terminated by mutual consent, if proposed by either party, by giving at least six months notice in writing to the other party.

VIETNAM NATIONAL MUSEUM OF NATURE
VIETNAM ACADEMY OF SCIENCE AND TECHNOLOGY
SOCIALIST REPUBLIC OF VIET NAM

BẢO TÀNG THIÊN NHIÊN VIỆT NAM
Phòng Địa chất

Doan Dinh Hung

Vietnam National Museum of Nature
Vietnam Academy of Science and Technology

Date: 29th Feb. 2020

FACULTY OF ADVANCED SCIENCE AND TECHNOLOGY,
KUMAMOTO UNIVERSITY
JAPAN

Associate Prof. Toshifumi Komatsu

Faculty of Advanced Science and Technology,
Kumamoto University

Date: 29th Feb., 2020

Jorge Norberto Beltramini

S. Mukundan, L. Atanda and J. N. Beltramini, "Thermocatalytic cleavage of C-C and C-O bonds in model compounds and kraft lignin by $NiMoS_2$/C nanocatalysts," RSC Sustainable Energy & Fuels, 3, 1317-1328, 2019.

M. Rashidi, J.N. Beltramini and D. Martin, "The selective cleavage of lignin aliphatic C-O linkages by solvent-assisted fast pyrolysis (SAFP)," Journal of inclusion Phenomena and Macrocylic Chemistry, 94, 297-307, 2019.

W. Wanwitoo, J. N. Beltramini, J. Bartley, N. Laosiripojana and W. Doherty, William, "Effect of HCOOK/ethanol on Fe/HUSY, Ni/HUSY and Ni– Fe/HUSY catalysts on lignin depolymerisation to benzyl alcohols and bioaromatics," ACS Omega, 4(16):16980-16993, 2019.

László Pusztai

Jure Cerar, Andrej Jamnik, Ildiko Pethes, Laszlo Temleitner, Laszlo Pusztai, Matija Tomsic, "Structural, rheological and dynamic aspects of hydrogen-bonding molecular liquids: Aqueous solutions of hydrotropic tert-butyl alcohol," Journal of Colloid and Interface Science, 560, 730-742, 2020.

Shinya Hosokawa, Jean-François Bérar, Nathalie Boudet, Wolf-Christian Pilgrim, László Pusztai, Satoshi Hiroi, Kenji Maruyama, Shinji Kohara, Hidemi Kato, Henry E. Fischer, and Anita Zeidler, "Partial structure investigation of the traditional bulk metallic glass Pd40Ni40P20," Physical Review B, 100, 054204, 2019.

Szilvia Pothoczki, László Pusztai and Imre Bako, "Molecular Dynamics Simulation Studies of the Temperature-Dependent Structure and Dynamics of Isopropanol–Water Liquid Mixtures at Low Alcohol Content," The Journal of Physical Chemistry B, 123 (35), 7599-7610, 2019.

Imre Bakó, János Daru, Szilvia Pothoczki, László Pusztai, Kersti Hermansson, "Effects of H-bond asymmetry on the electronic properties of liquid water – An AIMD analysis," Journal of Molecular Liquids, 293, 111579, 2019.

Imre Bakó, István Mayer, Andrea Hamza, László Pusztai, "Two- and three-body, and relaxation energy terms in water clusters: Application of the hierarchical BSSE corrected decomposition scheme," Journal of Molecular Liquids, 285, 171-177, 2019.

Yufeng Zheng

Wei Yuan, Dandan Xia, Y.F. Zheng, Xiangmei Liu, Shuilin Wu, Bo Li, Yong Han, Zhaojun Jia, Donghui Zhu, Liqun Ruan, Kazuki Takashima, Yunsong Liu, Yongsheng Zhou, "Controllable

biodegradation and enhanced osseointegration of ZrO2 nanofilm coated Zn-Li alloy: in vitro and in vivo studies," Acta Biomaterialia, 105, 290-303, 2020.

Hongtao Yang, Bo Jia, Zechuan Zhang, Xinhua Qu, Guannan Li, Wenjiao Lin, Donghui Zhu, Kerong Dai, Yufeng Zheng, "Alloying design of biodegradable zinc as promising bone implants for load-bearing applications," Nature Communications, 11, 401, 2020.

Guannan Li, Hongtao Yang, Yufeng Zheng, Xie-Hui Chen, Jian-An Yang, Donghui Zhu, Liqun Ruan, Kazuki Takashima, "Challenges in the use of zinc and its alloys as biodegradable metals: perspective from biomechanical compatibility," Acta Biomaterialia, 97(1), 23-45, 2019.

Mitsuhiro Aida

Ishihara H, Sugimoto K, Tarr PT, Temman H, Kadokura S, Inui Y, Sakamoto T, Sasaki T, Aida M, Suzuki T, Inagaki S, Morohashi K, Seki M, Kakutani T, Meyerowitz E, Matsunaga S, "Primed histone demethylation regulates shoot regenerative competency," Nat Commun 10, 1786, 2019.

Takumi Higaki

Kwon SH, Wi T, Park YI, Kim MW, Lee G, Higaki T, Choi JH, Lee R, "Non-invasive early detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor," Bioconjug Chem., 31(3), 803-812, 2020.

Keisho Maeda, Michiko Sasabe, Shigeru Hanamata, Yasunori Machida, Seiichiro Hasezawa, Takumi Higaki, "Actin filament disruption alters phragmoplast microtubule dynamics during the initial phase of plant cytokinesis," Plant Cell Physiol., 61(3), 445-456, 2020.

Risaku Hirai, Takumi Higaki, Yuto Takenaka, Yuki Sakamoto, Junko Hasegawa, Sachihiro Matsunaga, Taku Demura, Misato Ohtani, "The progression of xylem vessel cell differentiation is dependent on the activity level of VND7 in Arabidopsis thaliana," Plants, 9(1), 39, 2020.

Jeh Haur Wong, Takehide Kato, Samuel Belteton, Rie Shimizu, Nene Kinoshita, Takumi Higaki, Yuichi Sakumura, Daniel B. Szymanski, Takashi Hashimoto, "Basic proline-rich protein-mediated microtubules are essential for lobe growth and flattened cell geometry," Plant Physiology, 181(4), 1519-1534, 2019.

Akiko Nakamasu, Takumi Higaki, "Theoretical models for branch formation in plants," J Plant Res, 132(3), 325-333, 2019.

Ruda Lee

Song Yeul Lee, Ruda Lee†, Eunha Kim, Sanghee Lee, Yong Il Park, "Near-infrared light-triggered photodynamic therapy and apoptosis using upconversion nanoparticles with dual photosensitizers," Frontiers in Bioengineering and Biotechnology, 8, p275, 2020. (†co-first)

Ruda Lee, Yu Jin Choi, Myeong Seon Jeong, Yong Il Park, Keiichi Motoyama, Min Woo Kim, Seung-Hae Kwon, Jung Hoon Choi, "Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Nonsmall Cell Lung Cancer," Bioconjugate Chem., 31(3), 923-932, 2020.

Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, Ruda Lee*, Yong Il Park, "Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions," Frontiers in Bioengineering and Biotechnology, 8, p133, 2020. (*co-corresponding)

Seung-Hae Kwon, Taemin Wi, Yong Il Park, Min Woo Kim, Gibok Lee, Takumi Higaki, Jung Hoon Choi, Ruda Lee, "Non-invasive early detection of calpain 2-enriched non-small cell lung cancer using a human serum albumin-bounded calpain 2 nanosensor," Bioconjug Chem., 31(3), 803-812, 2020.

Ayaka Harada, Hiroyasu Tsutsuki, Tianli Zhang, Ruda Lee, Kinnosuke Yahiro, Tomohiro Sawa, Takuro Niidome, "Preparation of biodegradable PLGA-nanoparticles used for pH-sensitive intracellular delivery of an anti-inflammatory bacterial toxin to macrophages," Chem. Pharm. Bull., 68(4), 363-368, 2020.

Sofiane Hamidi, Yukiko Nakaya, Hiroki Nagai, Cantas Alev, Takeya Kasukawa, Sapna Chhabra, Ruda Lee, Hitoshi Niwa, Aryeh Warmflash, Tatsuo Shibata, and Guojun Sheng, "Mesenchymal-Epithelial Transition Regulates Initiation of Pluripotency Exit before Gastrulation," Development, 147(3), dev184960, 2020.

Min Woo Kim, Takuro Niidome, Ruda Lee, "Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer," Marine Drugs, 17 (10), 581, 2019.

Ruda Lee, Sung-Jae Choi, Kyung Chul Moon, Jong Woong Park, Kwangmeyung Kim, Soo-Young Yoon and Inchan Youn, "Fluorogenic Probe for Detecting Active Matrix Metalloproteinase-3 (MMP-3) in Plasma and Peripheral Blood Neutrophils to Indicate the Severity of Rheumatoid Arthritis," ACS Biomater. Sci. Eng., 5, 6, 3039-3048, 2019.

Atsushi Sainoki

Atsushi Sainoki, Duncan Maina, Adam Karl Schwartzkopff, Yuzo Obara, and Murat Karakus, "Impact of the intermediate stress component in a plastic potential function on rock mass stability around a sequentially excavated large underground cavity," International Journal of Rock Mechanics and Mining Science, 127, 104223, 2020.

Atsushi Sainoki, Chiaki Hirohama, Adam Schwartzkopff, "Dynamic Modelling of Induced Seismicity by Using Seismic Efficiency Constraints and a New Scaling Law for Slip-Weakening Distance," Pure and Applied Geophysics, 177, 637-659, 2020.

Y. Obara, K. Nakamura, S. Yoshioka, A. Sainoki, A. Kasai, "Crack front geometry and stress intensity factor of semi-circular bend specimens with straight through and chevron notches," Rock Mechanics and Rock Engineering, 53, 723-738, 2020.

Peng Kong, Lishuai Jiang, Jiaming Shu, Atsushi Sainoki, Qingbiao Wang, "Effect of Fracture Heterogeneity on Rock Mass Stability in a Highly Heterogeneous Underground Roadway," Rock Mechanics and Rock Engineering, 52, 4547-4564, 2019.

Kodama, J. I., Mitsui, Y., Hara, S., Fukuda, D., Fujii, Y., Sainoki, A., & Karakus, M., "Time-dependence of mechanical behavior of Shikotsu welded tuff at sub-zero temperatures," Cold Regions Science and Technology, 168, 102868, 2019.

Atsushi Sainoki, Hani S. Mitri, Damodara Chinnasane, Adam Karl Schwartzkopff, "Quantitative energy-based evaluation of the intensity of mining-induced seismic activity in a fractured rock mass," Rock Mechanics and Rock Engineering, 52, 4651-4667, 2019.

Takashi Ishida

Akihiro Yamamoto, Takashi Ishida, Mika Yoshimura, Yuri Kimura and Shinichiro Sawa, "Developing heritable mutations in Arabidopsis thaliana using a modified CRISPR/Cas9 toolkit comprising PAM-altered Cas9 variants and gRNAs," Plant and Cell Physiology, 60(10), 2255-2262, 2019.

Akiko Nakamasu

Akiko Nakamasu, Takumi Higaki, "Theoretical models for branch formation in plants," J Plant Res, 132(3), 325-333, 2019.

Minwoo Kim

Ruda Lee, Yu Jin Choi, Myeong Seon Jeong, Yong Il Park, Keiichi Motoyama, Min Woo Kim, Seung-Hae Kwon, Jung Hoon Choi, "Hyaluronic Acid-Decorated Glycol Chitosan Nanoparticles

for pH-Sensitive Controlled Release of Doxorubicin and Celecoxib in Nonsmall Cell Lung Cancer," Bioconjugate Chem., 31(3), 923-932, 2020.

Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, Ruda Lee, Yong Il Park, "Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions," Shibainu Frontiers in Bioengineering and Biotechnology, 8, p133, 2020.

Min Woo Kim, Takuro Niidome, Ruda Lee, "Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer," Marine Drugs, 17 (10), 581, 2019.

Adam Karl Schwartzkopff

Atsushi Sainoki, Duncan Maina, Adam Karl Schwartzkopff, Yuzo Obara, and Murat Karakus, "Impact of the intermediate stress component in a plastic potential function on rock mass stability around a sequentially excavated large underground cavity," International Journal of Rock Mechanics and Mining Science, 127, 104223, 2020.

Atsushi Sainoki, Chiaki Hirohama, Adam Schwartzkopff, "Dynamic Modelling of Induced Seismicity by Using Seismic Efficiency Constraints and a New Scaling Law for Slip-Weakening Distance," Pure and Applied Geophysics, 177, 637-659, 2020.

Atsushi Sainoki, Hani S. Mitri, Damodara Chinnasane, Adam Karl Schwartzkopff, "Quantitative energy-based evaluation of the intensity of mining-induced seismic activity in a fractured rock mass," Rock Mechanics and Rock Engineering, 52, 4651-4667, 2019.

Takahiro Hosono

Hosono, T., Saltalippi, C., Jean, J.-S., "Coseismic hydro-environmental changes: insights from recent earthquakes," Journal of Hydrology, 585, 124799, 2020.

Kei Ishida

Kei Ishida, Gozo Tsujimoto, Ali Ercan, Tongbi Tu, Masato Kiyama, Motoki Amagasaki, "Hourly-scale coastal sea level modeling in a changing climate using long short-term memory neural network," Science of The Total Environment, 720, 2020.

Makoto Kumon

M. Wakabayashi, H. G. Okuno and M. Kumon, "Multiple Sound Source Position Estimation by Drone Audition Based on Data Association Between Sound Source Localization and Identification," IEEE Robotics and Automation Letters, 5(2), 782-789, 2020.

Masayuki Tanabe

O. S. Lih, V. Jahmunah, R. S. Tan, E. J Ciaccio, T. Yamakawa, M. Tanabe*, M. Kobayashi, O. Faust, U. R. Acharya, "Comprehensive electrocardiographic diagnosis based on deep learning," Artificial Intelligence In Medicine, 103, 101789, 2020. (*co-corresponding)

U. Rajendra Acharya

S. K. Ghosh, R.N. Ponnalagu, R.K. Tripathy, U. R. Acharya, "Automated detection of heart valve diseases using chirplet transform and multiclass composite classifier with PCG signals," Computers in Biology and Medicine, 118, 103632, 2020.

D. Soh, E. Y. K. Ng, V. Jahmunah, S. L. Oh, R. S. Tan, U. R. Acharya, "A computational intelligence tool for the detection of hypertension using empirical mode decomposition," Computers in Biology and Medicine, 118, 103630, 2020.

E. Butun, O. Yildirim, M. Talo, R. S. Tan, U. R. Acharya, "1D-CADCapsNet: One dimensional deep capsule networks for coronary artery disease detection using ECG signals," Physica Medica, 70, 39-48, 2020.

O. S. Lih, V. Jahmunah, R. S. Tan , E. J Ciaccio, T. Yamakawa, M. Tanabe, M. Kobayashi, O. Faust, U. R. Acharya*, "Comprehensive electrocardiographic diagnosis based on deep learning," Artificial Intelligence In Medicine, 103, 101789, 2020. (*corresponding)

Chan Yam Meng, E.Y.K. Ng, V. Jahmunah, Joel En Wei Koh, Oh Shu Lih, Leonard Yip Wei Leon, U. Rajendra Acharya, "Automated detection of glaucoma using optical coherence tomography angiogram Images," Computers in Biology and Medicine, 115, 103483, 2019.

U. Raghavendra, Anjan Gudigar, Tejaswi N. Rao, Edward J. Ciaccio, E.Y.K. Ng, U. Rajendra Acharya, "Computer-aided diagnosis for the identification of breast cancer using thermogram images: A comprehensive review," Infrared Physics & Technology, 102, 103041, 2019.

U. Rajendra Acharya, Kristen M. Meiburger, Joel En Wei Koh, Jahmunah Vicnesh, Edward J. Ciaccio, Oh Shu Lih, Sock Keow Tan, Raja Rizal Azman Raja Aman, Filippo Molinari, Kwan Hoong Ng, "Automated plaque classification using computed tomography angiography and Gabor transformations," Artificial Intelligence in Medicine, 100, 101724, 2019.

Martino Di Serio

Tesser, R., Russo, V., Turco, R., Vitiello, R., & Di Serio, M., "Bio-lubricants synthesis from the epoxidized oil promoted by clays: Kinetic modelling," Chemical Engineering Science, 214, 2020.

Turco, R., Tesser, R., Russo, V., Vitiello, R., Fagnano, M., & Di Serio, M., “Comparison of different possible technologies for epoxidation of cynara cardunculus seed oil,” European Journal of Lipid Science and Technology, 122(1), 2020.

R. Turco, R. Ortega-Toro, R. Tesser, S. Mallardo, S. Collazo-Bigliardi, A. Chiralt Boix, M. Malinconico, M. Rippa, M. Di Serio, G. Santagata, “Poly (Lactic Acid)/Thermoplastic Starch Films: Effect of Cardoon Seed Epoxidized Oil on Their Chemicophysical, Mechanical, and Barrier Properties,” Coatings, 9(9), 574, 2019.

International Collaborative Publications from IROAST Visiting Professors and their Host Professors

U. Rajendra Acharya & Makiko Kobayashi

O. S. Lih, V. Jahmunah, R. S. Tan, E. J Ciaccio, T. Yamakawa, M. Tanabe, M. Kobayashi, O. Faust, U. R. Acharya, "Comprehensive electrocardiographic diagnosis based on deep learning," Artificial Intelligence In Medicine, 103, 101789, 2020.

Paul Bowen & Kazuki Takashima

Yoji Mine, Shunsuke Katashima, Rengen Ding, Paul Bowen, Kazuki Takashima, "Fatigue crack growth behaviour in single-colony lamellar structure of Ti–6Al–4V," Scripta Materialia, 165, 107-111, 2019.

Patrice Delmas & Toshifumi Mukunoki

M. Azhar, X. Chang, J. Debes, P. Delmas, C. Duwig, N. Dal Ferro, T. Gee, J. Marquez, F. Morari, K. Müller, T. Mukunoki, I. Piccoli, A. Gastelum Strozzi, "Advantages of multi-region kriging over bi-region techniques for computed tomography-scan segmentation," Soil Research, 57(6), 521-534, 2019.

Tomonari Furukawa & Makoto Kumon

Yamada, K., Kumon, M., Furukawa, T., "Belief-Driven Control Policy of a Drone with Microphones for Multiple Sound Source Search," IEEE International Conference on Intelligent Robots and Systems, 8968119, 5326-5332, 2019.

Yang Kim & Shinya Hayami

Kim, Y., Hayami, S., Weigand, J.J. et al., "Preface," J Incl Phenom Macrocycl Chem 94, 119-120, 2019.

Noamane, M.H., Ben Othmen, A., Al-Ayed, A.S., Yang Kim, Shinya Hayami, Abdelwaheb Hamdi, "Interaction of 2-furanylmethyl- and 2-thienylmethyl-amide derivatives of 1,3-di(carboxymethyl)calix[4]arene with metal salts, J Incl Phenom Macrocycl Chem, 94, 249–256, 2019.

Kusumoto, S., Kobayashi, F., Ohtani, R., Kim, Y., Hayami, S., Nakamura, M., "Triply methoxo-bridged tetranuclear nickel cubane complexes with salicylate esters," J Incl Phenom Macrocycl Chem 94, 195–199, 2019.

Sotaro Kusumoto, Atsushi Koga, Fumiya Kobayashi, Ryo Ohtani, Yang Kim, Leonard F. Lindoy, Shinya Hayami and Masaaki Nakamura, "Weak ferromagnetism derived from spin canting in an

amido-bridged homochiral Mn(iii) 1-D coordination polymer," Dalton Trans., 48, 8617-8622, 2019.

Reiko Oda & Makoto Takafuji

Shaheen Pathan, Hiroki Noguchi, Nobuo Yamada, Yutaka Kuwahara, Makoto Takafuji, Reiko Oda, Hirotaka Ihara, "Fabrication of Fluorescent One-dimensional-nanocomposites through One-pot Self-assembling Polymerization on Nano-helical Silica," Chemistry Letters, 48(9), 1088-1091, 2019.

Nobuo Yamada, Hiroki Noguchi, Yoshifumi Orimoto, Yutaka Kuwahara, Makoto Takafuji, Shaheen Pathan, Reiko Oda, Almara Mahammadali Rahimli, Mahammadali Ahmed Ramazanov, Hirotaka Ihara, "Emission-Color Control in Polymer Films by Memorized Fluorescence Solvatochromism in a New Class of Totally Organic Fluorescent Nanogel Particles," Chemistry A European Journal, 25(43), 10141-10148, 2019.

Zoran Ren & Kazuyuki Hokamoto

Novak N., Borovinšek M., Vesenjak M., Wormser M., Körner C., Tanaka S., Hokamoto K., Ren Z., "Crushing Behavior of Graded Auxetic Structures Built from Inverted Tetrapods under Impact," Physica Status Solidi (B) Basic Research, 256(1), 1800040, 2019.

Firuz Zare & Hamid Hosano

Negareh Ghasemi, Firuz Zare, Hamid Hosano, "A Review of Pulsed Power Systems for Degrading Water Pollutants Ranging from Microorganisms to Organic Compounds," IEEE Access, 7, 150863-150891, 2019.

Daniel P. Zitterbart & Kei Toda

Daiki Okane, Edwin P. Koveke, Koya Tashima, Kentaro Saeki, Seiya Maezono, Takanori Nagahata, Norio Hayashi, Kylie Owen, Daniel P. Zitterbart, Shin-Ichi Ohira, Kei Toda, "High Sensitivity Monitoring Device for Onboard Measurement of Dimethyl Sulfide and Dimethylsulfoniopropionate in Seawater and an Oceanic Atmosphere," Analytical Chemistry, 91 (16), 10484-10491, 2019.

External Funds

Name	Fund	Funder	Amount (x1,000 JPY) FY2019	Amount (x1,000 JPY) (Total funding FYs)
Mitsuhiro Aida	Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area)	JSPS	4,680	9,490 (2018-2019)
	Research Grant	Yamada Science Foundation	–	2,000 (2018-2019)
Takumi Higaki	Grant-in-Aid for Scientific Research on Innovative Areas	JSPS	11,310	57,460 (2018-2022)
	Grant-in-Aid for Scientific Research on Innovative Areas (Co-investigator)	JSPS	5,200*	2,445,300 (2016-2021)
Atsushi Sainoki	Grant-in-Aid for Early-Career Scientists	JSPS	2,210	4,160 (2019-2023)
	Grants-in-Aid for Scientific Research “Fostering Joint International Research (B)” (Co-investigator)	JSPS	650*	17,420 (2019-2023)
	FY2020 JSPS Postdoctoral Fellowship for Research in Japan (Standard) *Host Researcher	JSPS	-	-
	Research Grant	KAJIMA Technical Research Institute	500	500 (2019)
	Research Grant	General Incorporated Foundation	450	450 (2019)

		Kumamoto Kogakukai		
	Research Grant	Obayashi Corporation	2,200	2,200 (2019-2020)
Takashi Ishida	A-STEP (Co-investigator)	JST	150*	3,000 (2019-2020)
	Research Grant (Co-investigator)	-	432*	432 (2019)
	Research Grant (Co-investigator)	-	110*	2,300 (2018)**
Akiko Nakamasu	Research Grant	Shimadzu Science Foundation	1,000	1,000 (2019-2021)

JSPS: Japan Society for the Promotion of Science

JST: Japan Science and Technology Agency

*Amount granted to the co-investigator

** Amendment for Annual Report 2018

Publications Supported by IROAST Publication Support Program

No.	Name	Publication Information
1	**Ruda Lee** IROAST	Min Woo Kim, Takuro Niidome, Ruda Lee, “Glycol Chitosan-Docosahexaenoic Acid Liposomes for Drug Delivery: Synergistic Effect of Doxorubicin-Rapamycin in Drug-Resistant Breast Cancer,” Marine Drugs, 17(10), 581, 2019.
2	**Minwoo Kim** IROAST	Min Woo Kim, Gibok Lee, Takuro Niidome, Yoshihiro Komohara, Ruda Lee, Yong Il Park, “Platelet-like gold nanostars for cancer therapy: the ability to treat cancer and evade immune reactions,” Frontiers in Bioengineering and Biotechnology, 8, p133, 2020.

Regulations, Guidelines and Rules of IROAST

No.	Title
1	Regulations of the Kumamoto University International Research Organization for Advanced Science and Technology
2	Internal Rules for Selection of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)
3	Agreement on Procedures for Selection of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)
4	Guidelines for Interim Evaluation of Tenure-track Professors, Associate Professors and Assistant Professors at the International Research Organization for Advanced Science and Technology (IROAST)
5	Guidelines for Tenure Review of Tenure-track Professors, Associate Professors and Assistant Professors at the International Research Organization for Advanced Science and Technology (IROAST)
6	Guidelines for Interim Evaluation of Tenure-track Professors, Associate Professors and Assistant Professors Conducted by the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)
7	Visiting Professor Agreement of the International Research Organization for Advanced Science and Technology (IROAST)
8	Rules for Granting the Title of “Visiting Professor” in the International Research Organization for Advanced Science and Technology (IROAST)
9	Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Distinguished Professors
10	Rules for Selecting Distinguished Professors for the International Research Organization for Advanced Science and Technology (IROAST)
11	Outline of International Advisory Board of International Research Organization for Advanced Science and Technology (IROAST)
12	Guidelines for Implementing the Internship Researchers Acceptance Program of the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)
13	Guidelines for the System for Supporting Expenses Relating to Hiring a Part-Time Lecturer who will Substitute for a Young Faculty Member for International Joint Research of the International Research Organization for Advanced Science and Technology (IROAST) to be Dispatched Overseas

Regulations of the Kumamoto University
International Research Organization for Advanced Science and Technology

(Regulation No. 19 of February 24, 2016)

Revision Regulations No. 176 of March 31, 2017) Regulations No. 183 of April 7, 2017)

Article 1 (Aims)

These Regulations shall provide for necessary matters concerning the Kumamoto University International Research Organization for Advanced Science and Technology ("IROAST") in accordance with the provisions of Article 8-7, Paragraph 2 of Kumamoto University Regulations (established April 1, 2004).

Article 2 (Objective of Establishment)

The objectives of IROAST shall be to perform internationalized advanced science and technology research, discovery and development of human resources, in collaboration with the Faculty of Advanced Science and Technology, the Institute of Pulsed Power Science, the Center for Water Cycle, Marine Environment, and Disaster Management, and the Magnesium Research Center (the "science and technology research organizations"), thus to ensure improvement of basic research and applied research in science and technology fields at Kumamoto University, as well as internationalized level research and educational capabilities.

Article 3 (Operations)

IROAST shall perform the following operations:

(1) Operations with respect to implementation of international advanced science and technology research,

(2) Operations with respect to promotion of international joint research,

(3) Operations with respect to discovery and development of pioneering research personnel, and

(4) Any other operation necessary for achievement of the objectives of IROAST.

Article 4 (Organization)

IROAST shall consist of the following persons:

(1) Director,

(2) Vice Director,

(3) Full-Time Teacher,

(4) Young Faculty Members for International Joint Research,

(5) Professors, Associate Professors, Lecturers and Assistant Professors

(6) Visiting Professors, Visiting Associate Professors, and

(7) Other persons judged necessary by the Director.

Article 5 (Director)

1. The Director shall be selected by the President.
2. The Director shall administer management and operations of IROAST.
3. The term of office of a Director shall be two (2) years, and the Director may be re-elected.
4. The term of office of a substitute Director in the case of vacancy of the position of the Director shall be the remaining term of office of his/her predecessor, notwithstanding the provisions of the preceding paragraph.
5. Matters necessary for election of the Director shall be separately provided.

Article 6 (Vice Director)

1. A Vice Director shall be appointed out of the full-time professors of science and technology research organizations designated by the Director.
2. The Vice Director shall assist in the duties of the Director.
3. The term of office of the Vice Director shall be two (2) years, and the Vice Director may be re-elected. However, the term of office of the Vice Director shall end before the last day of the term of office of the Director who designated the relevant Vice Director.

Article 7 (Full-Time Teacher)

The President shall select Full-Time Teacher upon recommendation of the Director.

Article 8 (Young Faculty Members for International Joint Research)

1. Young Faculty Members for International Joint Research shall be established at IROAST aiming at ensuring improvement of international research capabilities in science and technology fields at the University.
2. Young Faculty Members for International Joint Research as referred to in the preceding paragraph shall be appointed by the President upon recommendation by the Director.
3. The Director shall, upon making recommendations as referred to in the preceding paragraph, conduct public advertising targeting science and technology research organizations, and decide on candidates for Young Faculty Members for International Joint Research out of the faculty recommended by the heads of the organizations.
4. Terms of office for Young Faculty Members for International Joint Research shall be three (3) years, in principle. However, if the Director judges it necessary, the term of office may be assigned to up to four (4) years.

Article 9 (Steering Committee)

1. The Kumamoto University International Research Organization for Advanced Science and Technology Steering Committee (the “Committee”) shall be established at IROAST, and consist of the Director, Vice Director, heads of the science and technology research organizations, and Assistant Dean of the Faculty of Advanced Science and Technology.
2. The Committee shall adopt resolutions in making decisions on the following matters indicated by the Director.

(1) Important matters with respect to management of IROAST,

(2) Other matters judged necessary by the Director.

3. The Committee shall exchange opinions with regard to future plans of science and technology research organizations, in addition to the provisions of the preceding paragraph.

Article 10 (Chairperson)

1. The Committee shall have a chairperson, and the Director shall serve as the chairperson.
2. The Chairperson shall call Committee meetings and chair the meetings.
3. If the chairperson is unable to act as the chairperson, the Vice Director shall perform the duties by delegation.

Article 11 (Proceedings)

1. Resolutions in proceedings may not be adopted unless a majority of Committee members is present.
2. Resolutions in proceedings of Committee meetings shall be adopted by a majority of Committee members present, and if the numbers of votes for and against are the same, the chairperson shall have the deciding vote.

Article 12 (Hearing of Views)

The chairperson may have persons other than Committee members attend Committee meetings and hear their views when necessary.

Article 13 (Administrative Affairs)

The administrative affairs of IROAST and the Committee shall be handled by the Administrative Division of the Science and Technology of Research/Education Affairs Department.

Article 14 (Miscellaneous Rules)

In addition to the matters provided in these Regulations, matters necessary for IROAST shall be separately provided.

Supplementary Provisions

These Regulations shall come into effect on April 1, 2016.

Supplementary Provisions (Regulations No. 176 of March 31, 2017)

These Regulations shall come into effect on April 1, 2017.

Supplementary Provisions (Regulations No. 183 of April 7, 2017)

1. These Regulations shall come into effect on April 7, 2017, and the provisions of Article 8, Paragraph 4 after revision shall be applicable on and after April 1, 2017 (the “Effective Date”).
2. For the terms of office of the persons appointed as Young Faculty Member for International Joint Research before the Effective Date, notwithstanding the provisions of Article 8, Paragraph 4 after revision under these Regulations, the provisions then in force shall remain applicable.

Internal Rules for Selection of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)

June 10, 2016

Approved by the IROAST Steering Committee

Article 1 (Aims)

These Internal Rules shall provide for necessary matters concerning selection of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (“IROAST”).

Article 2 (Establishment of Screening Committee)

The Director of the International Research Organization for Advanced Science and Technology (the “Director") shall, when it is necessary to select faculty, carry out document screening in the Steering Committee of the International Research Organization for Advanced Science and Technology, etc., and then later establish a Screening Committee for Faculty of the International Research Organization for Advanced Science and Technology (the “Screening Committee”).

Article 3 (Organization of Screening Committee)

The Screening Committee shall consist of the following persons:

(1) Director,

(2) Vice Director of the IROAST (the “Vice Director”),

(3) Heads of science and technology research organizations,

(4) Assistant Dean of the Faculty of Advanced Science and Technology,

(5) A few other professors in related fields judged necessary by the Director.

Article 4 (Chairperson)

The Committee shall have a chairperson, and the Director shall serve as the chairperson.

(1) The Chairperson shall call Committee meetings and chair the meetings.

(2) If the chairperson is unable to act as the chairperson, the Vice Director shall perform the duties by delegation.

Article 5 (Quorum)

A Screening Committee meeting shall be established when two-thirds or more Committee members are present at the meeting.

Article 6 (Duties)

The Screening Committee shall conduct the following matters:

(1) Matters concerning selection of final candidates of Tenure-track Professors and Associate Professors at IROAST, and

(2) Other matters judged necessary by the Director with respect to selection of the relevant professors.

Article 7 (Terms of Office)

The terms of office of Committee members as specified in Article 3, Item 5 shall be the meeting period of the respective Screening Committee meetings.

Article 8 (Administrative Affairs)

Administrative affairs of the Committee shall be handled by the Administrative Division of the Science and Technology of Research/Education Affairs Department.

Article 9 (Miscellaneous Rules)

In addition to the matters provided in these Internal Rules, matters necessary for selection of faculty at IROAST shall be separately provided.

Supplementary Provisions

These Internal Rules shall come into effect on June 10, 2016.

Agreement on Procedures for Selection of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)

June 10, 2016

Approved by the IROAST Steering Committee

Procedures concerning selection of Tenure-track Professors and Associate Professors at the International Research Organization for Advanced Science and Technology shall be provided as follows.

1. First stage document screening

   The Director of the International Research Organization for Advanced Science and Technology (the "Director") and the Vice Director of the International Research Organization for Advanced Science and Technology shall select persons subject to second stage document screening out of the persons who submit applications to an international recruitment.

   The Director shall report to the Steering Committee about the screening standards for the first stage document screening and the results of screening.

2. Second stage document screening

   The Director shall hold Steering Committee meetings, and out of the persons eligible for second stage document screening, select the persons eligible for third stage document screening (inquiries to the respective Departments of Science and Technology)

3. Third stage document screening (inquiries to the respective Departments of Science and Technology)

   The Director shall inquire with the respective Departments of Science and Technology with a list of persons eligible for third stage document screening about whether or not they desire to hire Tenure-track Professors and Associate Professors. In addition, upon request from the respective Departments of Science and Technology, application documents shall be provided.

4. Establishment of Screening Committee

   The Director shall hold Steering Committee meetings and establish a Screening Committee.

5. Final document screening

   The Chairperson of the Screening Committee (the "Chairperson") shall hold Screening Committee meetings, and determine applicants eligible for interviews based on answers from the respective Departments of Science and Technology.

6. Screening by interview

The Chairperson shall hold Screening Committee meetings, and conduct interviews of persons who pass the final document screening. Committee members except for the Chairperson shall submit to the Chairperson in writing the results of evaluation in interviews based on the set of application documents submitted by the persons who pass the final document screening and interview.

7. Selection of final candidates

The Chairperson shall select the final candidates using the results of evaluation submitted by Committee members pursuant to Paragraph 6 above as reference.

8. Report of final candidates

The Chairperson shall report to the President with documents in which are stated the final candidates and the reasons for selection, and the results of evaluation submitted by Committee members pursuant to Paragraph 6 above.

Supplementary Provisions

This Agreement shall come into effect on June 10, 2016.

Guidelines for Interim Evaluation of Tenure-track Professors, Associate Professors and Assistant Professors at the International Research Organization for Advanced Science and Technology (IROAST)

October 25, 2016
Approved by the IROAST Steering Committee

1. Aims

These Guidelines shall provide for necessary matters with respect to interim evaluation of Tenure-track Professors, Associate Professors and Assistant Professors (the "Tenure-track Professor") of the International Research Organization for Advanced Science and Technology.

2. Objectives

Interim evaluation shall be conducted for the purpose of confirmation and evaluation of the status of progress and future research potential of the Tenure-track Professor and for giving necessary advice as a first principle.

3. Implementation

(1) The Director of the International Research Organization for Advanced Science and Technology (the "Director") shall, in the conduct of an interim evaluation, entrust the interim evaluation to the departments relating to the research field of the Tenure-track Professor (the "related departments"), as it is necessary to have expert knowledge in the research fields.

(2) The heads of the related departments shall, in the conduct of interim evaluation, establish a review committee in the related departments, and conduct an interim evaluation based on these Guidelines and Tenure Review Standards indicated in advance of hiring the Tenure-track Professor, then notify the Tenure-track Professor of the results of evaluation, and report to the Director on the results of the interim evaluation. In such instance, if interim evaluation standards are separately provided by the related departments, the interim evaluation shall be carried out based on those standards.

(3) The Director shall report to the International Research Organization for Advanced Science and Technology Steering Committee (the "Steering Committee") on the results of reports received under the preceding item.

4. Timing

An interim evaluation shall be performed after the elapse of three (3) years from the day when the Tenure-track Professor was assigned, within three (3) months of that date.

5. Exclusion of stakeholders

The following persons shall be deemed to be stakeholders, and may not participate in the interim evaluation of the Tenure-track Professor. Provided that, upon request by the heads of the related departments, they may state their views on the interim evaluation.

(1) Mentors of the Tenure-track Professor,

(2) When the person judges by himself/herself that any of following items is applicable in a relationship with the Tenure-track Professor.

a. Relative or person with a close individual relationship of the same degree,

b. Relationship in which close joint research is conducted

(e.g., execution of joint project, co-authorship of research thesis, or having a close relationship with study group members with the same objectives),

c. Affiliation in the same research unit (researchers under the same professorship, etc.),

d. Close teacher and student relationship,

e. Confrontational relationship or competitive relationship where there is a possibility that the assessment may be deemed to be linked to the direct interests of the assessors, etc.

6. Other

Matters necessary for interim evaluation other than matters provided in these Guidelines shall be provided by the Steering Committee.

Supplementary Provisions

These Internal Rules shall come into effect on October 25, 2016.

Guidelines for Tenure Review of Tenure-track Professors, Associate Professors and Assistant Professors at the International Research Organization for Advanced Science and Technology (IROAST)

October 25, 2016
Approved by the IROAST Steering Committee

1. Aims

These Guidelines shall provide for necessary matters with respect to tenure review of Tenure-track Professors, Associate Professors and Assistant Professors (the "Tenure-track Professor") at the International Research Organization for Advanced Science and Technology.

2. Objectives

Tenure review shall be performed in order to evaluate the status of achievement of research by the Tenure-track Professor and the future potential, etc., thereof, and whether or not they possess the qualities required for grant of tenure.

3. Implementation

(1) The Director of the International Research Organization for Advanced Science and Technology (the "Director") shall, in the conduct of tenure review, entrust tenure review to the department that is related to the research field of the Tenure-track Professor (the "related departments") as it is necessary to have expert knowledge in the research fields.

(2) The heads of the related departments that accept entrustment pursuant to the provisions of the preceding item shall promptly prepare Tenure Review Standards and report these to the Director. The Director shall indicate the reported Tenure Review Standards before hiring the Tenure-track Professor.

(3) The Heads of the related departments shall, in the conduct of tenure review, establish a Tenure Review Committee in the related departments, and, based on these Guidelines and Tenure Review Standards provided in the preceding item, conduct a review on an absolute scale of the research achievement status and future potential, etc. of the Tenure-track Professor, then notify the Director of the results of review.

(4) The Director shall obtain the approval of the International Research Organization for Advanced Science and Technology Steering Committee (the "Steering Committee") upon receiving the results of review under the preceding item for grant of tenure relating to the Tenure-track Professor and report to the President, as well as notify the Tenure-track Professor and the heads of the related departments.

(5) The Director and the Steering Committee shall bear responsibility relating to the grant of tenure.

4. Timing

(1) Tenure review shall be performed after the elapse of four (4) years from the day when the Tenure-track Professor was assigned, within four (4) months of that date.

(2) When early tenure review is desired, notwithstanding the provisions of the preceding item, the heads of the related departments shall make such a request of the Director, based on the results of an interim evaluation provided separately.

5. Exclusion of stakeholders

The following persons shall be deemed to be stakeholders, and may not participate in the tenure review of the Tenure-track Professor. Provided that, upon request by the heads of the related departments, they may state their views about the tenure review.

(1) Mentors of the Tenure-track Professor,

(2) When the person judges by himself/herself that any of following items is applicable to a relationship with the Tenure-track Professor.

a. Relative or person with a close individual relationship of the same degree,

b. Relationship in which close joint research is conducted

(e.g., execution of joint project, co-authorship of research thesis, or having a close relationship with study group members with the same objectives),

c. Affiliation in the same research unit (researchers under the same professorship, etc.),

d. Close teacher and student relationship,

e. Confrontational relationship or competitive relationship where there is a possibility that the review may be deemed to be linked to the direct interests of the assessors, etc.

6. Other

Matters necessary for tenure review other than matters provided in these Guidelines shall be provided by the Steering Committee.

Supplementary Provisions

These Internal Rules shall come into effect on October 25, 2016.

Guidelines for Interim Evaluation of Tenure-track Professors, Associate Professors and Assistant Professors Conducted by the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)

July 17, 2019
Approved by the IROAST Steering Committee

1. Purpose of Evaluation

The interim evaluation is primarily intended to encourage Tenure-track Professors, Associate Professors and Assistant Professors (the "Tenure-track Professor") by confirming and evaluating the progress, quality and prospects of each Tenure-track Professor, as well as their future potential. This is then followed by the provision of helpful advice.

2. Timing of Evaluation

An interim evaluation shall be performed after the elapse of three (3) years from the day when the Tenure-track Professor was assigned, within three (3) months of that date.

3. Set-up of Interim Evaluation Committee

In order to conduct an interim evaluation of the Tenure-track Professor, the Director of the International Research Organization for Advanced Science and Technology (the "Director") should establish the Interim Evaluation Committee (the "Committee") shortly after consultation with the IROAST Steering Committee.

4. Committee Organization

The Committee shall consist of the following members:

(1) Director of IROAST
(2) Vice Director of IROAST
(3) Two science field professors selected from the Faculty of Advanced Science and Technology
(4) Three engineering field professors selected from the Faculty of Advanced Science and Technology
(5) A few professors selected from the Institute of Pulsed Power Science, Center for Water Cycle, Marine Environment and Disaster Management (CWMD), and Magnesium Research Center, Kumamoto University
(6) Other persons as deemed necessary by the Director

5. Chairperson

(1) The Committee shall have a chairperson, and the Director shall be assigned to the post.
(2) The chairperson shall convene and chair the Committee.
(3) If the chairperson is unable to perform his/her duties (due to unavoidable circumstances), a committee member previously designated by the chairperson will take over the duties.

6. Exclusion of stakeholders

The following persons shall be deemed to be stakeholders, and may not participate in the interim evaluation of the Tenure-track Professor. Provided that, upon request by the heads of the related departments, they may attend the Committee and state their views on the interim evaluation.

(1) Mentors of the Tenure-track Professor,
(2) When the person judges by himself/herself that any of following items is applicable in a relationship with the Tenure-track Professor.
(A) Relative or person with a close individual relationship of the same degree,
(B) Relationship in which close joint research is conducted
(e.g., execution of joint project, co-authorship of research thesis, or having a close relationship with study group members with the same objectives),
(C) Affiliation in the same research unit,
(D) Close teacher and student relationship or direct employment relationship,
(E) Confrontational relationship or competitive relationship where there is a possibility that the assessment may be deemed to be linked to the direct interests of the assessors, etc.

7. Implementation of the Interim Evaluation

In accordance with these Guidelines and examination criteria, the Committee shall implement an interim evaluation via document screening, interview, and consultations.

8. Hearing/Interview

(1) The Committee interviews the Tenure-track Professor based on materials provided for the evaluation and interview that he/she has prepared in advance.
(2) The interview shall consist of 20 minutes to explain past research and achievements, 10 minutes to explain future research to be done by the Tenure-track Professor, and 20 minutes of questions and answers.

9. Comprehensive Evaluation

(1) The following matters shall not be covered in the interim evaluation.
(A) Teaching ability (lectures, seminars, etc.)
(B) Ability to guide graduate students in education and research
(C) University management
(D) Academic society management
(E) Contribution to society
(F) Public awareness activities
(2) The Committee shall complete a comprehensive evaluation after consultation, which is based on the results of the evaluation of each member.
(3) If deemed necessary, the Committee may withhold the results of the comprehensive evaluation, request the submission of additional materials, and conduct the interview again.
(4) The Committee shall determine the results of the document screening and interview comprehensively to arrive at one of the following judgements by absolute evaluation. The Committee shall add some comments as to why they have reached their conclusion.
S Excellent
A Very good
B Good
C In need of improvement

10. Notification of Results

The chairperson shall notify the Tenure-track Professor of the comprehensive evaluation results in writing.

If an interim evaluation has been entrusted by another department/division, the results shall also be given to the head of the applicable department/division.

11. Miscellaneous

Matters that are not stipulated in these Guidelines and which are necessary for the interim evaluation shall be determined by the Committee.

Supplementary Provisions

These Guidelines shall come into effect on July 17, 2019.

Visiting Professor Agreement of the International Research Organization for Advanced Science and Technology (IROAST)

Partially amended on November 21, 2018
September 25, 2017
Approved by the IROAST Steering Committee

The agreement between the International Research Organization for Advanced Science and Technology (hereinafter referred to as "IROAST") and visiting professors is as follows. A 'host professor' is a faculty member in the science and technology fields of Kumamoto University who recommends an IROAST Visiting Professor candidate who fully meets the requirements of the IROAST Visiting Professorship. The host professor supports and cooperates with the candidate as he or she performs duties as an IROAST Visiting Professor.

(Requirements)
A visiting professor must be:

1. An internationally distinguished researcher or a researcher with distinguished achievements.
2. A researcher who can be expected to contribute to the promotion and expansion of Kumamoto University's research activities internationally.

(Duties)
The main tasks of a visiting professor are as follows:

1. Hold international seminars. When he/she is at Kumamoto University, he/she must hold at least one seminar that offers advanced knowledge and new insights on the topic in which he/she is an expert.
2. Use the IROAST name as one of his/her affiliations in any paper written during their time as a visiting professor at Kumamoto University. (Written fully as "The International Research Organization for Advanced Science and Technology, Kumamoto University, Kumamoto, Japan.")
3. Conclude a memorandum of understanding (MOU) with research groups associated with IROAST regarding his/her international research collaborations.
4. Promote academic and student exchanges between his/her home university/institute and Kumamoto University.
5. Apply for research grant programs, such as the Japan Society for the Promotion of Science's "Bilateral Programs" grant, in collaboration with his/her host professor.

(Research Space)

In principle, the IROAST host professor will provide an office and/or laboratory for the visiting professor while he/she stays at Kumamoto University.

(Period of Entitlement)

The title of Visiting Professor is given for a period of one year, with the possibility for extension available.

(Procedures for Entitlement)

The title of Visiting Professor is given with the approval of the IROAST steering committee.

(Report on Activities at Kumamoto University)

The visiting professor should submit an “IROAST Visiting Professor Activities Report,” after receiving approval from his/her host professor, to the IROAST director within one month of returning home. The report may be posted on the IROAST website with the consent of the visiting professor.

Rules for Granting the Title of "Visiting Professor" in the International Research Organization for Advanced Science and Technology (IROAST)

Partially amended on November 21, 2018
February 9, 2018
Approved by the IROAST Steering Committee

1. Aim and subject persons

The title of "Visiting Professor" shall be granted, based on the recommendation by faculty members in the science and technology area, to people who are world-level top researchers, who belong to other organizations (including Japanese researchers employed by Japanese organizations), and for whom it can be expected that internationally excellent pioneering research is strengthened and made more visible through international joint research with researchers of Kumamoto University.

A 'host professor' is a faculty member who recommends an IROAST Visiting Professor candidate who fully meets the requirements of the IROAST Visiting Professorship. The host professor supports and cooperates with the candidate as he or she performs duties as an IROAST Visiting Professor.

2. Selection

The title of "Visiting Professor" shall be granted by the University President from among recommended candidates after deliberation by the IROAST Steering Committee.

3. Title period

The title of "Visiting Professor" shall be granted from April 1 to March 31 of the following year of each fiscal year.

If the title is granted in the middle of a fiscal year, the title grant period shall begin a month after the month the title paperwork was submitted until March 31st of the following fiscal year. However, if the time for recommendation and time required for office tasks is shorter than three months, the title shall be granted in the next fiscal year.

4. Renewal

Title renewal shall be determined, in principle, on or before the last day of January of each fiscal year by each host professor.

If a host professor desires title renewal based on activities during the fiscal year, he/she must obtain the consent of the visiting professor and make a request to the Director of IROAST for renewal.

The Director of IROAST shall examine the request from the recommending host professor and, if renewal is appropriate, shall request title renewal from the University President.

The Director of IROAST shall report the names of renewed visiting professors at the IROAST Steering Committee meeting, which is held the beginning each fiscal year.

5. Host professor replacement

When a host professor is not able to host the Visiting Professor in the following fiscal year due to retirement or other exceptional reasons, and he/she wishes IROAST to continue collaborating with the Visiting Professor for the benefit of Kumamoto University and the formation of internationally advanced research hubs, the host professor can make a request to the Director of IROAST through following procedures:

(1) The host professor gains approval from a professor who wishes to become the replacement and from the Visiting Professor.
(2) The host professor makes a request to the Director of IROAST regarding the replacement by submitting the "Host researcher replacement form."

6. Restriction on renewal periods

Title renewals shall not be extended beyond March 31st, 2021 (the end of the first-phase period of the Research Organization).

(Host researcher replacement form)

Date: yyyy-mm-dd

To the Director of IROAST,

RE: Request for host professor replacement of an IROAST Visiting Professor and extension of the Visiting Professor

I would like to request the replacement of my position as the host professor of an IROAST Visiting Professor.

Following Article 5-(1) of the “Rules for Granting the Title of "Visiting Professor" for the International Research Organization for Advanced Science and Technology (IROAST),” I have gained approval from the professors written below to be replaced as a host professor due to (reasons for the replacement, e.g. my retirement).

Replacement professor: Name
IROAST Visiting Professor: Name

Sincerely,
Name, Professor
Affiliation

Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Distinguished Professors

Partially amended on November 21, 2018
Partially amended on February 9, 2018
Partially amended on June 21, 2017
April 21, 2017
Approved by the IROAST Steering Committee

The aims of employment of a Distinguished Professor in the International Research Organization for Advanced Science and Technology (hereinafter referred to as "IROAST") are to enhance and develop research in the fields of science and technology at Kumamoto University, to participate in international research collaborations, and to discover and foster young researchers with world-class abilities.

A 'host professor' is a faculty member who recommends an IROAST Distinguished Professor candidate who fully meets the requirements of the IROAST Distinguished Professorship. The host professor supports and cooperates with the candidate as he or she performs duties as an IROAST Distinguished Professor.

1. The Director of IROAST selects Distinguished Professors based on the "Selecting Distinguished Professors for the International Research Organization for Advanced Science and Technology (IROAST)" approved by the IROAST Steering Committee on February 9, 2018.

2. The main tasks of a Distinguished Professor are as follows:
   (1) Make suggestions from an international perspective to strengthen and promote world-leading research in the fields of science and technology at Kumamoto University.
   (2) Perform and promote international joint research with his/her host professor and group, and expand international networks.
   (3) Hold seminars and provide guidance on research projects and papers that meet international standards to graduate students.
   (4) Hold basic seminars for undergraduate students.
   (5) Promote academic and student exchanges between his/her home university/institute and Kumamoto University.

3. The Distinguished Professor should follow the "IROAST Distinguished Professor Activities Plan" (Form 3), which he/she submitted to IROAST at the time of application, to perform his/her duties in cooperation with his/her host professor. Those who were employed prior to the partial amendment of this agreement must submit the "IROAST Distinguished Professor Activities Plan" (Form 3) before each of his/her working periods of the 2017 fiscal year. When the professor wishes to make changes in the "IROAST Distinguished Professor Activities Plan", he/she needs to gain prior approval from the Director by submitting an "IROAST Distinguished Professor Activities Change Plan" (Form 5).

4. Research and education expense approvals, including travel expenses, are made at the discretion of the Director who determines the need for a budget on a case by case basis from applications submitted by the professors.

5. In principle, the host professor provides an office and/or laboratory for the Distinguished Professor while he/she stays at Kumamoto University.

6. The Distinguished Professor should submit to the Director the “IROAST Distinguished Professor Activities Report” (Form 4) by the end of January of each fiscal year of his/her contract after gaining approval from his/her host professor. The report may be posted on the IROAST website with the professor’s consent.

7. The Director will evaluate the “IROAST Distinguished Professor Activities Report” and will determine the renewal of the professor’s contract for the following fiscal year based on this evaluation.

Rules for Selecting Distinguished Professors for the International Research Organization for Advanced Science and Technology (IROAST)

Partially amended on November 21, 2018
February 9, 2018
Approved by the IROAST Steering Committee

(Subject)

1. Distinguished Professors shall be top world-class researchers who have the necessary capabilities to promote and strengthen research competence in the science and technology areas of the University, to participate in international joint researches and to develop and nurture internationally acceptable young researchers. A 'host professor' is a faculty member who recommends an IROAST Distinguished Professor candidate who fully meets the requirements of the IROAST Distinguished Professorship. The host professor supports and cooperates with the candidate as he or she performs duties as an IROAST Distinguished Professor.

(Candidate recommendations)

2. Suitable candidates shall be recommended by faculty members in science and technology areas (host professors). The recommendation is desirably made by two or more host professors.

(Documents to be submitted)

3. When recommending a suitable candidate, host professors shall submit the following documents:
   (1) Application form (Form 1);
   (2) Letter of Acceptance by Host Professor (Form 2);
   (3) Distinguished Professor Candidate Invitation Guidelines and Activity Plan (Form 3); and
   (4) Curriculum vitae

(Method of selection)

4. Distinguished Professors shall be selected by the Director of IROAST by taking into account characteristics of the research area and by hearing the opinions of the Steering Committee of IROAST based on the following assessment items. The opinions of recommending persons, et al. may be heard if necessary.

   [Assessment items]

   The candidate shall be excellent in the following assessment items compared with the selection standard for professors in the area in question.

○ Research achievements

< Reference index >

- Number of papers
- Number of cited papers
- FWCI (Field Weighted Citation Impact)
- Percentage of Top 10% papers
- Percentage of international joint authorship

○ Activities in academic societies

< Reference index >

- Number of invited lectures
- Number of invited papers
- Record of prizes received
- Achievement in holding international conferences, etc.

○ Activities in his/her organization and research group

< Reference index >

- Activity record as the head or group leader in his/her organization or research group
- Situation of acquiring external research funds
- Number of academic degrees granted, etc.

Outline of International Advisory Board
of International Research Organization for Advanced Science and Technology (IROAST)

September 25, 2017
Approved by the IROAST Steering Committee

(Purpose)
Article 1
With an aim to make use of guidance provided in international viewpoints for the management of the International Research Organization for Advanced Science and Technology (hereinafter referred to as "IROAST"), IROAST shall manage the IROAST International Advisory Board (hereinafter referred to as "the Advisory Board").

(Duties)
Article 2
The Advisory Board shall provide guidance regarding the following:

(1) Strengthening and sharpening the internationally distinguished leading research in the science and technology fields of Kumamoto University
(2) Promoting international research collaboration and expanding international research networks
(3) Finding and developing human resources in advanced research fields
(4) Other activities necessary for the achievement of IROAST's goals

(Organization)
Article 3
a. The Advisory Board shall consist of the following members:

(1) Director of IROAST (hereinafter referred to as "the Director")
(2) Vice Director of IROAST
(3) A few Distinguished Professors of IROAST
(4) A few external academics
(5) Other persons deemed necessary by the Director

b. The personnel described in (3), (4) and (5) of the preceding provision shall fall under at least one of the following, and be commissioned by the Director.

(1) A person who thoroughly understands the affairs in academia and research inside and outside Japan, and who is highly knowledgeable
(2) A person who brings diverse experience in academia

(Chairperson)
Article 4
a. The Advisory Board shall have a chairperson, and the Director shall be assigned to that post.
b. The chairperson shall call and chair the Advisory Board.

c. In the event that the chairperson is unable to attend to his/her duties, a board member (assigned by the chairperson in advance) shall perform duties on behalf of the chairperson.

(Administrative Work)
Article 5
Administrative work of the Advisory Board is to be undertaken by the Administrative Division of Science and Technology, Research/Education Affairs Department.

(Miscellaneous Provision)
Article 6
Essential details concerning the Advisory Board that are not specified in this outline shall be determined by the Director separately.

Guidelines for Implementing the Internship Researchers Acceptance Program of the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)

Date: February 9, 2018
Approved by: IROAST Steering Committee

(Principle)

1. These Guidelines shall specify necessary matters for the Program that accepts students, et al. enrolled in universities in foreign countries in the International Research Organization for Advanced Science and Technology (hereinafter, "IROAST") for a short period mainly for performing research guidance.

(Purpose)

2. The purpose of this Program shall be to provide students, et al. enrolled in universities in foreign countries who desire to learn advanced science and technology with opportunities of internship, to contribute to the development of global human resources and thereby ensure the improvement of capabilities of international research in science and technology areas and of internationally accepted teaching methods of the University.

(Name)

3. Students, et al. who participate in the Program shall be called "IROAST Young Internship Researchers" (hereinafter, the "Internship Researchers").

(Acceptance period)

4. The acceptance period for the Internship Researchers shall be two (2) to eight (8) weeks, in principle.

(Host researchers)

5. Researchers who accept Internship Researchers (hereinafter, the "Host Researchers") shall be researchers who belong to IROAST, in principle.

(Application procedure)

6. Host Researchers shall contact students, et al. enrolled in universities in foreign countries who desire to be the Internship Researchers in advance shall file an application with the Director of the International Research Organization for Advanced Science and Technology (hereinafter, “the

Director of IROAST") one (1) month or before the desired date of starting acceptance using a separately prescribed form.

(Selection)

7. Internship Researchers shall be selected by the Director of IROAST and the Vice Director of IROAST based on the opinions of the Host Researchers who have expressed the desire to take care of them.

(Acceptance permission)

8. The Director of IROAST shall permit the acceptance of Internship Researchers who are selected in item 7 and for whom prescribed procedures are taken.

(Program contents)

9. The contents of the Program for the Internship Researchers shall be decided by the Director of IROAST and the Host Researchers who guide them based on the contents of applications by the Internship Researchers.

(Issuance of certificate of completion)

10. Research activities by the Internship Researchers shall be evaluated by the Host Researchers who guide them based on their reports, daily activities, etc. and, if it is considered that they have been completed, the Director of IROAST shall issue a certificate of completion.

(Internship Program participation fee)

11. An Internship Program participation fee shall not be collected.

(Expenses incurred for implementing the internship)

12. Expenses for machinery, equipment, reagents, or other items connected with the implementing the internship shall be borne by the Host Researchers.

(Research space)

13. Space needed for research during the period in which the Internship Researchers stay at the University shall be arranged by the Host Researchers, in principle.

(Aid for travel expenses, etc.)

14. The Director of IROAST shall provide aid for travel and living expenses of the Internship Researchers in whole or in part.

(Obligation of compensation, etc.)

15. If the Internship Researchers lose or damage facilities, machinery, equipment, etc. of the University during the acceptance period due to their willful misconduct or gross negligence, they shall repair them or compensate for the damage promptly.

(Compliance matters)

16. Internship Researchers shall procure travel insurance, etc. on their own expense.
    (2) Internship Researchers shall not disclose or divulge any information to any third party on research that they could come to know.
    (3) The Director of IROAST may request the Internship Researchers to attend a "research ethics course" designated by the University.
    (4) If Internship Researchers intend to connect information equipment (including their own private devices) to the University's network, they shall comply with the information security policy of the University. The Director of IROAST may request that the Internship Researchers attend an "e-learning training" conducted by the University implements for students each year.
    (5) If Internship Researchers use software in research rooms, etc., they shall submit an "Affirmation of Compliance with Copyright Laws."
    (6) Beyond what is specified in these Guidelines, the Internship Researchers shall comply with all regulations of the University and abide by all instructions of the Host Researchers.
    (7) If a student is judged to be inappropriate as an Internship Researcher, the University shall cancel the Program and not permit subsequent acceptance of the student.

(Office tasks)

17. Office tasks for implementing the internship researchers' acceptance Program shall be handled by the Administrative Division of Science and Technology of the Research/Education Affairs Department.

(Handling by other departments of science and technology)

18. If researchers who belong to the Faculty of Advanced Science and Technology, the Institute of Pulsed Power Science, the Center for Water Cycle, Marine Environment, and Disaster Management, or the Magnesium Research Center express a desire to accept the Internship Researchers, the Director of IROAST and the dean/director of the department where the researcher in question belongs (including the Advisor to the Dean in the case of the Faculty of Advanced Science and Technology) shall consult and decide.

(Miscellaneous provisions)

19. Beyond what is specified in these Guidelines, other necessary matters for the Program shall be specified by the Director of IROAST separately.

Supplementary provisions

These Guidelines shall come into force from April 1, 2018.

Guidelines for the System for Supporting Expenses Relating to Hiring a Part-Time Lecturer who will Substitute for a Young Faculty Member for International Joint Research of the International Research Organization for Advanced Science and Technology (IROAST) to be Dispatched Overseas

June 19, 2019
Approved by the IROAST Steering Committee

Purpose

The International Research Organization for Advanced Science and Technology (IROAST) will support part-time lecturer expenses to facilitate lectures which are supposed to be taught by the IROAST Young Faculty Member for International Joint Research (hereinafter referred to as "Young Faculty Member" at his/her faculty or graduate school while he/she is dispatched overseas.

Target Faculties, etc.

- Faculty of Science , Faculty of Engineering , Graduate School of Science and Technology

Descriptions

- Part-Time Lecturer Expenses (allowances and travel expenses)

  The target courses are, in principle, lectures of the undergraduate / graduate school to which the IROAST International Joint Researcher belongs, and where the lectures are supposed to be taught by said Young Faculty Member (hereinafter referred to as "courses to be supported").

  However, if it is deemed appropriate for the curriculum of the department, major, course / educational program (hereinafter referred to as "affiliated department, etc.") to which said lecturer belongs, lectures other than the courses to be supported will also be covered.

Recruitment Procedure

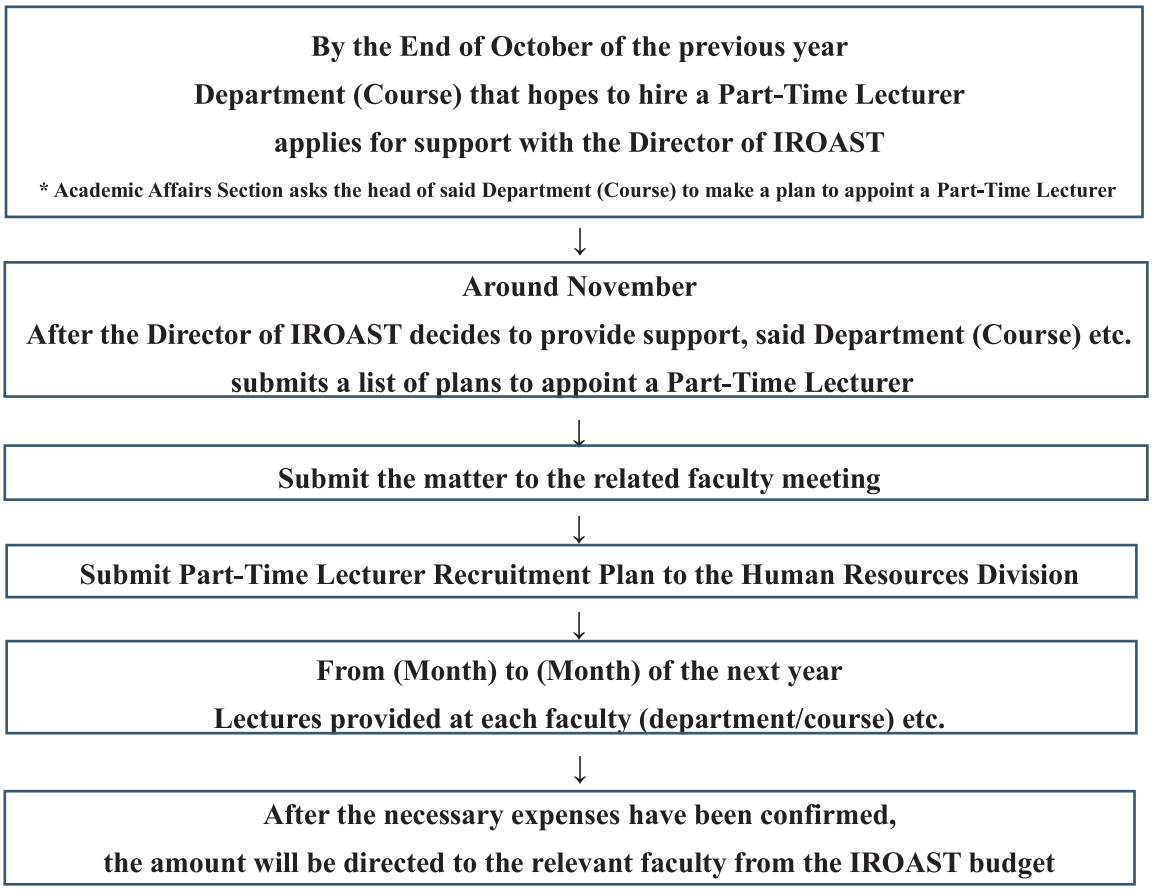
- In principle, the head of the affiliated department, etc. who wishes to hire a Part-Time Lecturer, shall submit the Attachment to the Director of the IROAST by the end of October of the year previous to the year the Young Faculty Member will be dispatched.
- The Director of IROAST shall promptly decide whether they will provide support, and shall notify the head of the affiliated department.
- Procedures after the decision of support will be taken by the affiliated department, etc., based on "Handling Guidelines for Adoption of Part-Time Lecturer at Kumamoto University「熊本大学における非常勤講師の採用に関する取扱要領」".

Diversion of Part-Time Lecturer Expenses

- When the amount of support for the Part-Time Lecturer is decided, IROAST will direct it to the relevant department, etc.

Target Period

- Until March 31, 2022 (the first phase of IROAST)



Attachment

Month D, Yr

To: Director of the International Research Organization for Advanced Science and Technology (IROAST)

○○ ○○, Head of the Department, Major, Course / Educational Program

Supporting the Expenses Relating to Hiring a Part-Time Lecturer who will Substitute for a Young Faculty Member for International Joint Research of the International Research Organization for Advanced Science and Technology (IROAST) to be Dispatched Overseas

I would like to request your assistance in providing the expenses to hire a Part-Time Lecturer for the following subject who will substitute for an IROAST Young Faculty Member for International Joint Research while he/she is dispatched overseas.

Descriptions

1. Course Name:

*For other than the supported courses, please describe why you need the support.

2. Course Period: _____Term (From _____ to _____)
1st, 2nd … Month D,Yr Month D,Yr

3. Timetable: _____, _____period (total periods per week_____, total number of times_____)
Day of the week nth

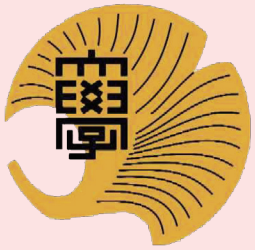
【Researcher to be Dispatched Overseas】

Young Faculty Member for International Joint Research (Department (Course) of ○○) Associate Professor ○○ ○○

Dispatch period From _____ to _____

【* Reason for needing assistance】

* Specifically describe a reason relevant to the courses to be supported, e.g. Necessity to make a curriculum.



Kumamoto University
International Research Organization for
Advanced Science and Technology
© 2020 IROAST