



## **Annual Report 2016-2017**





# Annual Report 2016-2017

International Research Organization for Advanced Science and Technology  
Kumamoto University

*“Science is the knowledge of consequences and dependence of one fact upon another.”*

*Thomas HOBBS, Leviathan*





## Contents

|   |     |
|---|-----|
| Preface.....  | 2   |
| IROAST Members .....  | 4   |
| Operation and Management of IROAST .....  | 11  |
| 1. IROAST Steering Committee Activities.....  | 11  |
| 2. IROAST Research Support Programs.....  | 11  |
| 3. Pre-meeting with International Advisory Board Members.....   | 12  |
| Research Activities.....  | 15  |
| 1. IROAST Researchers .....   | 15  |
| 2. Distinguished Professors.....  | 31  |
| 3. Young Faculty Members for International Joint Research.....  | 39  |
| 4. Visiting Professors.....   | 45  |
| 5. Researchers Supported by the IROAST International Joint Research Travel Support<br>Program.....          | 67  |
| IROAST Symposiums.....  | 83  |
| IROAST Seminars.....  | 93  |
| Agreements & Memorandums of Understanding.....  | 149 |
| IROAST Researcher Publications.....   | 163 |
| International Collaborative Publications from IROAST Visiting Professors and their Host<br>Professors ..... | 169 |
| External Funds .....  | 173 |
| Publications Supported by the IROAST Publication Support Program .....                                      | 175 |
| Regulations, Guidelines and Rules of IROAST.....  | 177 |

## 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 professors 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 specific areas described below, recruitment and 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 create strong international networks of researchers, especially in the following four advanced areas of science and technology: Nano Material Science, Green Energy, Environmental Science and Advanced Green Bio.

IROAST recruited tenure-track professors, associate professors, and postdoc researchers from around the world. Successful tenure-track candidates will be promoted to tenured posts at the Graduate School of Science and Technology after qualification at IROAST. Whenever there is a vacancy in a tenure-track position, a new researcher will be recruited to widen IROAST's range of research activities. The organization will invite world-leading researchers as Distinguished Professors or guest professors to perform collaborative research, hold international seminars, and provide intensive lectures for graduate students. A new program has been operated to send young faculty members from the graduate school to overseas universities and institutions to enlarge the international joint research networks of IROAST.

To import excellent minds in the above four areas, we currently have five tenure-track researchers: one full professor, three associate professors, and one assistant professor, as well as two post-doctoral researchers who are working together with the tenure-track researchers. In addition, we have two part-time distinguished professors, one from the Hungarian Academy of Science and another from Peking University. Soon we will welcome another distinguished professor from University of Glasgow. We are continuing to recruit even more distinguished professors. To initiate

additional collaboration, we have twenty seven visiting professors from top global universities and institutions from around the world. We hope to see them to join the IROAST team as additional part-time distinguished professors.

The ultimate goal of IROAST is to act fully and globally as a hub of world-class, cutting-edge research alongside the Magnesium Research Center and the Institute of Pulsed Power Science where Kumamoto University has been already recognized as one of the leading institutions in the world.

A handwritten signature in black ink, reading 'Takashi HiYama' with a stylized flourish at the end.

Dr. Takashi HIYAMA, Professor Emeritus  
Distinguished Professor  
Director of International Research Organization for  
Advanced Science and Technology (IROAST)  
Kumamoto University

E-mail: [hiyama@cs.kumamoto-u.ac.jp](mailto:hiyama@cs.kumamoto-u.ac.jp)  
URL: <http://www.cs.kumamoto-u.ac.jp/hiyama/>

# IROAST Members

## Director / Vice-Director



Takashi Hiyama



Jun Otani

## Project Professor / Distinguished Professors



Toshiyuki Tosha



László Pusztai



Yufeng Zheng

## Tenure-track Professor / Associate Professors / Assistant Professor



Mitsuhiro Aida



Takumi Higaki



Aeju Lee



Atsushi Sainoki



Takashi Ishida

## Postdoctoral Researchers



Aditya Ardana



Akiko Nakamasu



Adam Karl  
Schwartzkopff

## Young Faculty Members for International Joint Research



Armando T.  
Quitain  
IPPS (~Jan.31,2018)



Satoshi Hinokuma  
FAST



Yasuko Matsubara  
FAST



Makoto Kumon  
FAST  
(April 1, 2018~)

## Visiting Professors



Josep-Lluís  
Barona-Vilar  
Universidad de  
Valencia  
Spain



Jorge Norberto  
Beltramini  
The University of  
Queensland  
Australia



Paul Bowen  
The University of  
Birmingham  
UK



Maria Jose Cocero  
Universidad de  
Valladolid  
Spain



Patrice Delmas  
The University of  
Auckland,  
New Zealand



Martin Dienwiebel  
Karlsruhe Institute  
for Technology  
Germany



**Amir A. Farajian**  
Wright State  
University  
USA



**Etsuko Fujita**  
Brookhaven  
National Laboratory  
USA



**Tomonari  
Furukawa**  
Virginia Polytechnic  
Institute and State  
University  
USA



**Hamid Ghandehari**  
University of Utah  
USA



**Olivier Hamant**  
Research Director  
INRA, RDP, ENS  
Lyon  
France



**Yang Kim**  
Kosin University  
Korea



**Konstantinos  
Kontis**  
University of  
Glasgow  
UK



**Ick Chan Kwon**  
Korea Institute of  
Science and  
Technology  
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



**Dmitri Aleks  
Molodov**  
RWTH Aachen  
University  
Germany



**Rahul Raveendran  
Nair**  
The University of  
Manchester  
UK



**Reiko Oda**  
Université de  
Bordeaux  
France



**Ramesh S. Pillai**  
University of  
Geneva  
Switzerland



**Zoran Ren**  
University of  
Maribor  
Slovenia



**Supri Soengkono**  
GNS Science  
New Zealand



**Gioacchino  
Viggiani**  
Université Grenoble  
Alpes  
France



**Thomas Waitz**  
University of Vienna  
Austria



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



**Firuz Zare**  
The University of  
Queensland  
Australia

FAST: Faculty of Advanced Science and Technology, Kumamoto University

IPPS: Institute of Pulsed Power Science, Kumamoto University



### Project Professor

|   | Name                | Period of Appointment | Former Affiliation   |
|---|---------------------|-----------------------|--|
| 1 | Dr. Toshiyuki Tosha | April 1, 2016-        | Qualified Project Researcher<br>Priority Organization for innovation<br>and Excellence, Kumamoto<br>University |

### Distinguished Professors

|   | Name  | Period of Appointment | Affiliation  |
|---|---|-----------------------|--|
| 1 | Dr. László Pusztai<br>Host Professor:<br>Shinya Hosokawa (FAST) | April 1, 2017-        | Wigner Research Centre for Physics,<br>Hungarian Academy of Science,<br>Hungary (Scientific Advisor)           |
| 2 | Dr. Yufeng Zheng<br>Host Professor:<br>Kazuki Takashima (FAST)  | May 1, 2017-          | Department of Materials and<br>Engineering, College of Engineering,<br>Peking University, China<br>(Professor) |

### Tenure-Track Professor/Associate Professors

|   | Name                                       | Period of Appointment | Former Affiliation  |
|---|--|-----------------------|---|
| 1 | Dr. Mitsuhiro Aida<br>Professor            | July 1, 2017-         | Postdoctoral Researcher<br>Department of Applied Biological<br>Science, Tokyo University of Science<br>PhD: Kyoto University (1999)                           |
| 2 | Dr. Takumi Higaki<br>Associate Professor   | August 1, 2017-       | Research Associate Professor<br>Graduate School of Frontier<br>Sciences, The University of Tokyo<br>PhD: The University of Tokyo (2009)                       |
| 3 | Dr. Aeju Lee<br>Associate Professor        | January 1, 2017-      | Postdoctoral Researcher<br>Department of Drug Discovery and<br>Development, Instituto Italiano Di<br>Tecnologia, Italy<br>PhD: Korea University, Korea (2013) |
| 4 | Dr. Atsushi Sainoki<br>Associate Professor | January 1, 2017-      | Postdoctoral Researcher<br>Mine Design Laboratory, McGill<br>University, Canada<br>PhD: McGill University, Canada<br>(2014)                                   |

|   |   |               |   |
|---|---|---------------|---|
| 5 | Dr. Takashi Ishida<br>Assistant professor | June 1, 2016- | Postdoctoral Researcher<br>Graduate School of Science and<br>Technology, Kumamoto University<br>PhD: Nara Institute of Science and<br>Technology (2007) |
|---|---|---------------|---|

### Postdoctoral Researchers

|   | Name  | Period of<br>Appointment        | Former Affiliation                                     |
|---|---|---------------------------------|--|
| 1 | Dr. Aditya Ardana<br>Aeju Lee Laboratory                  | June 1, 2017-<br>March 31, 2018 | PhD: The University of Queensland,<br>Australia (2016) |
| 2 | Dr. Adam Karl Schwartzkopff<br>Atsushi Sainoki Laboratory | July 1, 2017-                   | PhD: The University of Adelaide,<br>Australia (2016)   |
| 3 | Dr. Akiko Nakamasu<br>Takumi Higaki Laboratory            | December 1, 2017-               | PhD: Ochanomizu University (2010)                      |

### Young Faculty Members for International Joint Research

|   | Name  | Period of<br>Appointment                | Partner University   |
|---|---|---|--|
| 1 | Dr. Armand T. Quitain<br>Assistant Professor, IPPS (-January<br>31, 2018) | November 1,<br>2016-January 31,<br>2018 | Chemical Engineering and<br>Environmental Technology<br>Department, Universidad de<br>Valladolid, Spain            |
| 2 | Dr. Satoshi Hinokuma<br>Assistant Professor, FAST                         | April 1, 2017-<br>March 31, 2020        | The Barcelona Institute of Science<br>and Technology, Institute of<br>Chemical Research Catalonia (ICIQ),<br>Spain |
| 3 | Dr. Yasuko Matsubara<br>Assistant Professor, FAST                         | April 1, 2017-<br>March 31, 2019        | Department of Computer Science,<br>Carnegie Mellon University, USA   |
| 4 | Dr. Makoto Kumon<br>Associate Professor, FAST                             | April 1, 2018-<br>March 31, 2021        | Department of Mechanical<br>Engineering, Virginia Polytechnic<br>Institute and State University, USA               |

## Visiting Professors

|    | Name                         | Affiliation   | Host Professor  |
|----|------------------------------|---|---|
| 1  | Dr. Josep-Lluís Barona-Vilar | University of Valencia, Spain (Professor)   | Hiroataka Ihara (FAST)  |
| 2  | Dr. Jorge Noberto Beltramini | The University of Queensland, Australia (Associate Professor)   | Shinya Hayami (FAST)  |
| 3  | Dr. Paul Bowen               | The University of Birmingham, UK (Deputy Pro-Vice-Chancellor and Feeney Professor of Metallurgy)  | Kazuki Takashima (FAST)   |
| 4  | Dr. Maria Jose Cocero        | University of Valladolid, Spain (Professor)   | Tetsuya Kida (FAST)<br>Armando Quitain (IPPS/IROAST, -January 31, 2018) |
| 5  | Dr. Patrice Delmas           | The University of Auckland (Associate Professor)  | Toshifumi Mukunoki (FAST)   |
| 6  | Dr. Martin Dienwiebel        | Karlsruhe Institute of Technology, Germany (Professor)  | Kazuki Takashima (FAST)   |
| 7  | Dr. Amir A. Farajian         | Wright State University, USA (Associate Professor)  | Hamid Hosano (Hosseini) (IPPS)  |
| 8  | Dr. Etsuko Fujita            | Brookhaven National Laboratory, USA (Senior Chemist)  | Yutaka Kuwahara (FAST)  |
| 9  | Dr. Tomonari Furukawa        | Virginia Polytechnic Institute and State University, USA (Professor)  | Makoto Kumon (FAST)   |
| 10 | Dr. Hamid Ghandehari         | University of Utah, USA (Professor)   | Hamid Hosano (Hosseini) (IPPS)  |
| 11 | Dr. Olivier Hamant           | INRA in the Plant Reproduction and Development Laboratory, ENS Lyon, France (Research Director)   | Shinichiro Sawa (FAST)  |
| 12 | Dr. Yang Kim                 | Kosin University, Korea (Professor Emeritus)  | Shinya Hayami (FAST)  |
| 13 | Dr. Konstantinos Kontis      | University of Glasgow, UK (Professor)   | Hamid Hosano (Hosseini) (IPPS)  |
| 14 | Dr. Ick Chan Kwon            | Korea Institute of Science and Technology, South Korea (Professor)  | Takuro Niidome (FAST)   |
| 15 | Dr. Pavel Lejček             | Academy of Sciences of the Czech Republic, Czech Republic (Professor)<br><br>University of Chemistry and Technology, Prague, Czech Republic (Professor) | Sadahiro Tsurekawa (FAST)   |

|    |                                 |  |                                |
|----|---------------------------------|--|--------------------------------|
| 16 | Dr. Viren Ivor Menezes          | Indian Institute of Technology<br>Bombay, India (Professor)  | Hamid Hosano (Hosseini) (IPPS) |
| 17 | Dr. Dmitri Aleks<br>Molodov     | RWTH Aachen University, Germany<br>(Professor)   | Sadahiro Tsurekawa (FAST)      |
| 18 | Dr. Rahul Raveendran<br>Nair    | The University of Manchester, UK<br>(Professor)  | Shinya Hayami (FAST)           |
| 19 | Dr. Reiko Oda                   | CNRS, University of Bordeaux,<br>France (Senior Principal Investigator)  | Hiroataka Ihara (FAST)         |
| 20 | Dr. Ramesh Shanmughom<br>Pillai | University of Geneva, Switzerland<br>(Professor)   | Tokio Tani (FAST)              |
| 21 | Dr. Zoran Ren                   | University of Maribor, Slovenia<br>(Professor)   | Kazuyuki Hokamoto (IPPS)       |
| 22 | Dr. Supri Soengkono             | GNS Science, New Zealand (Senior<br>Principal Investigator)  | Toshiyuki Tosha (IROAST)       |
| 23 | Dr. Gioacchino Viggiani         | University of Grenoble Alpes, France<br>(Professor)  | Jun Otani (FAST)               |
| 24 | Dr. Thomas Waitz                | University of Vienna, Austria<br>(Associate Professor)   | Mitsuhiro Matsuda (FAST)       |
| 25 | Dr. Zhenghe Xu                  | Southern University of Science and<br>Technology, China<br>(Professor)<br><br>University of Alberta, Canada<br>(Professor) | Makoto Takafuji (FAST)         |
| 26 | Dr. Firus Zare                  | The University of Queensland,<br>Australia (Professor)   | Hamid Hosano (Hosseini) (IPPS) |

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 have opened the Steering Committee meetings 14 times in the year of 2016, and 8 times in the year of 2017 to discuss and to determine varieties of regulations required for the successful operation and management of the IROAST. In addition, a good number of research supporting programs has been running under the fully understanding by the committee members. All the following regulations are attached in the annual report.

R1: Regulations of IROAST

R2: Internal Rules for Selection of Tenure-track Professors and Associate Professors

R3: Agreement on Procedures for Selection of Tenure-track Professors and Associate Professors

R4: Guidelines for Interim Evaluation of Tenure-track Professors and Associate Professors

R5: Guidelines for Tenure Review of Tenure-track Professors and Associate Professors

R6: Agreement of the IROAST for Visiting Professors

R7: Handling of Granting the Title of “Visiting Professor” for the IROAST

R8: Agreement of the IROAST for Distinguished Professors

R9: Selecting Distinguished Professors for the IROAST

## 2. IROAST Research Support Programs

We have prepared several research supporting programs running in parallel in order to promote internationally collaborated research works towards the configuration of international joint research networks and also to bring brains 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 the opportunity to promote their joint research works at overseas universities and institutions totally at least for one year.

### 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 in order to conclude MOUs to promote internationally collaborated research works and/or to perform their joint research there.

### IROAST Visiting Professor and Visiting Professor Candidate Invitation

We invite Visiting Professors and candidates of Visiting Professors to IROAST in order to promote the joint research with their host researchers toward the configuration of international

joint research networks and also to open international seminars to attract young researchers including graduate students into the cutting-age research activities.

#### Research Award from IROAST (for IROAST faculty members only)

We select excellent and powerful IROAST faculty members at the end of every fiscal year to appreciate their research activities and give them the Research Award from IROAST.

#### IROAST Proofreading/Publication Support

We give the financial support for the proofreading/publication to the researchers mainly belonging to the Graduate School of Science and Technology to increase the number of publications from the area of science and technology.

#### IROAST Research Internship Program (Starting from April, 1, 2018)

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

#### IROAST Symposia

We invite key-note speakers from overseas universities and also universities in Japan to open international symposia with specific titles two to three times a year.

#### IROAST Seminar and International Collaborative Research Support Program

We invite excellent and powerful researchers from overseas universities and institutions to open international seminars and also to start new internationally collaborated research works.

### **3. Pre-meeting with International Advisory Board Members**

On October 9, 2017, Prof. HIYAMA, Director of IROAST, and Mr. KUMAGAI, Chief Administrator, visited the Heinrich Heine University in Dusseldorf, Germany to have a meeting with IROAST International Advisory Board members of IROAST, Prof. Dr. Peter WESTHOFF, Vice President for Research and Technology Transfer and Dr. Anne GELLERT, Director of the International Office.

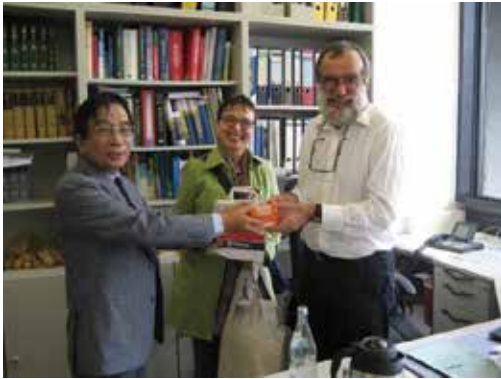
The purpose of the meeting was to exchange ideas with the board members to promote further international collaboration.

After reporting the details of IROAST activities including our progress and achievements to the members including our research supporting programs, we discussed how to bring further improvement to our research supporting activities. The members gave us their satisfaction to our current achievements. However, in the discussion, they suggested to open the internship program at the IROAST to make the international brain circulation more efficient considering the future development of young excellent researchers.

Following the suggestions from the board members we started the procedure to open the internship program and we have concluded its regulation about the end of the fiscal year of 2017 through the discussion at the Steering Committee.

We have already selected one student as a young internship researcher among three candidates from McGill University, Canada from June to August in 2018.

In the evening of October 9, our staffs also had the courtesy meeting with Vice President for International Relations Prof. Dr. Andrea von Hülsen-Esch in her office to talk about the possibility to have both academic and student exchange programs between the Heinrich Heine University in Dusseldorf and Kumamoto University.



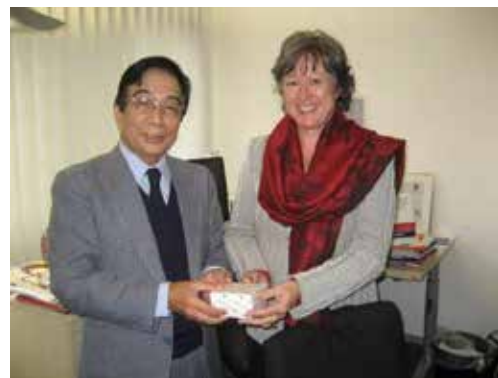
From left Director Hiyama, Dr.Gellert, and Prof. Dr. Westhoff



Director Hiyama giving an explanation to advisory board members



Director Hiyama and Mr. Kumagai meeting with Prof. Dr. Westhoff



Director Hiyama and Prof. Dr. Hülsen-Esch







## Research Activities

### 1. IROAST Researchers

| No. | Name                           | Project Title  |
|-----|--------------------------------|--|
| 1-1 | <b>Tosha Toshiyuki</b>         | Geothermal energy  |
| 1-2 | <b>Mitsuhiro Aida</b>          | Shoot meristem formation and maintenance in <i>Arabidopsis thaliana</i>  |
| 1-3 | <b>Takumi Higaki</b>           | Quantitative and theoretical analysis on plant morphology  |
|     | <b>Akiko Nakamasu</b>          |  |
| 1-4 | <b>Aeju Lee</b>                | Polymeric Nanoconstructs for Combination Therapy and Multimodal Imaging  |
|     | <b>Aditya Ardana</b>           |  |
| 1-5 | <b>Atsushi Sainoki</b>         | Development of a methodology for estimating the risk of induced seismicity occurring in a reservoir or a deep aquifer due to fluid injection |
|     | <b>Adam Karl Schwartzkopff</b> |  |
| 1-6 | <b>Takashi Ishida</b>          | Unraveling the molecular mechanisms of the plant stem cell and development   |



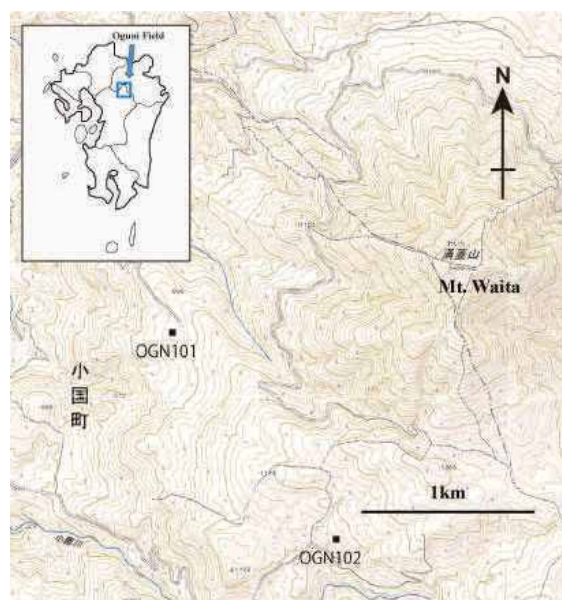
|                |   |       |                   |
|----------------|---|-------|-------------------|
| No. 1-1        | Geothermal energy                       |       |                   |
| Name           | Toshiyuki Tosha                         |       |                   |
| Affiliation    | IROAST<br>Email: tosha@kumamoto-u.ac.jp | Title | Project Professor |
| Research Field | Green Energy                            |       |                   |

Green (renewable) energy refers to the resource that is recognised as being able to be used permanently as an energy source. Solar power, Wind power, Hydropower, Geothermal, Solar heat, Heat in the atmosphere and other natural heat source, Biomass are regulated by the Japanese law. Renewable energy is an excellent energy that scarcely exhausts carbon dioxide, which causes global warming, during power generation and heat utilisation. Despite excellent renewable energy, geothermal energy has not been advanced in Japan due to risks arising from the development of an underground resource and being excluded from the political support in the 2000s. For this reason, large-scale geothermal power plants have not been constructed since 2000. In view of this situation, I have been engaged in activities to contribute to geothermal development not only domestically but also overseas.

In Kumamoto Prefecture, Oguni and Minamiaso have been regarded as areas with abundant geothermal resources. At Oguni, the construction of the power station was progressing with support of national survey program and corporate survey by a private company progressed since the 1980's. The company, however, withdrew from the development in 2002 because of the failure of the local residents' understanding. A small geothermal power plant with the install capacity of 2MW was constructed.

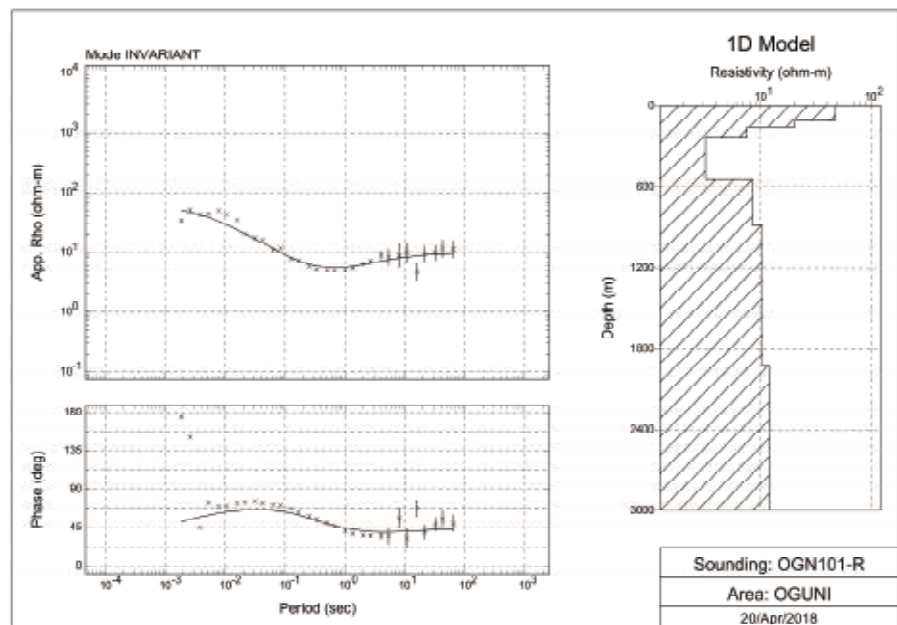
Minamiaso suffered severe damage due to the Kumamoto earthquake in 2016. Roads necessary for the investigation of the geothermal energy development were cut off and living reconstruction of residents was taken first priority rather than the development. Geothermal development does not proceed at Minamiaso. As regional contribution, aggressive investigations have been made in these two geothermal development areas, such as cooperation with local governments, educational activities for residents, and advice to companies promoting development.

We obtained and analysed gravity gradient survey data taken by a helicopter that is capable of wide area exploration. This survey data is carried out by JOGMEC as a part of a wide area survey program for the geothermal development. At Oguni the survey was conducted as a region surrounding Mt. Waita including Kokonoe in Oita Prefecture. Kumamoto University has concluded MOU with Geological and Nuclear Science (GNS Science) in New Zealand, and using this survey data, we are collaborating on establishing interpretation and analysis methods. This year, Dr. Supri Soengkono of GNS Science visited Japan and discussed on the joint research work on presenting results. The aerial survey has also been carried out around Mt. Aso including Minamiaso and this data was jointly studied with Sumiko Resources Exploration & Development Co. Ltd.



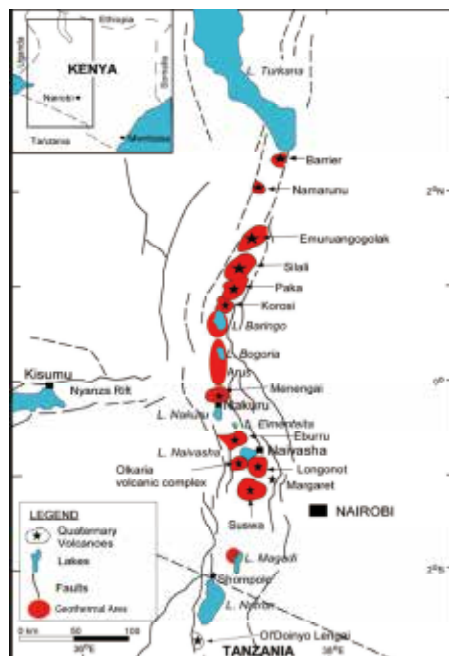
Location map for the MT survey at Oguni

Regarding the geothermal resources at Oguni, geothermal fluid flow analysis using TOUGH2, a geothermal flow simulator. From the analysis of the areal gravity gradient data, geothermal water is predicted to originate under Mt. Waita and to flow to Sugawara directly though it was considered to flow along the Takenoyu Fault. Therefore another flow analysis based on new findings has to be conducted. At



A tentative result of 1D analysis at OGN101 (Hase, 2018)

Oguni, MT (Magneto-telluric) survey was conducted to obtain resistivity structure. As the study is only one-dimensional analysis results at two survey points, preliminary conclusions are only obtained that there are areas with high resistivity at the surface layer, low resistivity area under it, and again high resistivity region, implying the existence of geothermal fluid with low resistivity. For overseas cooperation, micro earthquake lectures and observation helps in the geothermal areas in Indonesia and Kenya were carried out in a program supported by JICA.



Geothermal field in Kenya (Omenda and Simiyu, 2015)

|                |   |       |           |
|----------------|---|-------|-----------|
| No. 1-2        | Shoot meristem formation and maintenance in <i>Arabidopsis thaliana</i> |       |           |
| Name           | Mitsuhiro Aida  |       |           |
| Affiliation    | IROAST<br>Email: m-aida@kumamoto-u.ac.jp                                | Title | Professor |
| Research Field | Advanced Green Bio  |       |           |

The main goal of our group is to elucidate the molecular mechanisms of shoot meristem formation, which is a critical process for plant growth and development. The shoot meristem is a highly dividing group of undifferentiated cells that generates all types of shoot organs, such as leaves, stems and flowers. We have been focusing on the functions of *CUP-SHAPED COTYLEDON* genes *CUC1*, *CUC2* and *CUC3*, which encode transcription factors expressed in shoot organ boundaries. We have identified a number of downstream genes, whose expression is activated by CUC proteins, and one of these is *SHOOT MERISTEMLESS (STM)* gene, whose activity is essential for postembryonic shoot meristem maintenance. We have uncovered that the activity of *STM* is mainly responsible for embryonic shoot meristem initiation downstream of CUC proteins. A part of this analysis has been published as a collaborative work with research groups in Cardiff University (UK) and University Nottingham (UK). The paper describes a gene regulatory network consisting of *STM* and other transcription factors as well as the microRNA164, which together control multiple processes including hormone biosynthesis, cell differentiation and leaf positioning and thus orchestrate the shoot meristem activity essential for shoot growth (Scofield et al, 2018).

Further international and multidisciplinary research collaborations with overseas research groups of Heinrich-Heine University (Germany), Max Planck Institute for Plant Breeding Research (Germany) and University of Silesia (Poland) as well as several domestic research groups of Tokyo Science University, Tohoku University and Nara Institute of Science and Technology is going on to understand molecular mechanisms regulating shoot organ development. A new collaboration with Palacky University (Czech Republic) on transcriptional regulation of shoot regeneration, which also involves main regulators for shoot meristem activity. These collaborative activities include young researchers and those with various discipline, facilitates me to conduct highly advanced, international, multidisciplinary research including new field.

In addition to the above activities, I have co-organized a symposium, “Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems” with two other tenure track researchers of IROAST, Takumi Higaki and Takashi Ishida. The details are described in the section of IROAST Symposium Report.

#### Publication

Scofield S, Murison A, Jones A, Fozard J, Aida M, Band LR, Bennett M and Murray JAH (2018). Coordination of meristem and boundary functions by transcription factors in the SHOOT MERISTEMLESS regulatory network. *Development* (2018) 145, dev157081. doi:10.1242/dev.157081.

|                |   |       |                         |
|----------------|---|-------|-------------------------|
| No. 1-3        | Quantitative and theoretical analysis on plant morphology |       |                         |
| Name           | Takumi Higaki   |       |                         |
| Affiliation    | IROAST<br>Email: thigaki@kumamoto-u.ac.jp                 | Title | Associate Professor     |
| Name           | Akiko Nakamasu  |       |                         |
| Affiliation    | IROAST<br>Email: nakamasu@kumamoto-u.ac.jp                | Title | Postdoctoral Researcher |
| Research Field | Advanced Green Bio  |       |                         |

## 1. Research achievements

### a) Quantitative evaluation of cytoskeletal organizations (T. Higaki)

Cytoskeletal organizations are tightly related to various cell activities including cell division, cell expansion, and cell differentiation. For example, the orientation of cortical microtubules determines the cellulose deposition direction, which regulates plant cell growth orientation. Therefore, visualization and evaluation of cytoskeletal organizations are essential techniques in cell biology. Because of recent advances in microscope technology, the image acquisition efficiency has been significantly improved, and it is now easy to obtain a large number of digital microscopic images in a short time. With these technical backgrounds, development of the high-throughput quantitative evaluation method has now become an important issue for state-of-the-art cell biology. In FY2017, we had developed an image analysis framework for high-throughput quantitative evaluation of cytoskeletal bundling using intensity distribution statistics as a collaboration with Prof. Seiichiro Hasezawa (The University of Tokyo), Prof. Kazuhiko Nishitani (Tohoku University), and Dr. Kaoru Katoh (AIST). Our technique was appropriate to detect cytoskeletal bundling at least in our image datasets including synthetic and microscopic images. We had prepared the manuscript for publication (Higaki et al. in preparation.), and gave presentations about this work in the 81th annual meeting of the Botanical Society of Japan (September 8, 2017), the 26<sup>th</sup> annual meeting of the Bioimaging Society (September 16, 2017), and the 59<sup>th</sup> annual meeting of the Japanese Society of Plant Physiologists (March 29, 2018). I was also invited to give a talk about this work as the seminar hosted by a Grant-in-Aid for Scientific Research on Innovative Areas "Platforms for Advanced Technologies and Research Resources: Advanced Bioimaging Support" (<http://www.nibb.ac.jp/abis/?lang=en>), in National Institute for Basic Biology (January 17, 2018). In addition, we had collaborated on quantitative evaluation of plant cortical microtubule organizations and published three original papers (Kuki et al. 2017 Plant Direct; Dou et al. 2018 Plant Physiol; Akita et al. 2018 Plant Sig Behav).

### b) Theory based approach to investigate the leaf morphogenesis (A. Nakamasu)

The theoretical approaches utilizing simulation are powerful tool to understand complex phenomena in biology. For example, a morphogenesis is an event that accompanied by a continuous growth, then it is difficult to puzzle out. Of which, leaf shapes expanding on a two-dimensional plane are comparatively simple systems to understand. We focused on the divarication types of leaf in *Microsorium pteropus* and its variants. These aquatic ferns having three different types of divarication were found to be very closely related by molecular phylogenetic analysis. Then the apical growth of leaf that satisfied the all three types of divarication was indicated by developmental analysis. We are now submitting the paper about this topic as a collaboration with Prof. Seisuke Kimura (Kyoto Sangyo University).

### c) Analyses of dynamic pattern through the modeling of plant ER (A. Nakamasu)

Dynamic patterns, i.e., spatially ordered kinetics, observed in biological systems are considered



to positively remove the bias of positional information. An endoplasmic reticulum (ER) in plant cells is one of such system that shows moving nets interacting with actin flows. We constructed a mathematical model based on the partial differential equation (PDE). By combining spatially distributed two structures, some kind of periodic pattern by PDE and an actin mesh dependent perturbation, we successfully obtained the dynamics of the system. I was invited to give a talk about this topic in seminar at University of Miyazaki (March 8, 2018). Then we approached from actual interactions of component molecules of ER to construct a model consist of reaction-diffusion system. This model describing the polymerization and depolymerization of phospholipid successfully achieved the autonomous generation of vehicle-like distribution of components. This vehicle that were characteristic in ER maintained stable for a long time by choosing the parameters.

## 2. International research collaboration

### a) Quantitative evaluation of cytoskeletal organizations (T. Higaki)

I co-organized the international symposium entitled “Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems” together with Prof. Mitsuhiro Aida (IROAST) and Assistant Prof. Takashi Ishida (IROAST) (November 14, 2017). For this symposium, I invited Prof. Brad Day (Michigan State University) and Prof. Bo Liu (UC Davis), and we had a face-to-face discussion with them on our international collaborations. With Prof. Day, we had collaborated on quantitative evaluations of actin cytoskeletal organizations in *Arabidopsis thaliana* leaf epidermal cells stimulated by plant pathogenic signals. We had prepared the manuscript for publication (Lu et al. in preparation.). To enhance our collaboration with Prof. Day, we had prepared to conclude the general international agreement for academic cooperation between Michigan State University (MSU) and the Faculty of Advanced Science and Technology (FAST) and IROAST, Kumamoto University. With Prof. Liu, we also had collaborated on quantification of mitotic spindle morphology in *A. thaliana* root cells. To formalize our collaboration, we concluded a memorandum of understanding (MOU) relating to our collaboration with Prof. Liu laboratory (December 20, 2017). I also got a collaboration offer from Prof. Yuling Jiao (Chinese Academy of Science) who was invited by Prof. Aida for the IROAST symposium. Then we had started to collaborate on quantitative evaluation of cytoskeletal density and orientations in plant leaves. We also performed international collaboration with Prof. Tonglin Mao (China Agricultural University), and published an original paper in Plant Physiology (2016/2017 Impact Factor: 6.456) (Dou et al. 2018 Plant Physiol). In this international collaboration, I quantitatively evaluated cortical microtubule density in *A. thaliana* cotyledon pavement cells using confocal images. In addition, we had performed international collaboration with Prof. Liam Dolan (University of Oxford) and Dr. Masa H Sato (Kyoto Prefectural University) on cortical microtubules in plant root hairs. We had revised the manuscript for publication (Hirano et al. in revision.).

### b) Theory based approach to investigate the leaf morphogenesis &

### c) Analyses of dynamic pattern through the modeling of plant ER (A. Nakamasu)

Interdisciplinary studies such as applications of mathematics in biology are new pathway to interact researchers in all over the world, therefore, we would like to promote international collaborative research with the scientists who experimentally investigate the plant and the mathematician who treat the dynamic pattern, in the future.

## 3. Prospect for further research collaboration

### a) Quantitative evaluation of cytoskeletal organizations (T. Higaki)

Various trials to improve plant stomatal movement have been conducted based on recent societal demands for higher carbon fixation efficiency. To improve stomatal movement, the main targets were previously limited to molecules related to gene expression or activation of plasma membrane  $H^+$ -ATPase, however, technical limitations were pointed out. We previously revealed

the H<sup>+</sup>-ATPase translocation mechanisms with the membrane traffic factor, PATROL1 (Proton ATPase Translocation Control 1), which is a key regulator of delivery of H<sup>+</sup>-ATPase to plasma membranes, using live cell imaging and quantitative image analysis techniques. Our finding of PATROL1 has led to a new strategy that the stomatal response can be improved by regulation of H<sup>+</sup>-ATPase translocation. Actually, we reported that overexpression of PATROL1 promoted plant growth. Thus, our upcoming results in this research are expected to have a great impact not only on the basic science field but also on society. As a faculty member of Advanced Green Bio section in IROAST, we will improve our PATROL1 works by international collaborations with oversea cytoskeleton experts including my collaborators described above. Recently, our co-immunoprecipitation analyses combined with mass spectroscopy suggested that cytoskeletal components interacted with PATROL1. In addition, our live cell imaging showed that GFP-PATROL1 became to localize on filamentous structures that resembled cytoskeletons under the specific conditions. These data imply an interesting hypothesis that PATROL1 interacts with cytoskeletons to deliver H<sup>+</sup>-ATPase to plasma membranes. To verify this hypothesis, we would perform international collaborations. We will biochemically examine direct interaction between PATROL1 and cytoskeletal components using co-sedimentation assay. *In vivo* dual observations and quantitative image analyses on GFP-PATROL1 and RFP-labeled cytoskeletons will be conducted to test these colocalizations. In addition, we will quantitatively evaluate the effects of genetic or pharmacological cytoskeletal perturbations on the localization of H<sup>+</sup>-ATPase and stomatal movement.

b) Theory based approach to investigate the leaf morphogenesis (A. Nakamasu)

A morphogenesis is difficult to understand even in leaf, because most of that consists in the combination of several growth styles based on different positional information. By simply combine the different growth manners, various shapes of leaf are known to be generated theoretically. We would like to investigate the existence of these differences of growth pattern in actual plants as collaborate with the experimental biologists.

c) Analyses of dynamic pattern through the modeling of plant ER (A. Nakamasu)

We improve the model constructing vehicles to generate net pattern, then try to move this pattern having tubes as observed in the actual plant ER. More detail of the mechanism of dynamic patterns should be investigated, then the obtained knowledge will be applied to industrial problems. This model will be useful to design the network which is issue of social concern. Because the ER of plant cell is known to construct Euclid Steiner networks (ESN). The algorithm to solve Steiner Minimal Tree is treated with graph theory then categorized in NP difficulty. We are now preparing to collaborate with researchers who are mathematician associated with this problem.

|                |   |       |                         |
|----------------|---|-------|-------------------------|
| No. 1-4        | Polymeric Nanoconstructs for Combination Therapy and Multimodal Imaging |       |                         |
| Name           | Aeju Lee  |       |                         |
| Affiliation    | IROAST<br>Email: aeju-lee@kumamoto-u.ac.jp                              | Title | Associate Professor     |
| Name           | Aditya Ardana   |       |                         |
| Affiliation    | IROAST<br>Email: aditya_ardana@kumamoto-u.ac.jp                         | Title | Postdoctoral Researcher |
| Research Field | Advanced Green Bio  |       |                         |

### 1. Research achievements

**First, I focused on suggesting early and non-invasive diagnosis of Parkinson's disease (PD).** There has been interest in the potential development of tissue biopsy for the diagnosis of PD. I found that one of imaging sensor shown specific signal in PD brain. I believe that this research opens possibility to early and non-invasive way for detecting PD. (Figure 1)

**Second, I developed trans-blood brain barrier delivery carriers for PD.** Sustained and safe delivery of drug across the blood brain barrier (BBB) is a major hurdle for successful therapy in PD. Therefore, I designed multi-drug loaded polymeric nanoparticles for effective drug delivery to the brain. We were finalizing characterize materials and move to animal experiment. (Figure 2)

**Third, I developed dual-probe nanoparticles to detect metastatic cancer cells using Matrix-metalloproteinase-2.** Matrix metalloproteinases (MMPs) are a family of zinc-dependent enzymes capable of degrading extracellular matrix components. Previous studies have shown that the upregulation of MMP-2 is closely related to metastatic cancers. The MMP-2-PLGA-PEI nanoparticles contained MMP-2 sensor and RhoB. It can detect not only the presence of MMP-2 activity and visualize the location of the nanoparticles. This approach allowed us to visualize MMP-2 activities in cancer cells and their microenvironment. (Figure 3)

**Fourth, Dr. Aditya synthesis pH-sensitive polymers for developing cancer target controlled release nanoparticles.** Dr. Aditya focused on synthesis of biodegradable pH-sensitive polymer for a year. He finalizes characterization of three different pka polymers. Now we expect forming various type of nanoconstructs to confirm the availability as a drug carrier. (Figure 4)

### 2. International collaboration

Based on my collaboration, one Korean Ph.D student came to Japan and developed imaging sensor and drug delivery system in my laboratory since September, 2017. The collaborator is Veterinarian and has expertise in brain anatomy. Our interest is brain disease, for example, ischemia, Parkinson's disease. So that, we share knowledge and experiences to suggest new paradigm. Now we start to prepare manuscript together and he contribute histological analysis to prove targeting and therapeutic efficacy of my materials.

For developing new imaging sensors, I make collaboration with young assistant Professor in Chonnam national University. The collaborator is chemist and synthesis upconversion nanoparticles (UCNPs) which has self-activated fluorescence signal. With his expertise, I can improve my imaging field experience in disease diagnosis. We perform interdisciplinary research in the field of chemistry and medicine. We discuss about disease application and prepare materials.

My mentor, Prof. Takuro Niidome introduced me to School of Pharmacy and medicine to expend my field. We have different specialties, so that I developed bio-imaging sensor for appling to patient-derived samples. We've already published paper and expanded our collaboration.

### 3. Prospect for further research collaboration



After some invited seminars in Korea, I've got suggestion for making collaboration in bio-mass imaging and metabolomics field. The researchers are interested in Parkinson's disease metabolism and therapeutic effect of my drug delivery carrier. So that, I start to give animal-derived specimens and discuss about meaningful results.

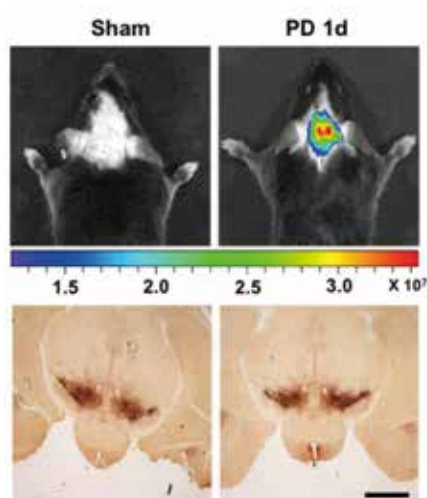


Figure 1. NIR fluorescence images and histological analysis in Parkinson's disease



Figure 2. Images of cell internalized nanoparticles (by Cryo EM) and nanoparticles (by TEM)

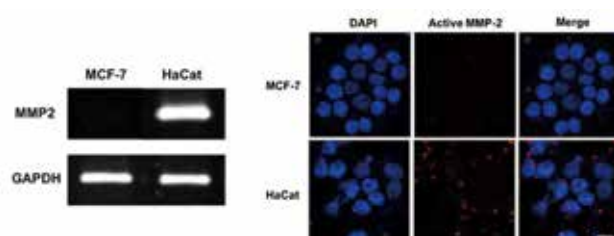


Figure 3. MMP-2 gene expression analysis and cellular level of active MMP-2

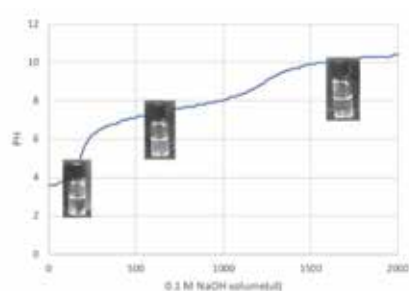


Figure 4. Potentiometric titration curve and optical image of pH-sensitive polymer

|                |  |       |                         |
|----------------|--|-------|-------------------------|
| No. 1-5        | Development of a methodology for estimating the risk of induced seismicity occurring in a reservoir or a deep aquifer due to fluid injection |       |                         |
| Name           | Atsushi Sainoki  |       |                         |
| Affiliation    | IROAST<br>Email: atsushi_sainoki@kumamoto-u.ac.jp  | Title | Associate Professor     |
| Name           | Adam Karl Schwartzkopff  |       |                         |
| Affiliation    | IROAST<br>Email: aschwartzkopff@kumamoto-u.ac.jp   | Title | Postdoctoral Researcher |
| Research Field | Advanced Green Bio   |       |                         |

### 1. Research achievements

During this fiscal year, I have been primarily devoted into writing papers on induced seismicity and the deformation of rockmass in deep hard rock mines as well as developing a cutting-edge numerical simulation program for replicating induced seismicity occurring due to fluid injection into reservoirs. Regarding the above-mentioned papers, seven papers have been accepted in international journals. Also, I attended an international conference held in Korea named Young Scholar's Symposium on Rock Mechanics, where I gave an oral presentation. Furthermore, I presented two papers in domestic conferences. As preparation for conferences in 2018, I submitted an abstract to EUROCK2018 held in Russia, which has been accepted and will attend the conference in 2018. Regarding the novel numerical simulation code that Dr. Schwartzkopff has been developing, the code is still under development, but recently he could successfully obtain almost the same numerical simulation result as a fluid injection experiment in the field. Thus, we aim to publish a journal paper soon after making a few modifications to the code. A part of the result will be presented by him in an international conference held in Beijing in October, 2018. An abstract has been already submitted to the conference. Also, I received two types of grant-in-aid from JSPS: Grant-in-Aid for Research Activity Start-up and JSPS postdoctoral fellowship to hire a postdoc from a foreign country. For the latter one, a postdoctoral fellow will come to Japan in September, 2018 and is supposed to join IROAST.

### 2. International research collaboration

First, I invited Assistant Prof. Agus Sasmito from McGill University and concluded MOU while discussing potential research collaboration. Also, I stayed in Pennsylvania State University for two months and conducted research under the supervision of Prof. Derek Elsworth. Thereafter, I invited him to Kumamoto University and concluded MOU. Prof. Derek Elsworth was eventually appointed as a visiting professor of IROAST starting in April, 2018. I'm planning to closely conduct further collaborative research with his laboratory in 2018. The other ongoing international collaborative research activity is deep mining issues in China. I visited Shandong University of Science and Technology in September, 2017 to check the progress of collaborative research and to give a talk to students there. I also made a discussion regarding to a joint PhD student from China. There is one PhD student who is keen to study at Kumamoto University as a joint PhD under my supervision in the field of rock mechanics and mining engineering for sustainable energy development.

### 3. Prospect for further research collaboration

Further research collaboration will be developed with India. I visited Kolar Gold Fields called (K.G.F.) in March, 2018, where seismic activity has been taking place in an abandoned, deep hard mine subjected to ground water inflow. The government institution (National Institute of Rock Mechanics) will start to work on the issue, with which there will be a possibility of me

concluding MOU to conduct research for elucidating the mechanism of the seismic activity at the mine. In addition to India, there might be an opportunity to develop research collaboration with University of Tasmania in Australia, where I visited in February in 2018. The senior lecturer at the university developing a numerical code to simulate rock fracturing process suggested that I utilize the code to study asperity degradation on a fault surface, which is an important issue deeply related to the occurrence of induced seismic activity.



Photo taken at NIRM office in India



Underground mine visit in India



Lab tour at NIRM in India



Photo taken in Shandong province (山东省)



Underground mine visit in Gifu prefecture, Japan

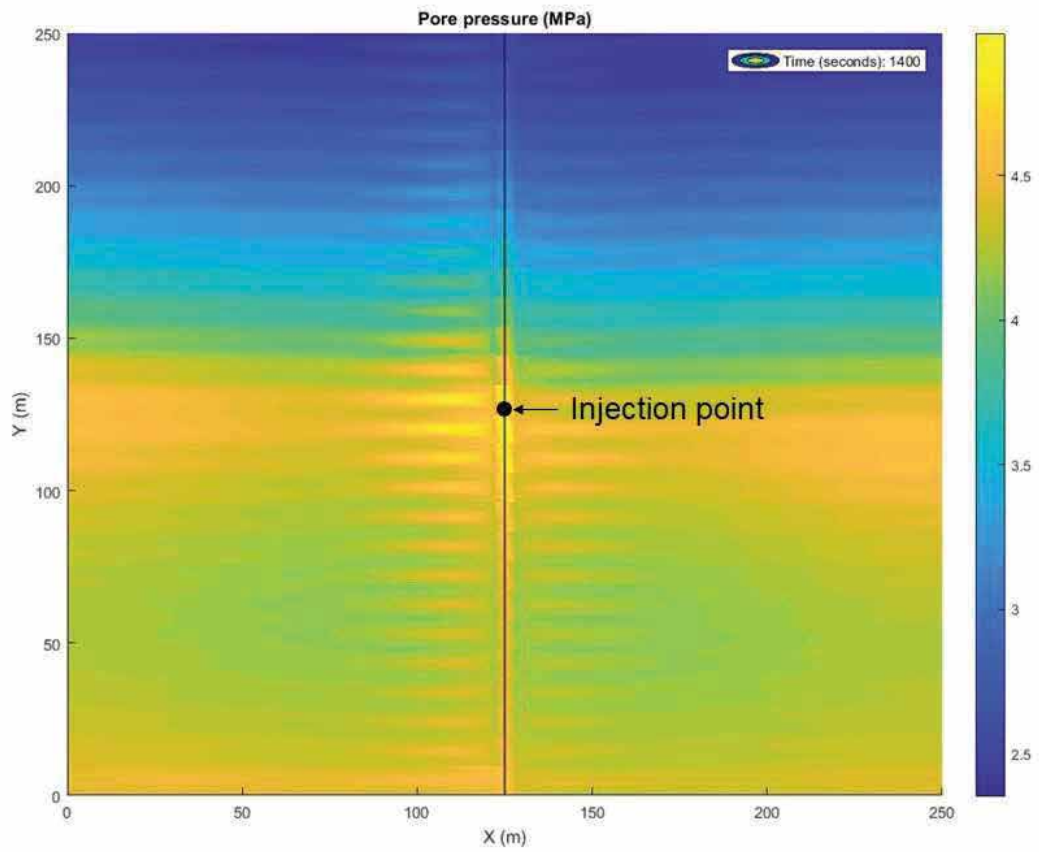




Visit to University of Tasmania in Australia



Visit to a CO<sub>2</sub> injection site at Tomakomai, Hokkaido, Japan



Numerical simulation result of pore pressure distribution

|                |  |       |                     |
|----------------|--|-------|---------------------|
| No. 1-6        | Unraveling the molecular mechanisms of the plant stem cell and development |       |                     |
| Name           | Takashi Ishida   |       |                     |
| Affiliation    | IROAST<br>Email: ishida-takashi@kumamoto-u.ac.jp                           | Title | Assistant Professor |
| Research Field | Advanced Green Bio   |       |                     |

## 1. Research achievements

A major part of our research topic is to understand molecular mechanisms underlying plant stem cells. Both shoot and root meristem contain stem cells that is responsible for the continuous cell production for growth of plant. The ligand–receptor-mediated cell-to-cell communication mechanism plays important roles in coordinating the stem cells. Although the importance of this communication is broadly recognized, most peptide-encoding genes are yet to be characterized due to their small gene size. To override the problem, we have established a collection for mutants for CLE-peptide-encoding genes, a representative signaling peptide gene family in plant, and published the collection as following;

- I. A collection of mutants for CLE-peptide-encoding genes in Arabidopsis generated by CRISPR/Cas9 mediated gene targeting. Yasuka L. Yamaguchi\*, Takashi Ishida#\*, Mika Yoshimura, Yuko Imamura, Chie Shimaoka and Shinichiro Sawa, Plant and Cell Physiology, pcx139 (2017), <https://doi.org/10.1093/pcp/pcx139>. \* These authors contributed equally to this work. # Corresponding author

Another research topic is aiming to understand molecular insights of parasitism especially focusing on plant-nematode interactions. Root-knot nematodes (RKNs) parasitize multiple species of rooting plants and induce characteristic tissue expansion called galls on the roots of their host plants. RKNs are thought to hijack plant cellular machinery to ensure generation of such characteristic tissue, however, the underlying mechanisms have not yet been elucidated. By using next-generation sequencing-based transcriptome profiling, we found that RKNs modulate vascular stemness genes to stimulate ectopic cell proliferation in the galls.

We also analyzed the behavior of RKN in response to photostimulation.

- II. Root-Knot and Cyst Nematodes Activate Procambium-Associated Genes in Arabidopsis Roots. Yamaguchi YL, Suzuki R, Cabrera J, Nakagami S, Sagara T, Ejima C, Sano R, Aoki Y, Olmo R, Kurata T, Obayashi T, Demura T, Ishida T, Escobar C, Sawa S. Frontiers in Plant Science, Volume 8, doi: 10.3389/fpls.2017.01195, 2017.

- III. Negative phototaxis in *M. incognita*. Oota M, Gotoh E, Endo M, Ishida T, Matsushita T, Sawa S, International Journal of Biology, Volume 9, 51-55, 2017.

I have co-organized a symposium, The 1st IROAST Symposium "Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems", with Professor Aida and Associate professor Higaki.

I have organized the 11th IROAST Seminar –The spindle assembly checkpoint in plants.

Dr. Shinichiro Komaki, Assistant Professor, Nara Institute of Science and Technology of Biological Sciences, gave a presentation on his work that were performed in Universität Hamburg. The detail are described in the IROAST Seminar Report 11.

## 2. International research collaboration

The publication number II was accomplished by an international collaboration with a research group in University of Castilla-La Mancha (Spain). In addition, several manuscripts whose contents were acquired based on international collaboration were under reviewing or in preparation.

In FY2017, we have started some international collaboration on the genome editing technique in plants. Well established pipeline for rapid generation of a transgene-free Arabidopsis mutant is one of our advantage in the plant science field and will provide us further collaborations.

### 3. Prospect for further research collaboration

We are planning to attend some international conferences in FY2018 to present our recent achievement including CRISPR/Cas9-mediated gene targeting techniques. Although establishment of CRISPR/Cas9-based genome editing has been widely used in various biological fields including animal sciences and microbiology, the use for plant science has been delayed. We think that our high throughput pipeline for gene targeting in Arabidopsis will be a solution to override the problem. We would like to do collaborative research with this method.

In addition, we will deposit the mutant collection for CLE-peptide encoding genes for public bioresource center. This may also provide opportunities to spread our efficient method.







## 2. Distinguished Professors

| No. | Name                  | Project Title   |
|-----|-----------------------|---|
| 2-1 | <b>László Pusztai</b> | Study of microscopic and mesoscopic structures of amorphous materials |
| 2-2 | <b>Yufeng Zheng</b>   | Development and evaluation of biomaterials                            |

|                       |   |       |                    |
|-----------------------|---|-------|--------------------|
| No. 2-1               | Study of microscopic and mesoscopic structures of amorphous materials   |       |                    |
| Name                  | László Pusztai  |       |                    |
| Affiliation (home)    | Wigner Research Centre for Physics,<br>Hungarian Academy of Sciences, Hungary<br>Email: pusztai.laszlo@wigner.mta.hu<br>lpusztai@kumamoto-u.ac.jp | Title | Scientific Advisor |
| Research Field        | Nanomaterial Science  |       |                    |
| Period of appointment | 04/01/2017-03/31/2017 (80 working days)   |       |                    |
| Host Professor        | Shinya Hosokawa   |       |                    |
| Affiliation           | Department of Physics, Faculty of Advanced<br>Science and Technology<br>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 2017 that are specific to my stays at IROAST of Kumamoto University(KU).

*(1) Hydrogen bonding and its consequences in alcohol-water, and specifically, in ethanol-water mixtures.* The aim of these activities is to reveal and characterize **nanoscale** aggregations of molecules, which aggregates are held together temporarily by hydrogen bonding between the constituent molecules. As a preliminary, series of molecular dynamics simulations for *ethanol-water mixtures*, with 20 to 80 molar % ethanol content, as well as for pure ethanol and water have been performed. XRD experimental data have been approximated nearly quantitatively, providing a good basis for revealing details of the atomic structure. During my first months at IROAST, I have been concerned with cluster formation and percolation (via hydrogen bonds) present in these liquid mixtures. Percolation analyses revealed that each mixture (even the one containing 80 mol % ethanol) is above the 3D percolation threshold, with fractal dimensions,  $d_f$ , between 2.6 to 2.9, depending on concentration. Monotype water cluster formation was also studied in the mixtures: 3D water percolation can be found in systems with less than 40 mol % ethanol, with fractal dimensions between 2.53 and 2.84. These observations can be put in parallel with experimental data on some thermodynamic quantities, such as the excess partial molar enthalpy and entropy.

(Published as: Gereben, O., Pusztai, L., Cluster formation and percolation in ethanol-water mixtures; *Chem. Phys.*; **496**, 1-8 (2017); DOI: <http://dx.doi.org/10.1016/j.chemphys.2017.09.003>.)

(2) *The missing micro-segregation in water-methanol mixtures.* In the beginning of this millennium, a very influential publication (Dixit et al., *Nature*, 2002) suggested that in such mixtures (specifically, at 70 molar % of methanol), hydrophilic (-OH groups) and hydrophobic (-CH<sub>3</sub> groups) parts of the methanol molecules segregate, to form nano-sized ‘microheterogeneities’. This work has received nearly 1000 independent citations and triggered hundreds of related papers over the past 15 years. As a result of the ‘nature of things’, the existence of such ‘microheterogeneities’ has become part of the ‘canonical knowledge’ – yet, the most direct experimental technique, small angle neutron scattering (SANS) has not been applied for supporting or defying this hypothesis. During my stay at IROAST, I have analysed SANS data taken just before my arrival and conducted an extensive literature search for comparable data. No signs of any segregation could be seen on any data set; that is, there is no experimental evidence for micro-segregation in water-methanol liquid mixtures.

(A. Len, L. Pusztai, to be published in *physica status solidi (b)*.)

(3) *Temperature dependent structure of water-alcohol mixtures.* There is an overall lack of diffraction data, as a function of decreasing temperature, on these important liquid mixtures. To tackle this situation, we have applied for, and been granted experimental beamtime in the SPring-8 synchrotron facility (Hyogo, Japan) at the BL04B2 high energy X-ray diffractometer (see photo below, showing the 5-detector setup of the instrument). We used 4 days of experimental time, to study water-methanol and water-ethanol mixtures, from room temperature down to about -100 C. Data are currently being analysed.



#### **Talks at meetings, seminars:**

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

(1) *9th IROAST Seminar – 4th International Symposium on Kumamoto Synchrotron Radiation (ISKSR4): Cooperation of Experiments and Computer Sciences* (15 May, 2017, Kumamoto University)

Title: “Determining the structure of hydrogenous materials by polarized neutron diffraction”

(2) *Swedish-Japanese Workshop on Nano-Structure Science by Novel Light Sources* (2 to 3 October 2017; Lunds Universitet (University of Lund, Sweden))

Title: “Reverse Monte Carlo modeling of structural disorder: focus on information deficiency in multi-component systems”

(3) *16th IROAST Seminar—5th International Symposium on Kumamoto Synchrotron Radiation (ISKSR5)* (100th Anniversary Hall in the Faculty of Engineering, November 1-2, 2017): *Progress of Data Analysis, Data-Driven Science, and Theory for Science*.

Title: “Consistency checks between results of computer simulations and diffraction experiments.”

## 2. Overview and significance of the research collaboration and lecture(s) to the students

During my stays at IROAST, I’ve collaborated mostly with my host professor, Dr. Hosokawa, and his co-workers at the Department of Physics (Dr. Jens Stelhorn, a JSPS post-doctor, Mr. Benedict Paulus, a young research visitor from the University of Marburg, and Dr. Yoichi Nakajima, a young tenured-track fellow).

### *Research proposals submitted:*

(1) JSPS post-doctoral application for Dr. E. Galicia (UNAM, Mexico); with Prof. Hosokawa (not approved)

(2) JSPS ‘bilateral’, aiming at collaboration with Hungary; with Prof. Hosokawa (not approved)

(3) JSPS ‘KAKENHI’, type ‘A’; with Dr. Nakajima (under review)

(4) Various beamtime applications to world class large scale facilities in Japan: SPring-8 synchrotron source (one with Dr. Temleitner of the Wigner RCP, Hungary; and another one with Dr. Nakajima); and J-PARC pulsed neutron source (with Dr. Nakajima). All these proposals are still under review.

I think the above joint proposals signify a reasonable start of collaborations with KU researchers; if approved, they would provide ‘food for thought’ for quite some time during the coming years.

## 3. Comments to or suggestions for IROAST/Kumamoto University

I am happy to be willing to continue 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. I thank all the IROAST staff members for their hospitality (and in particular, Murao san and Sato san, without whom I would have not been able to survive in Kumamoto for this long!).

Admittedly, I did have some initial difficulties with understanding how research activities may be expected without any research funding – but this issue has been clarified and, at least to some extent, resolved lately, so I’m optimistic concerning the future.

## 4. Prospect for further research collaboration with Kumamoto University

(See under point 2.)

## 5. Impressions of Kumamoto University/Kumamoto

Everyday life is comfortable here (if only it was easier to check in/check out at the City Hall!). And the canteen, which is only 20 metres from the IROAST building, is honestly the best of the (not too many...) ones I know in Japan!

|                       |  |       |           |
|-----------------------|--|-------|-----------|
| No. 2-2               | Development and evaluation of biomaterials   |       |           |
| Name                  | Zheng Yufeng   |       |           |
| Affiliation (home)    | Department of Materials Science and Engineering, College of Engineering, Peking University, China<br>Email: yfzheng@pku.edu.cn<br>yfzheng@kumamoto-u.ac.jp | Title | Professor |
| Research Field        | Nanomaterial Science   |       |           |
| Period of appointment | 05/01/2017-03/31/2017 (91 working days)  |       |           |
| Host Professor        | Kazuki Takashima   |       |           |
| Affiliation           | Faculty of Advanced Science and Technology<br>Email: takashik@gpo.kumamoto-u.ac.jp   | Title | Professor |

### 1. Research achievements

On Oct. 12, 2017, I gave a lecture (The 12th IROAST Seminar) at the Magnesium Research Center, with Prof. Shinji Ando as organizer. My talk was entitled “Magnesium Alloys Designed as Degradable Metallic Biomaterials”.

<http://iroast.kumamoto-u.ac.jp/symposiumsseminars/12th-iroast-seminar/>



On Jan. 22, 2018, I co-organized a joint seminar (The 25th IROAST Seminar) about Bioengineering with Prof. Jun Otani. My talk was entitled “Metallic Biomaterials used in Medicine”.

<http://iroast.kumamoto-u.ac.jp/symposiumsseminars/january-22mon-2018-iroast-ircms-joint-seminar-on-bioengineering/>





I had a plenary lecture entitled “Controllable degradation of biodegradable metals via surface modification” at 6th International Symposium on Surface and Interface of Biomaterial held at Chengdu, China from Oct. 16-19, 2017.

[issib2017.csp.escience.cn/](http://issib2017.csp.escience.cn/)



I attended 39th annual meeting of Japanese Society for Biomaterials, held at Tokyo from Nov.20-21, 2017, and gave an oral presentation entitled “Fundamentals of the theory of biodegradable metals”.

<http://kokuhoken.net/jsbm/>



I had a plenary lecture entitled “New directions and technologies for Metallic Biomaterials” at the 8th International Conference on Advanced Materials Research (ICAMR 2018), hold at Fukuoka, from Jan.20-21, 2018.

<http://www.icamr.org/index.html>

In this financial year, I applied for Grants-in-Aid for Scientific Research -KAKENHI-(A), with the project title “Development of novel Zn-(Mg, Ca, Sr, Li, Mn) alloy systems with enhanced mechanical and biological properties as absorbable orthopedics implant”, together with Prof. Kazuki Takashima, Jun Otani and Liqun Ruan as co-investigators.



In this financial year, I published one paper with the affiliation of IROAST: Hongtao Yang, Cong Wang, Chaoqiang Liu, Houwen Chen, Yifan Wu, Jintao Han, Zichang Jia, Wenjiao Lin, Deyuan Zhang, Wenting Li, Wei Yuan, Hui Guo, Huafang Li, Guangxin Yang, Deling Kong, Donghui Zhu, Kazuki Takashima, Liqun Ruan, Jianfeng Nie, Xuan Li, Yufeng Zheng, Evolution of the degradation mechanism of pure zinc stent in the one year study of rabbit abdominal aorta model, *Biomaterials*, 145 (2017) 92-105

## 2. Overview and significance of the research collaboration and lecture(s) to the students

I conducted research collaboration with Prof. Kazuki Takashima. I fabricated the Mg alloy micro-tube samples and provide to Prof. Takashima's team, and they will conduct mechanical-testing, which might be tension, bending, fatigue in the air and corrosion fatigue in the simulated body fluid using micro-sized materials cut from the micro-tube. The significance of this work is to reveal the mechanical performance of the biodegradable Mg alloys under different stress condition.

I conducted research collaboration with Prof. Jun Otani, Prof. Toshifumi Mukunoki, and Prof. Yoshitaka Nakanishi by a joint experimental work on biodegradable zinc, and we are going to conduct the micro-CT observation on the corroded bulk or tube samples at different timepoints after static immersion in simulated body fluid or under dynamic flow impact pressure chamber pumped with simulated body fluid by rotary pump. The significance of this work is to reveal the corrosion mechanism of biodegradable zinc under different corrosion environment.

I collaborated with Prof. Liqun Ruan, Prof. Hokamoto Kazuyuki, and Dr. Tanaka Shigeru on the feasibility of metal forming (Zn foil combining with Mg alloy micro-tube) with the pulsed power. We are trying to see what will happen when the Mg alloys undergo the pulsed power. The significance of this work is to reveal the influence of pulsed power on the plastic deformation of Mg alloys, and corresponding microstructural evolution.

On Dec. 22, 2017, I gave a lecture, entitled "Metallic Biomaterials: New Directions and Technologies" to graduate student at Engineering Building, with the host of Prof. Kazuki Takashima. The significance of this lecture is to let the students to understand the most important aspects of newly-emerging metallic biomaterials, on the one hand how to endow new biofunctions, antibacterial function, promoted osteogenesis, reduced in-stent restenosis and inhibition of inflammatory cells for the traditional metallic biomaterials such as 316L stainless steel and Ti alloys; on the other hand the feasibility studies on the newly-developed biodegradable metals (Mg and its alloys, Fe and its alloys, Zn and its alloys) and amorphous bulk metallic glasses.

## 3. Comments to or suggestions for IROAST/Kumamoto University

Kumamoto University is a globally active research university, not only serve the functions of being a central research facility and cultivating leaders in the local community, but also promote international intellectual exchange, educate international students, and train graduate students capable of producing a bilateral international exchange.

I had the chance to meet President Shinji Harada of KU, and knew that KU is keeping increased internationalization by international academic and student exchange program, global-collaboration research programs with the world's leading researchers, and other such international activities. My host Professor, Vice president of KU, Prof. Kazuki Takashima is an internationally well-known material scientist, and smile can always be found on his face. He is so kind to me and be helpful for arranging my work plan. Every details had been considered by him. I had the chance to visit Prof. Tsuyoshi Usagawa, dean of school of Engineering, and

unbelievable to know that School of Engineering has a history of 120 years, even older than the first modern university in China.

I enjoyed my stay at IROAST@KU, and appreciated the staff's help very much. Here you can find many professors undergoing advanced academic research, and they are open to establish international research networks, promotion of ongoing cutting-edge research projects, and initiation of innovative interdisciplinary research projects. During my working at IROAST, Prof. Takashi Hiyama gave me many good suggestions on how to write a good funding proposal. Prof. Jun Otani provided me the office once it was necessary. The administrative staffs are very kind and helpful either. I still remembered on the first day I started my work at KU, Mr. Kumagai and Ms. Morishita showed me around the campus. Ms. Chen and Mr. Yasunari provided me many useful information on funding applications. Ms. Murao and Ms. Sato helped me a lots on small things in the daily life. I highly appreciate their support and help, and my staying at KU will be a good memory for me.

#### 4. Prospect for further research collaboration with Kumamoto University

In the 2018 financial year, I would like to explore research collaboration with Dr. Aeju Lee@IROAST, on the stimulation of new bone formation with magnesium alloys. And future collaboration with the professors in the field medicine will be considered. For example, I had contacted Prof. Kenichi Tsujita and Dr. Yasuhiro Izumiya, Department of Cardiovascular Medicine, Graduate School of Medical Science in this financial year, and expect to find a common interest to work together.

#### 5. Impressions of Kumamoto University/Kumamoto

I must say that Kumamoto is a quiet but beautiful city. I really enjoyed walking on the peaceful riverside road when I went to my office.





### 3. Young Faculty Members for International Joint Research

| No. | Name                      | Project Title   |
|-----|---------------------------|---|
| 3-1 | <b>Armando T. Quitain</b> | Carbon Dioxide Utilization Technologies   |
| 3-2 | <b>Satoshi Hinokuma</b>   | CO <sub>2</sub> conversion reactions and will develop combined operando spectroscopic techniques based on synchrotron X-ray |
| 3-3 | <b>Makoto Kumon</b>       | Autonomous Control of Drones for Environment Monitoring   |

|                  |   |       |                     |
|------------------|---|-------|---------------------|
| No. 3-1          | Carbon Dioxide Utilization Technologies   |       |                     |
| Name             | Armando T. Quitain  |       |                     |
| Affiliation      | Faculty of Advanced Science and Technology<br>Email: quitain@kumamoto-u.ac.jp                             | Title | Assistant Professor |
| Research Field   | Nanomaterial Science/ Green Energy/ Environmental Science/  |       |                     |
| Period of Travel | August 3, 2017-August 29, 2017<br>September 3, 2017-October 24, 2017<br>November 1, 2017-January 31, 2018 |       |                     |
| Host Researcher  | Maria Jose Cocero   |       |                     |
| Affiliation      | Chemical Engineering and Environmental<br>Technology Department, Valladolid University,<br>Spain          | Title | Professor           |

## 1. Overview and significance of your international research collaboration

To mitigate global warming, the use of carbon dioxide (CO<sub>2</sub>) for processes involving synthesis of chemicals and fuels have been gaining research interests recently. In this regard, the following related research topics were pursued in collaboration with Prof. Maria Jose Cocero Alonso of the High Pressure Processes Group at Valladolid University (Spain).

### *Reactive Separation Utilizing Synergy of Supercritical CO<sub>2</sub> and Water*

Hydrolysis of natural organic compounds into more bioactive and bioavailable materials are gaining popularity in food and pharmaceutical industries. However, conventional method, such as the one for hydrolysis of citrus glycoconjugates such as hesperidin (HPD) to hesperetin (HPT) shown in Fig. 1, employs

- ① harmful catalysts such as sulfuric acid, while obtaining low yield, and
- ② separation of the target compounds from the reaction products requires tedious approaches.

We addressed the abovementioned drawbacks of the conventional method by:

- ① employing the synergy of subcritical H<sub>2</sub>O and supercritical CO<sub>2</sub> for the
- ② combined and simultaneous reaction and separation processes

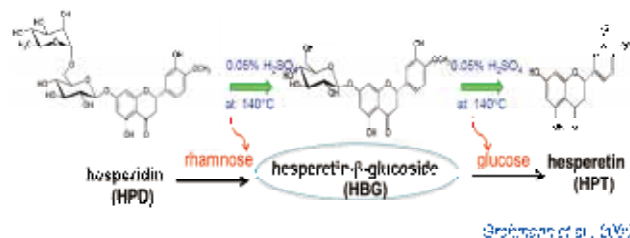
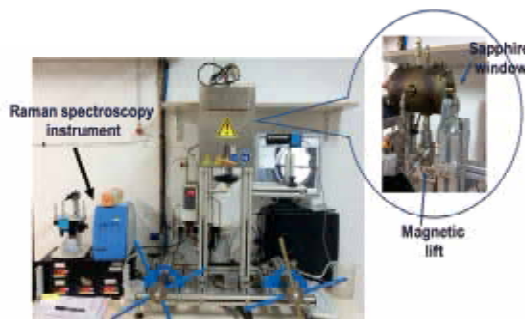


Fig. 1. Hydrolysis of hesperidin to hesperetin

## 2. Research achievements and progress of international joint research

We have succeeded in hydrolyzing hesperidin to hesperetin in the temperature range of 150 to 200 °C, and pressures of 15 to 25 MPa obtaining higher yield. Simultaneous and selective separation of hesperetin was achieved by simply passing SCCO<sub>2</sub> through the reaction products. In the current research, however, the starting materials (*i.e.* hesperidin and water) are loaded initially into the reactor, sealed, and then set in an oven. The temperature and pressure are raised to the desired conditions by heating the reactor *with the sample inside*, and by pumping CO<sub>2</sub>, respectively. The presence of *transient period* would not give accurate determination of kinetics and thermodynamic properties of the system. Thus, in this international research collaboration, the applicant worked together with Prof. María José Cocero, on the use of modified phase equilibrium visual cell with sapphire window and a magnetic lift to inject solids to address the problem on the effect of the transient period, and for more accurate determination of kinetics and solubility parameters.

Also, using our novel approach, it was likely that the significant increase in the yield of the HPT was the direct cleavage of the glycosidic bond linking the rutinose and the HPT, thus bypassing the formation of the intermediate products (HBG) [please see Fig 1]. A much better approach is to investigate the reaction by in-situ Raman analyses, by using the apparatus only available at the laboratory of Prof. Maria Jose Cocero of Valladolid University. This apparatus is equipped with phase equilibrium visual cell ( $P_{\text{max}}=30\text{MPa}$ ,  $T_{\text{max}}=500^{\circ}\text{C}$ ) with sapphire window and a magnetic lift to inject solids (as shown in Fig. 2). It is specially designed for studying hydrolysis in sub and supercritical water. A Raman probe can be attached thru the window cell to optically monitor the reaction going on inside. Using this apparatus, it is also possible to inject a sample into the cell containing hot pressurized water, using the magnetic lift, thus accurate determination of reaction mechanism, kinetics, thermodynamic and physicochemical properties of the system could be carried out. In addition, this collaboration also contributed to the advancement of the knowledge and know-how on “green sustainable chemistry and chemical engineering” utilizing the combined  $\text{H}_2\text{O}-\text{CO}_2$  system, a promising green reaction solvent. We are currently elucidating the mechanism by molecular dynamic simulation coupled with time-dependent sugar analyses by HPLC.



**Fig. 2** Apparatus for in-situ reaction monitoring (Valladolid University, Spain)

In addition, three of his students (under the TOBITATE Ryugaku Japan Young Ambassador Program and GSST Overseas Internship Program) also joined him to investigate the underlying mechanism of graphene oxide-based catalyzed reactions of ①cellulose in synergy with microwave, ②acetylation of limonene in supercritical  $\text{CO}_2$  ③laser-induced conversion of glycerol to hydrogen. The Memorandum of Agreement between Kumamoto University and Valladolid University has also been concluded and signed.

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

My proposal for JSPS Grant-in-Aid for Scientific Research (Fostering Joint International Research) has been selected for funding to support further research collaboration with Valladolid University and Wuerzburg University for a period of 3 years. One graduate student also received travel grant under the TOBITATE Ryugaku Japan Young Ambassador Program to pursue his research on related topic in Valladolid University. Prof. Maria Jose Cocero was also selected as one of the IROAST Visiting Professors, and will visit Kumamoto University this year 2018.

### 4. Comments to or suggestions for IROAST (programs).

IROAST and its programs have been actively supporting the globalization of Kumamoto University's research. It has contributed a lot to my development and a big turning point of my career as a researcher. I strongly recommend young researchers to take advantage of these once-in-a-lifetime opportunities.



|                  |   |       |                         |
|------------------|---|-------|-------------------------|
| No. 3-2          | CO <sub>2</sub> conversion reactions and will develop combined operando spectroscopic techniques based on synchrotron X-ray |       |                         |
| Name             | Satoshi Hinokuma  |       |                         |
| Affiliation      | Faculty of Advanced Science and Technology<br>Email: hinokuma@kumamoto-u.ac.jp  | Title | Assistant Professor     |
| Research Field   | Nanomaterial Science  |       |                         |
| Period of Travel | August 5, 2017-February 1, 2018   |       |                         |
| Host Researcher  | Atsushi Urakawa   |       |                         |
| Affiliation      | The Barcelona Institute of Science and Technology, Institute of Chemical Research<br>Catalonia, Spain                       | Title | Group Leader, Professor |

### 1. Overview and significance of international research collaboration

IR spectroscopy is by far the most popular method of choice for in situ/operando studies due to contained rich chemical information and versatility to study gas, liquid, solid and solid-fluid (gas/liquid) interfaces. Thanks to the complementary information content, simultaneous IR and X-ray spectroscopic studies are of obvious benefits in research and scientific community; however, the combination has not been implemented widely due to technical limitations. In this project, we aim at showing the feasibility of IR spectroscopy combined with XAS-XRD using transmission and diffuse reflection sampling configurations with a modular IR spectrometer and at showing the rich information contents achieved by the unique combination. This is the first step of our planned long-term action to combine various IR spectroscopic techniques (transmission, internal/external/diffuse reflection modes) with a perspective to extend the scope further to space- and time-resolved studies and studying materials at solid-liquid interfaces.

In both transmission and diffuse reflection cases, self-supporting discs (i.e. pellet made of the material itself without dilution) were used. Transmission configuration was employed when the sample thickness is suited for all three detection methods, whereas DRIFTS configuration was employed when the sample thickness is too large for transmission IR and/or information on surface species needs to be maximized. A pellet sample was placed in a heatable sample holder (aiming to go up to ca. 400-500 °C using a coil heating elements around the pellet). The cell is being built and was commissioned before the beamtime. The IR spectrometer was brought from ICIQ. In this first attempt, well defined microporous materials such as MOF (Zr-, Cu-BTC) were studied. Finally, the study were summarized and submitted as original paper of *European Journal of Inorganic Chemistry*.

### 2. Research achievements and progress of international joint research

We also study about Pt/Al<sub>2</sub>O<sub>3</sub> as useful catalyst NO-H<sub>2</sub> and CO-O<sub>2</sub> moderation reaction for IR spectroscopy combined with XAS-XRD using DRIFTS/ATR cell. In this study, space- and time-resolved DRIFTS/ATR of NO and/or CO adsorbed on Pt/Al<sub>2</sub>O<sub>3</sub> were also obtained with XAS-XRD. To our knowledge this is the first test of combing IR using the modular spectrometer which became only recently available and perfectly suited to perform in combination with X-ray spectroscopy. Now, we are analyzing the results to submit to publication with higher Impact Factor.

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

The prospect for new research collaboration with Professor Debasish Chakraborty (Technical University of Denmark) is now considered. Chakraborty *et al.* noted the potentiality of NH<sub>3</sub> fuel as a renewable and carbon-free energy source, and reported a bottom-up approach to design a



novel and high performance core–shell Ru–Cu nanoparticle catalyst for the oxidation of  $\text{NH}_3$  to  $\text{N}_2$  [*Angew. Chem., Int. Ed.* 129 (2017) 8837.]. This is critically advanced study for  $\text{NH}_3$  fuel. Moreover, they have been commercializing technology to decompose  $\text{NH}_3$  into  $\text{H}_2$  for use in fuel cells. Hinokuma also studies about novel combustion catalysts for  $\text{NH}_3$  fuel as a renewable and carbon-free energy source, and therefore visited to Professor Chakraborty (Technical University of Denmark) to ask new research collaboration. Professor Chakraborty showed favorable responses for the research collaboration.

|                  |  |       |                     |
|------------------|--|-------|---------------------|
| No. 3-3          | Autonomous Control of Drones for Environment Monitoring  |       |                     |
| Name             | Makoto Kumon   |       |                     |
| Affiliation      | Faculty of Advanced Science and Technology<br>Email: kumon@gpo.kumamoto-u.ac.jp                      | Title | Associate Professor |
| Research Field   | Environmental Science  |       |                     |
| Period of Travel | March 13, 2018-March 18, 2018  |       |                     |
| Host Researcher  | Tomonari Furukawa  |       |                     |
| Affiliation      | Department of Mechanical Engineering,<br>Virginia Polytechnic Institute and State<br>University, USA | Title | Professor           |

#### 1. Overview and significance of international research collaboration

The project is aimed to develop the novel autonomous drone system that is effectively applicable for monitoring the environment. As the current technology requires significant work by operators to realize the mission with the safety conditions, autonomy and high-level control techniques is necessary. As such drone technologies have been widely studied in these days, it is significantly important to conduct the research project with the international collaboration.

#### 2. Research achievements and progress of international joint research

During the visit to VT on March (Mar. 13-18) supported by IROAST, I shared the information on:

- A) Projects of autonomous drones and automobiles at Prof. Furukawa's group
- B) Extension of SSL of NLOS that was conducted at Kumamoto University as a part of collaborative research project.

#### 3. Prospect for further research collaboration with the visited university

A plan to visit the institution as a visiting scholar to progress the collaborative researches is now under consideration, and about to be fixed.

#### 4. Comments to or suggestions for IROAST program

I appreciate the program for the opportunity to keep the international collaboration with top-level researcher. It would be nice if this project will be shared with more Kumamoto University fellows.





## 4. Visiting Professors

| No.  | Name   | Project Title  |
|------|--|--|
| 4-1  | <b>Martin Dienwiebel</b><br>HP: <b>Kazuki Takashima</b>            | Friction and wear of novel Magnesium alloys  |
| 4-2  | <b>Yang Kim</b><br>HP: <b>Shinya Hayami</b>                        | Supramolecules for application as catalyst and fluorescent materials   |
| 4-3  | <b>Pavel Lejček</b><br>HP: <b>Sadahiro Tsurekawa</b>               | Structure and properties of non-equilibrium grain boundary   |
| 4-4  | <b>Josep-Lluís Barona-Vilar</b><br>HP: <b>Hirohisa Ihara</b>       | International collaboration research for design and application of organic/inorganic hybrid gel                      |
| 4-5  | <b>Tomonari Furukawa</b><br>HP: <b>Makoto Kumon</b>                | Sound Source Localization in Non-Field of Sight  |
| 4-6  | <b>Etsuko Fujita</b><br>HP: <b>Yutaka Kuwahara</b>                 | Development of catalytic system for CO <sub>2</sub> reduction by supramolecular system                               |
| 4-7  | <b>Ramesh Shanmughom Pillai</b><br>HP: <b>Tokio Tani</b>           | Studies on roles of nuage in piRNA biogenesis and functions  |
| 4-8  | <b>Rahul Raveendran Nair</b><br>HP: <b>Shinya Hayami</b>           | Property and application for Graphene oxide material   |
| 4-9  | <b>Amir A. Farajian</b><br>HP: <b>Hamid Hosano (Hosseini)</b>      | Modification of intracellular organelles and cell nucleus by shock wave and nsPEF for nanoparticle/DNA/drug delivery |
| 4-10 | <b>Viren Menezes</b><br>HP: <b>Hamid Hosano (Hosseini)</b>         | Novel Needle-less Drug/Vaccine Delivery  |
| 4-11 | <b>Jorge Noberto Beltramini</b><br>HP: <b>Shinya Hayami</b>        | Mechanics, dynamics and thermodynamics of grain boundaries in metals   |
| 4-12 | <b>Dimitri Aleks Molodov</b><br>HP: <b>Hamid Hosano (Hosseini)</b> | Design and Synthesis of Novel Nanostructured Catalysts for Selective Biomass Conversion into Chemicals and Fuels     |

HP: Host Professor

\*Their visits were supported by IROAST.

|                 |  |       |                      |
|-----------------|--|-------|----------------------|
| No. 4-1         | Friction and wear of novel Magnesium alloys  |       |                      |
| Name            | Martin Dienwiebel  |       |                      |
| Affiliation     | Applied Nanotribology, Karlsruhe Institute for Technology (KIT), Germany<br>Email: martin.dienwiebel@kit.edu | Title | Heisenberg-Professor |
| Research Field  | Nanomaterial Science   |       |                      |
| Period of Visit | August 15, 2017-August 17, 2017  |       |                      |
| Host Professor  | Kazuki Takashima   |       |                      |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: takashik@gpo.kumamoto-u.ac.jp                           | Title | Professor            |

#### 1. Research achievements

The aim of the initial visit was to obtain an overview over the research activities of Kumamoto University and to provide a lecture on the field of Applied Nanotribology. During the visit it was possible to visit several groups and to identify common interests.

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

In the subsequent time a collaboration was started with Prof. Yoji Mine to investigate tribological properties of magnesium alloys that were developed at Kumamoto University. Magnesium is a material that is not widely used for tribological applications until now. For this reason there is a significant potential for new research in this field. The outstanding equipment and knowledge in micromechanics at Kumamoto University brings a fruitful results.

#### 3. Comments/suggestions about IROAST/Kumamoto University

For IROAST it might be beneficial if there would be a possibility where all visiting professor could meet, identify common interests and widen the network of IROAST.

#### 4. Prospect for further research collaboration with Kumamoto University

After the first year we hope to obtain first scientific result in the new collaboration, which might allow to apply for a joint research grant (e.g. DFG-JSPS) to extend the present research.

#### 5. Impressions of Kumamoto University/Kumamoto

The University carries out top level research and the students are very motivated and interested to learn novel areas of materials science such as Tribology.

|                 |  |       |           |
|-----------------|--|-------|-----------|
| No. 4-2         | Supramolecules for application as catalyst and fluorescent materials         |       |           |
| Name            | Yang Kim   |       |           |
| Affiliation     | Kosin University, Korea<br>Email: ykim@kumamoto-u.ac.jp                      | Title | Professor |
| Research Field  | Nanomaterial Science / Green Energy / Supramolecular Chemistry               |       |           |
| Period of Visit | April 1, 2017 - March 31, 2017   |       |           |
| Host Professor  | Shinya Hayami  |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: hayami@kumamoto-u.ac.jp | Title | Professor |

### 1. Research achievements

A new three-dimensional supramolecule like cryptands was prepared to give several kinds of metal complexes, which will be applied as candidates of catalyst, fluorescent material, extractant, and so on after characterization by spectroscopic method and X-ray crystallography. Publication during 2017-2018 is as follows:

- “Intermolecular Interaction Tuning of Spin-Crossover Iron(III) Complexes with Aromatic Counteranions Asami Tsukiashi, Manabu Nakaya, Fumiya Kobayashi, Ryo Ohtani, Masaaki Nakamura, Jack M. Harrowfield, **Yang Kim**, and Shinya Hayami, *Inorg. Chem.* **2018**, 57, 2834–2842.
- Foreword “Celebrating Professor Len Lindoy’s 80th Birthday”, Jonathon E. Beves, Jack K. Clegg, F. Richard Keene, **Yang Kim**, *Aust. J. Chem.* **2017**, 70, 447–449.
- “Synthesis of a Novel Dibenzylamide Derivative of p-tert-Octylcalix[4]arene and its Extraction Properties Towards Noble Metal Ions”, Jee Young Kim, Yoga Priastomo, Shintaro Morisada, Hidetaka Kawakita, Keisuke Ohto, **Yang Kim**, *Aust. J. Chem.* **2017**, 70, 450-455.
- “Crystal Structure of a Heterometallic Luminophore: The Ru(II) Complex of a Ferrocenyl-Terpyridine with a Flexible Linkage” Young Hoon Lee, Jong Won Shin, Yusuke Sekimoto, Shinya Hayami, Jack Harrowfield, **Yang Kim**, *Aust. J. Chem.* **2017**, 70, 632–636.
- “Chiral discrimination in solid-state interactions of cobal(III)–polyamine complex cations with tris-(dipicolinato)lanthanate(III) anions”, Jack M. Harrowfield, **Yang Kim**, Brian W. Skelton, Alexandre N. Soboleva, Allan H. White, *CrystEngComm*, **2017**, 19, 2372-2379.
- “Anion-dependent interpenetration in lattices of Ag(I) complexes of a divergent quaterpyridine-donor ligand”, Jong Won Shin, Young Hoon Lee, Jack Harrowfield, Shinya Hayami, **Yang Kim**, *Polyhedron*, **2017**, 130, 94–99.

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

Kumamoto University has many excellent researchers and professors as well as many good facilities and advanced equipment for research. I am very satisfied to collaborate with my host professor at Kumamoto University.

### 3. Comments/suggestions about IROAST/Kumamoto University

In my opinion, IROAST/Kumamoto University may need more overseas students and researchers as well as more opened introduction of student/faculty exchange program to develop into a world-class university.

### 4. Prospect for further research collaboration with Kumamoto University

I hope to draw many good research results from collaborative researches with Kumamoto University, and plan closer collaboration in mutual interesting research fields.



#### 5. Impressions of Kumamoto University/Kumamoto

Kumamoto is not a big city but a beautiful city, and the people are nice. It is all preserved in the historical city which is the possibility of combining sightseeing and the rest for the tourist. It is also quiet town and more than enough city for education and residence. Kumamoto University gives advanced knowledge to students with excellent faculty and educational environment. In particular, the Chemistry Department is equipped with excellent research facilities as well as faculty members with excellent career and research abilities, and it is believed to have sufficient potential as a world-class university.

|                 |  |       |           |
|-----------------|--|-------|-----------|
| No. 4-3         | Structure and properties of non-equilibrium grain boundary   |       |           |
| Name            | Pavel Lejček   |       |           |
| Affiliation     | Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic, AND University of Chemistry and Technology, Prague, Czech Republic<br>Email: lejcekp@fzu.cz | Title | Professor |
| Research Field  | Nanomaterial Science   |       |           |
| Period of Visit | October 14, 2017-October 29, 2017  |       |           |
| Host Professor  | Sadahiro Tsurekawa   |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: turekawa@kumamoto-u.ac.jp   | Title | Professor |

### 1. Research achievements

The results on genesis of grain boundaries in bent single crystals obtained at Kumamoto University on the samples prepared at the Institute of Physics were discussed and presently serve as a material for preparation of joint paper. Additionally, some other ideas were discussed (i) possibility of joint research on studies of grain boundary segregation in molybdenum-based alloys; (ii) study of the effect of presence of sulfur at grain boundaries in nickel on its recrystallization behavior; etc.

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

The research collaboration with Kumamoto University is very fruitful (see item 1). The study of genesis of the grain boundaries in bent single crystal was aimed to explain the genesis of non-equilibrium grain boundaries during severe plastic deformation (e.g. ECAP). Experimental study of the grain boundary segregation in molybdenum should serve for comparison of experimental results with theoretical calculations which represents the necessary step in further development of computational materials science. Explanation of sulfur effect on recrystallization of nickel can serve in understanding the recrystallization behavior of nickel and nickel base alloys which are applied in technology, and in prediction of the grain size in such materials.

### 3. Comments/suggestions about IROAST/Kumamoto University

The cooperation between Kumamoto University and Institute of Physics, Prague/Czech Republic is very good and desired by the Czech side. It brings clear scientific results as well as serves for education of Japanese students (by discussing with the foreigner professor or by realization of students' stays in the Czech Republic). It would be also suitable if Czech students come for a period to Kumamoto University: unfortunately, the interest among them is rather low mainly due to their studying program and terms in the Czech Republic.

### 4. Prospect for further research collaboration with Kumamoto University

This collaboration is very successful and the Czech side is highly interested in continuing this successful collaboration in future in any possible form.

### 5. Impressions of Kumamoto University/Kumamoto

I attended Kumamoto University already several times in the past and am very happy that I got this opportunity. The research in the field of my interest is at very high scientific level, the staff as well as students are very friendly and open to discuss the problems and cooperate.

Unfortunately, some equipment of the Department and definitely of the University at all was damaged during the earthquake in Spring 2016. I was very surprised how quickly this equipment was replaced by new one and how all works perfectly. The traces of the earthquake are also apparent in the city of Kumamoto, however, I like to see the activity in their remove. What is also important, the living in Kumamoto is easy also for foreigners.

|                 |  |       |           |
|-----------------|--|-------|-----------|
| No. 4-4         | 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),<br>Universidad de Valencia, Spain<br>Email: Jose.Luis.Barona@uv.es | Title | Professor |
| Research Field  | Nanomaterial Science   |       |           |
| Period of Visit | November 14, 2017-November 24, 2017  |       |           |
| Host Professor  | Hirotaka Ihara   |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: ihara@kumamoto-u.ac.jp  | Title | Professor |

1. Research achievements: During the period of 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 gave two seminar lectures to PhD and master students on the foundations of modern science and the history of science and medicine tradition in Spain. Valencia was the main focus.

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 a National/Imperial Institute of Nutrition in Tokyo. Similarly the research projects developed by the Ihara Lab could find fruitful partnership in Valencia.

3. Comments/suggestions about 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.

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 master and PhD students, as well as the introduction of credits in humanities (philosophy of science and technology), history of health and medical sciences, and history.

5. Impressions of Kumamoto University/Kumamoto: Both Kumamoto University and IROAST are doing a hard effort in favor of internationalization. IROAST research projects, groups and topics have impact and good links with the international community. But also, internationalization means nowadays being fluent in foreign languages, with particular emphasis in English. Undergraduate and postgraduate students would make a step forward if a part of their

courses were taught in English as well. Kumamoto 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.



Photograph at the seminar (16th Nov. 2017)



Photograph of Prof. Barona-Vilar and Prof. Hiyama, Director (16th Nov. 2017)

|                 |  |       |                     |
|-----------------|--|-------|---------------------|
| No. 4-5         | Sound Source Localizatin in Non-Field of Sight   |       |                     |
| Name            | Tomonari Furukawa  |       |                     |
| Affiliation     | Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, USA<br>Email: tomonari@vt.edu | Title | Professor           |
| Research Field  | Advanced Green Bio   |       |                     |
| Period of Visit | November 22, 2017-December 2, 2017   |       |                     |
| Host Professor  | Makoto Kumon   |       |                     |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: kumon@gpo.kumamoto-u.ac.jp  | Title | Associate Professor |

#### 1. Research achievements

A seminar talk entitled “Road Condition Measurement and Suspension/Traction Control for Active Safety and Autonomous Driving” was given on November 28, at Kumamoto University. I also discussed on the project of “Non-Line-of-Sight Sound Localization in Unknown Indoor Environments” that was initiated at VT, with Prof. Kumon at Kumamoto University, and shared the details of its technology as a part of incoming collaborative work.

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

As Prof. Kumon has worked in the field of Robot Audition that provides practical acoustic signal processing techniques in real environments, the concept of Non-Line-of-Sight Sound Localization can be improved for real use cases, which is important.

#### 3. Comments/suggestions about IROAST/Kumamoto University

It is significantly important for international research collaborations to have the continuous support.

#### 4. Prospect for further research collaboration with Kumamoto University

It is planned to accept the host professor as a visiting scholar at VT for the further collaboration.

#### 5. Impression of Kumamoto University/Kumamoto

It was great to visit and work with Kumamoto University, and I hope that this international collaboration lasts.

|                 |  |       |                     |
|-----------------|--|-------|---------------------|
| No. 4-6         | Development of catalytic system for CO <sub>2</sub> reduction by supramolecular system |       |                     |
| Name            | Etsuko Fujita  |       |                     |
| Affiliation     | Chemistry Division, Brookhaven National Laboratory, USA<br>Email: fujita@bnl.gov       | Title | Senior Chemist      |
| Research Field  | Green Energy   |       |                     |
| Period of Visit | December 2, 2017-December 7, 2017  |       |                     |
| Host Professor  | Yutaka Kuwahara  |       |                     |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: kuwahara@kumamoto-u.ac.jp         | Title | Assistant Professor |

I was promptly picked up by Prof. Kuwahara upon my arrival at the Kumamoto Airport on Dec. 4, 2017. The next morning, Prof. Kuwahara picked me up at the Hotel and drove me to Kumamoto University using a university-owned electric vehicle. It was my first experience to ride an electric vehicle. I discussed our current collaborative research on electro- and photo-chemical CO<sub>2</sub> reduction using self-organized rhenium catalysts in gels, and presented the 20th IROAST Seminar entitled “Hydrogen Production and Storage with Carbon Dioxide Hydrogenation” for the faculty members and students in the Department of Applied Chemistry and Biochemistry. I also had the opportunity to listen to a research presentation by a postdoctoral research associate. While Prof. Kuwahara seems to be quite busy with teaching and setting up new lab space in the IROAST area, I am pleased to see his considerable research progress. We will keep collaborating on the project, and I am looking forward to his visit to BNL in the summer of 2018. I also discussed various theoretical/computational projects with Prof. Sugimoto, who had visited BNL many years ago. Prof. Kuwahara showed me his group’s laboratories and as well as many disturbing pictures of the laboratories and equipment that he took right after two earthquakes in April, 2016. I am glad to see the recovery and active educational/research activities at the university. I was also very impressed by the continuing achievements on internationalization, strong global academic networks and international collaborative research programs via the IROAST program.

The dinner with Professors Hiyama, Ihara, Nagaoka, Takafuji and Kuwahara at a restaurant near Kumamoto University was fantastic, and I really enjoyed our stimulating conversation and their hospitality.

Prof. Kuwahara took me the Kumamoto Castle that was severely damaged by an earthquake (magnitude 6.2) and another earthquake (magnitude 7.3) in April, 2016. The damage was much more severe than I imagined from the news I had heard in the US. While I saw the efforts to repair the castle, the restoration will seemingly take many years. Professor Kuwahara kindly took me to Mount Aso and the Aso Shrine on the way to the airport. Again, I observed the destructive power of earthquakes in Mashiki and it was really heartbreaking to see such damage.





Photograph of Dr. Fujita,  
Visiting Professor of IROAST and Senior Chemist of Brookhaven National Laboratory, USA,  
at the research room of IROAST bldg.

|                 |   |       |           |
|-----------------|---|-------|-----------|
| No. 4-7         | Studies on roles of nuage in piRNA biogenesis and functions   |       |           |
| Name            | Ramesh Shanmughom Pillai  |       |           |
| Affiliation     | Department of Molecular Biology, University of Geneva, Switzerland<br>Email: Ramesh.Pillai@unige.ch | Title | Professor |
| Research Field  | Advanced Green Bio  |       |           |
| Period of Visit | December 17, 2017-December 24, 2017   |       |           |
| Host Professor  | Tokio Tani  |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: ttani@sci.kumamoto-u.ac.jp                     | Title | Professor |

### 1. Research achievements

My laboratory is investigating the role of small noncoding RNAs and chemical modifications of RNA in control of gene expression. The research collaboration with Prof. Tani's group concerns the study of germline small noncoding RNAs called PIWI-interacting RNAs (piRNAs). Last year we made the key findings (*Pandey et al., Plos Genetics, 2017; Wenda et al., Developmental Cell, 2017*) that artificial tethering of certain piRNA biogenesis factors to an artificial reporter transcript was sufficient to result in generation of piRNAs from the transcript in the fly (*Drosophila melanogaster*) ovaries. We could reproduce similar effect in a cell culture model (OSC) derived from fly ovaries. Our findings indicate that targeting of the transcript to the perinuclear cytoplasmic granules called nuage is critical for this biogenesis process. This latter finding of a link between nuage localization and processing makes our collaboration with Prof. Tani's lab very interesting.

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

Students in Prof. Tani's lab screened for natural compounds that alter the size of the nuage structures. This study was done in the Silkworm (*Bombyx mori*) BmN4 ovarian cell line. Two compounds with distinct effects were identified: while one of the compounds led to increase in nuage size, the other dispersed the granules. This now provides us with two key tools for dissecting the piRNA biogenesis pathway mechanisms using a convenient cell culture model. First, by dispersing the granules, we can ask whether nuage structures are essential for piRNA biogenesis? This is an important question, as related P-bodies in somatic cells are shown to be dispensable for microRNA-mediated silencing and shown to be formed rather as a consequence of the repression process. Second, what are the molecular targets of these compounds? Third, will increased nuage size reduce the dynamic nature of nuage components like the RNA helicase Vasa (Xiol et al., *Cell*, 2014), and thus affect piRNA processing? These valuable chemical compounds generated in Kumamoto will now open up possibilities for shedding molecular insights into the piRNA biogenesis pathway. We hope to be able to publish these results in 2018.

### 3. Comments/suggestions about IROAST/Kumamoto University

Continue the good work that IROAST/Kumamoto University is doing in setting up this international collaboration opportunity. It brings broader exposure to the students in the University, and also provides them access to potential PhD and postdoctoral positions abroad. This will facilitate a healthy "brain circulation" between Kumamoto and outside Universities.

#### 4. Prospect for further research collaboration with Kumamoto University

My hope is that the ongoing collaboration will lead to interesting results that will result in a joint publication, and open up the possibilities for a joint Swiss-Japan research grant that will provide economic muscle for our joint-research. Perhaps that might also lead to recruitment of joint PhD students who will carry out research in our two labs.

#### 5. Impressions of Kumamoto University/Kumamoto

I am always impressed by my visits to Kumamoto University. In my view Kumamoto is one of the leading places in Japan for higher education and research. My interaction with the students and faculty at Kumamoto is always a scientifically enriching experience. Kumamoto City is a great place to visit with its citizens who are very helpful and kind, its many sites of historical importance, and of course, the food is amazing!



|                 |   |       |           |
|-----------------|---|-------|-----------|
| No. 4-8         | Property and application for Graphene oxide material  |       |           |
| Name            | Rahul Raveendran Nair   |       |           |
| Affiliation     | Materials Physics, National Graphene Institute and School of Chemical Engineering and Analytical Science, The University of Manchester, UK<br>Email: rahul@manchester.ac.uk | Title | Professor |
| Research Field  | Nanomaterial Science/ Green Energy/ Environmental Science   |       |           |
| Period of Visit | December 2, 2017-December 9, 2017   |       |           |
| Host Professor  | Shinya Hayami   |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: hayami@kumamoto-u.ac.jp  | Title | Professor |

### 1. Research achievements

Research in 2D materials and membrane encompasses a range of multi-disciplinary and cross-disciplinary areas in Physics, Chemistry, and Chemical Engineering. The main scope of my research is the novel synthesis and construction of application-oriented devices based on two-dimensional (2D) crystals to explore new physical phenomena. I'm actively engaged in the design and development of 2D materials based membranes and nanofluidic devices for probing fundamental molecular transport at the nanoscale and their potential applications. I also explore magnetic, superconducting and other unusual physical properties of 2D materials. My research mainly involves preparation and characterisation of membranes, engineering the pore dimensions and pore structure by chemical functionalization and developing surface modification strategies for fabricating functional membranes for diverse applications such as water purification, separation, and related technologies. Other major activities include developing high throughput techniques to realise large area membranes for applications such as gas separation, pervaporation, desalination, membrane-assisted catalytic reactions, barrier coating, organic solvent nano-filtration, membranes for healthcare technology, and (bio) pharmaceutical purification.

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

Research Collaboration between universities is critical for skills development, the generation, acquisition, and adoption of knowledge. The benefits of university linkages are wide-reaching: they can help avoid duplications, exploit synergies, and complementarities of scientific and technological capabilities. In our collaboration, Hayami lab. has researched about GO and its applications and our lab. has also focused on GO material. So we can expect about the synergy effects for the materials and fundamental properties. As a results, we can develop the good performance materials for real applications.

### 3. Comments/suggestions about IROAST/Kumamoto University

In this year, we plan a workshop between UK-JP about 2D materials. At that time, our lab. will organize it with Hayami lab. So IROAST/Kumamoto University can also contribute for the workshop.

### 4. Prospect for further research collaboration with Kumamoto University

Now we have collaborated really about 2D materials. So we can publish for many paper with high IF.

#### 5. Impressions of Kumamoto University/Kumamoto

I feel Kumamoto University and the students is very high level one. So we can succeed to collaborate each other for long term.

|                 |  |       |                     |
|-----------------|--|-------|---------------------|
| No. 4-9         | Modification of intracellular organelles and cell nucleus by shock wave and nsPEF for nanoparticle/DNA/drug delivery |       |                     |
| Name            | Amir A. Farajian   |       |                     |
| Affiliation     | Department of Mechanical and Materials Engineering, Wright State University, USA<br>Email: amir.farajian@wright.edu  | Title | Associate Professor |
| Research Field  | Nanomaterial Science/ Advanced Green Bio   |       |                     |
| Period of Visit | December 16, 2017-December 27, 2017  |       |                     |
| Host Professor  | Hamid Hosano   |       |                     |
| Affiliation     | Institute of Pulsed Power Science<br>Email: hosseini@kumamoto-u.ac.jp  | Title | Professor           |

Prof. Amir Farajian and Prof. Hamid Hosseini initiated the process of Memorandum of Agreement between the two universities that was signed by both universities' authorities in 2017.

Prof. Farajian and Prof. Hosseini discussed details of a few collaborative research topics. Based on these discussions, materials for performing experiments by Prof. Hosseini's group at Kumamoto University were determined. The results of these experiments will be shared with Prof. Farajian's group at Wright State University, where corresponding simulation tasks will be performed. Prof. Hosseini also agreed to check the possibility of a supercomputer account at Kyushu University, so that the collaborative simulations will be performed more effectively.

Kumamoto University has several ambitious and highly rewarding research-related activities incorporating domestic talents and international expertise. This impressive vision on cutting-edge collaborative research will surely be mutually fruitful. The calm environment of Kumamoto, its beautiful scenery, and advanced facilities, provide excellent support for scientific research and education.

Prof. Farajian would like to thank IROAST and Kumamoto University generally, and Prof. Hosseini and Director Hiyama particularly, for the opportunity of visiting Kumamoto and discussion collaboration. He hopes that mutual research will result in good publications. He also hopes for possibly longer visits at both universities to promote mutual collaboration.

|                 |   |       |           |
|-----------------|---|-------|-----------|
| No. 4-10        | Novel Needle-less Drug/Vaccine Delivery   |       |           |
| Name            | Viren Ivor Menezes  |       |           |
| Affiliation     | Department of Aerospace Engineering,<br>Indian Institute of Technology Bombay,<br>India<br>Email: viren@aero.iitb.ac.in | Title | Professor |
| Research Field  | Advanced Green Bio  |       |           |
| Period of Visit | February 9, 2018-February 18, 2017  |       |           |
| Host Professor  | Hamid Hosano  |       |           |
| Affiliation     | Institute of Pulsed Power Science<br>Email: hosseini@kumamoto-u.ac.jp   | Title | Professor |

#### 1. Significance of the Symposium/Meeting/Joint Research

Held an interaction on high-speed flow dynamics relevant to reentry capsules. The session included discussion on sensor development, calibration and implementation in a short duration hypersonic test facility for acquisition of surface heat-flux. The concept can be extended to shock waves research, which is an impulse phenomenon.

#### 2. Possibility of Future Research Collaboration with Kumamoto University

Future research collaborations will include, high-speed flow dynamics, medical applications of shock waves and interaction of shock waves with condensed media.

#### 3. Impression of Kumamoto University

Excellent campus and infrastructure for high-end research. Enjoyed my stay having technical discussions with the members of the Institute of Pulsed Power Science. Would like to visit again in future.

#### 4. Impression of Kumamoto

Clean and friendly city with an excellent connectivity.



Meeting with Prof. Hosano and Dr. N. Hosano  
at IPPS, Kumamoto University.



|                 |  |       |           |
|-----------------|--|-------|-----------|
| No. 4-11        | Mechanics, dynamics and thermodynamics of grain boundaries in metals   |       |           |
| Name            | Dmitri Aleks Molodov   |       |           |
| Affiliation     | Institute of Physical Metallurgy and Metal Physics (IMM), RWTH Aachen University, Germany<br>Email: molodov@imm.rwth-aachen.de | Title | Professor |
| Research Field  | Nanomaterial Science   |       |           |
| Period of Visit | March 19, 2018-March 29, 2018  |       |           |
| Host Professor  | Sadahiro Tsurekawa   |       |           |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: turekawa@kumamoto-u.ac.jp   | Title | Professor |

During the last couple of years the cooperative research work by groups led by Prof. S. Tsurekawa in Kumamoto and Prof. D. Molodov in Aachen focused on the study of the local mechanical behavior in the close vicinity of grain boundaries in aluminum. The experiments utilizing the nanoindentation technique were performed in the Laboratory of Prof. Tsurekawa on aluminum bicrystals with various grain boundaries produced at the IMM in Aachen. Specifically, the behavior of different special boundaries with  $\Sigma 3$  orientation relationship, i.e. coherent and incoherent twin boundaries, as well as that of boundaries with misorientations in the transition range between low and high angle regimes was addressed. The obtained results revealed a number of new interesting and important features in the mechanical behavior of grain boundaries. First of these results are reported in the paper recently published in the highly respected journal “Materials Science & Engineering A” (2018, volume 716, pp. 37-41).

In the course of last year the cooperative research on this topic was extended by involving in the collaboration Dr. Luis Barrales-Mora (the former co-worker of Prof. Molodov, currently Professor of the George W. Woodruff School of Mechanical Engineering Georgia Tech Lorraine in Metz, France), who applied atomistic simulations for investigations of the mechanics of grain boundaries. The obtained simulation results have appeared to be very interesting and deepened our understanding of the interaction between moving dislocations and different  $\Sigma 3$  grain boundaries. It has been therefore decided to intensify the simulation work by utilizing the computational capacity of the supercomputer in the Research Center Jülich, Germany. The respective application by Prof. Molodov was recently approved.

The time of the recent stay of Prof. D. Molodov in Kumamoto was used for intensive discussions with Prof. S. Tsurekawa and his students. The next steps in the cooperative research were discussed and the respective time plan was established. It has been decided to prepare at least two more publications on the basis of the experimental and simulation results obtained on aluminum bicrystals. The both partners also agreed to continue the study efforts by applying the nanoindentation technique to bicrystals of other metals, particularly magnesium. The magnesium bicrystals containing different grain boundaries are already delivered in Kumamoto. Furthermore, the discussions in Kumamoto have revealed a great interest in conducting a series of experiments on bicrystals of copper to investigate the effect of a magnetic field on grain boundary energy. Further steps in developing the mutually beneficial research cooperation in the mentioned directions are currently under discussion between the partners.

During his last stay in Japan, on 21 March 2018, Prof. D. Molodov as a representative/Visiting Professor of the IROAST/Kumamoto University has delivered the invited lecture at the Symposium on Multiscale engineering of green energy materials organized by Prof. S. Tsurekawa in the frame of the 2018 JIM Spring Meeting in Chiba/Tokyo. The support of the participation of Prof. D. Molodov in this Meeting from IROAST/Kumamoto University is highly appreciated.

Finally, it should be noted that the IROAST/Kumamoto University did a very good job of organizing and also financing the visit of Prof. D. Molodov in Kumamoto. This is great support for the successful collaborative research work detailed above. Thanks a lot!

|                 |   |       |   |
|-----------------|---|-------|---|
| No. 4-12        | Design and Synthesis of Novel Nanostructured Catalysts for Selective Biomass Conversion into Chemicals and Fuels  |       |   |
| Name            | Jorge Norberto Beltramini   |       |   |
| Affiliation     | Nanomaterials Centre (NANOMAC); Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Australia<br>Email: <a href="mailto:j.beltramini@uq.edu.au">j.beltramini@uq.edu.au</a><br>And<br>Department of Chemistry, Physics and Engineering, Queensland University of Technology, Australia<br>Email: <a href="mailto:jorge.beltramini@qut.edu.au">jorge.beltramini@qut.edu.au</a> | Title | Associate Professor/<br>Senior Research Fellow<br><br>Adjunct Professor |
| Research Field  | Nanomaterial Science/ Green Energy/ Environmental Science   |       |   |
| Period of Visit | March 8, 2018-March 31, 2018  |       |   |
| Host Professor  | Shinya Hayami   |       |   |
| Affiliation     | Faculty of Advanced Science and Technology<br>Email: <a href="mailto:hayami@kumamoto-u.ac.jp">hayami@kumamoto-u.ac.jp</a>   | Title | Professor   |

During March 2018, we implemented the basic concepts for the design of a new class of catalysts based on metal, metal oxides and metal sulfides supported on different materials such carbon as graphene oxide, fullerene and in the future the use of metal organic frameworks (MOFs) to be used tested for biomass molecule conversion into key chemical feedstock and pharmaceutical precursors using conventional and microwave reaction type reactors and conditions.

We propose significant scientific and technical innovation in the development of the reactions to produce chemicals and fuels from waste rural biomass, and in the development of an entirely new class of catalysts and their application to biofuels. These hybrid nano-porous catalysts will substantially increase the productivity of chemicals synthesized produced from waste agriculture cellulose. These new catalysts will have a wide impact and be also important for the catalysis of many other reactions, including for example, the more effective production of transportation fuels. Moreover, these new technologies are a major challenge, for which we have promising preliminary results during the month of March I spent at Professor Hayami laboratory facilities. With improved catalysts this will be commercially viable. Development of a three-way tertiary metal promoted nano catalyst for the conversion of lignocellulosic material into valuable chemicals will be a major step forward in producing a large-scale industry for the Japanese market with export potential. This research will also substantially progress knowledge in the field of well-designed hybrid catalysts for energy and other applications.

An added novelty of the method to produce these catalysts is that we can produce bulk nano-porous catalysts in any desired shape or form, such as powder, rod, wire, sheet, chips etc., depending upon the precursor shape. Production of any desired precursor shape is easy because the precursors are in most cases nano ductile metals capable of being easily deformed to the desired shape. This allows greater flexibility in the reactor design for catalytic synthesis. Therefore, we can optimise the reactor and catalysts characteristics for greatest performance.

Professor Shinya Hayami research work and facilities at Chemistry Department at Kumamoto

University is very well international recognized for his 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 characterization, catalysis and production of key and fine chemicals as well as sustainable fuels for the future economy of Japan and the entire world.

It is also important to remark the decisive contribution to this research project from IROAST at Kumamoto University that allowed my visit to be possible. I would like also to mention that I have just been awarded at 2018 JSPS invitational long term Fellowship that I am planning to start at the end of 2018 to develop at Professor Hayami research facilities a project on Selective Catalytic Methane Oxidation using Metal Organic Framework (MOF) Functionalized Catalysts. Current routes to activate the strong C–H bond in methane require high temperatures, several steps, are costly and inefficient, and produce waste. Because of these reasons, the direct oxidation of methane to methanol is still regarded as one of the remaining grand challenges of catalysis









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

| No. | Name                           | Project Title   |
|-----|--------------------------------|---|
| 5-1 | <b>Shinichiro Sawa</b>         | Analysis of mechano-function in plant development   |
| 5-2 | <b>Shinya Hosokawa</b>         | Atomic Structures and positional fluctuations in a quasi-crystal by x-ray fluorescence holography                         |
| 5-3 | <b>Toshifumi Mukunoki</b>      | Study on remediation mechanism of Volatile Organic compounds in ground using X-ray CT method and Lattice Boltzmann method |
| 5-4 | <b>Tomohiko Tomita</b>         | Climate change in the Indonesian maritime continent and its impacts on the tropicalization of Japanese climate            |
| 5-5 | <b>Hamid Hosano (Hosseini)</b> | Biofuel and Omega-3 Fatty Acid Green Electro-Extraction from Microalgae   |
| 5-6 | <b>Toshiyuki Tosha</b>         | Construction of a geothermal conceptual model at Oguni, Kumamoto  |
| 5-7 | <b>Donald S. Shih</b>          | Integrated Computational Materials Engineering of Advanced Mg alloys  |
| 5-8 | <b>Kei Ishida</b>              | Development of hybrid downscaling method over Shira River Basin   |

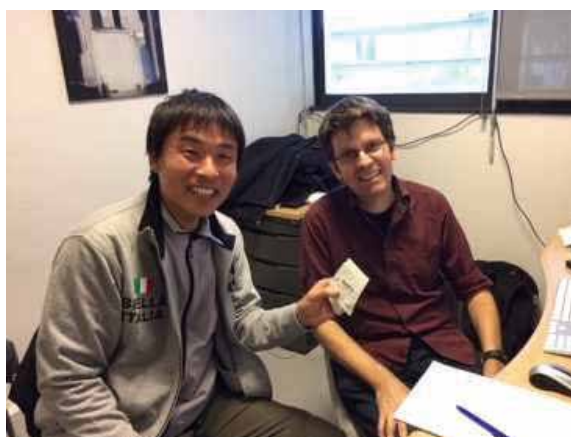
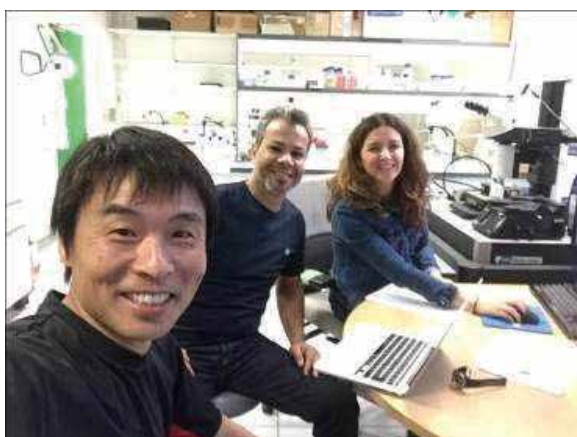
|                    |  |       |                                 |
|--------------------|--|-------|---------------------------------|
| No. 5-1            | Analysis of mechano-function in plant development                          |       |                                 |
| Name               | Shinichiro Sawa  |       |                                 |
| Affiliation        | Faculty of Advanced Science and Technology<br>Email: sawa@kumamoto-u.ac.jp | Title | Professor                       |
| Research Field     | Advanced Green Bio   |       |                                 |
| Period of Travel   | October 13, 2017-October 28, 2017  |       |                                 |
| Visited Researcher | Oliver Hamant  |       |                                 |
| Affiliation        | ENS-Lyon   | Title | DR2 (IROAST Visiting Professor) |

### 1. Overview and significance of the international research collaboration

In order to start international collaboration, I have visited Olivier Hamant laboratory in Lyon, France according to MOU.

### 2. Research achievements and progress of the international joint research

To perform collaboration about mechano-biology on the shoot formation using Arabidopsis, I have visited Olivier Hamant Laboratory in Lyon (left panel) to perform Atomic Force Microscope experiment (right panel). We could measure turgor pressure using Arabidopsis mutants, and we have suggested the mechanical cue is also important in the Arabidopsis shoot development.



Left; AFM experiments with collaborators, Ali Ferjani and Pascale Milani.

Right; Discussion with Olivier Hamant.

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

I have applied a proposal for Grant-in-Aid for Scientific Research on Innovative Areas, KAKENHI, with Olivier Hamant, and when we the project we will send some researchers and students to perform mechano-biological experiments. ENS-Lyon already agreed with the collaboration with our group in Kumamoto University and with other groups in the project of Grant-in-Aid for Scientific Research on Innovative Areas.

|                    |   |       |                                    |
|--------------------|---|-------|------------------------------------|
| No. 5-2            | Atomic Structures and positional fluctuations in a quasi-crystal by x-ray fluorescence holography |       |                                    |
| Name               | Shinya Hosokawa   |       |                                    |
| Affiliation        | Faculty of Advanced Science and Technology<br>Email: shhosokawa@kumamoto-u.ac.jp                  | Title | Professor                          |
| Research Field     | Nanomaterial Science  |       |                                    |
| Period of Travel   | November 6, 2017-November 14, 2017  |       |                                    |
| Visited Researcher | 1. Marc de Boissieu<br>2. Nathalie Boudet   |       |                                    |
| Affiliation        | 1. SIMaP, France<br>2. CNRS, France   | Title | 1. Head of Lab.<br>2. Group Leader |

### 1. Overview and significance of the international research collaboration

This international collaboration was aimed to carry out an x-ray fluorescence holography (XFH) experiments on a quasicrystal using a third-generation synchrotron radiation facility, ESRF, at Grenoble, France (see Fig. 1). The XFH technique has recently been developed remarkably by our research group in Japan, which enables one to draw three-dimensional (3D) atomic images around a specific element emitting fluorescent x-rays. Many foreign groups have much interest for the feasibility of this technique to investigate the local- and intermediate-range structures around a specific element and their positional fluctuations.



Fig. 1. The photograph of the ESRF main building (right) and the experimental ring (left) with a mountain of French Alps (backdrop).

This is the first XFH experiment using a foreign synchrotron radiation (SR) facility collaborated with Dr. Marc de Boissieu of Science et Ingénierie des Matériaux et Procédés (SIMaP) at Grenoble, France, who is currently Chief Executive Officer of The European Integrated Center for the Development of New Metallic Alloys and Compounds (C-MAC). His major is mainly the structure and dynamics of quasicrystal metallic alloys studied using SR. He was interested in our new technique to investigate the structures and their positional fluctuations. The sample with a good quality was provided by his group.

The XFH experiment at the ESRF was supported by Dr. Nathalie Boudet of Centre national de la recherche scientifique (CNRS) as the local contact, who is a group leader of Institut Néel/CNRS at Grenoble, France and organizes one of the beamlines in ESRF. She was the host researcher for our post doc in 2016 fiscal year by the JSPS program of Strategic Young Researcher Overseas

Visits Program for Accelerating Brain Circulation.

Three members of our group (see Fig. 2) joined the experiment together with a Polish student from Jagiellonian University in Krakow and a Japanese professor from Nagoya Institute of Technology. Dr. Boudet prepared the experimental setups to adopt our technique to her beamline in the ESRF.



Fig. 2. The photograph of the experimental room in ESRF, where three members of our group are sitting.

## 2. Research achievements and progress of the international joint research

Quasicrystal was discovered by a Nobel Prize winner, D. Shechtman in 1984, and is called the third phase of solid states different from crystal and amorphous phases. Although it loses a translational symmetry defining the crystal phase, the atomic structure exhibits a highly ordered configuration. The diffraction pattern shows five-, eight-, ten-, or twelvefold rotational symmetry, which does not appear in usual crystals.

For the XFH experiment, we employed an  $\text{Al}_{73}\text{Ni}_{12}\text{Co}_{15}$  decagonal quasicrystal, and obtained 3D atomic structures around the Ni and Co elements. Figure 3(a) shows the measured hologram of the Co  $K\alpha$  fluorescent x-ray intensities with changing the incident and azimuthal angles. A beautiful tenfold symmetry is realized in the hologram, indicating an excellent quality of the quasicrystal sample.

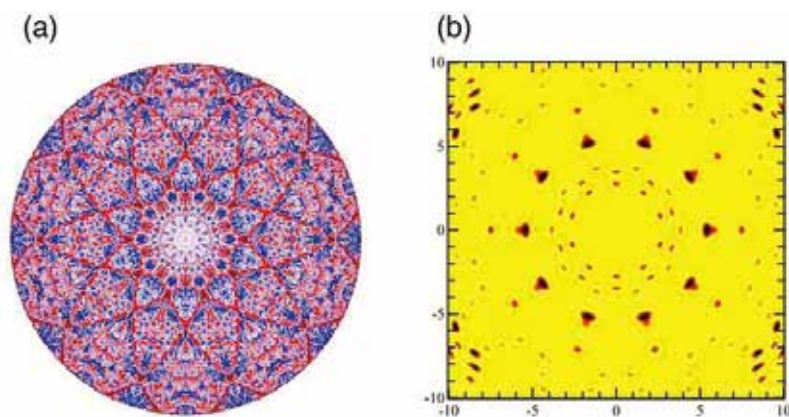


Fig. 3. The XFH experimental results of a quasicrystal, (a) the measured hologram and (b) the reconstructed atomic image on the (001) plane.

Figure 3(b) shows the reconstructed atomic image on the (001) plane, where the central Co is located at the center of the image. The tenfold symmetry is again seen in the atomic image of the second-neighboring atoms, which is a superimpose of different local quasicrystal structures around the Co atoms. A slightly different 3D atomic image is also observed around the Ni atoms. A detailed analysis of the presently obtained XFH data is now in progress in combination with the

existing experimental knowledges obtained by Dr. de Boissieu on the structures and dynamics of quasicrystals.

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

We plan to invite Dr. de Boissieu as a guest professor of the IROAST for the further collaborations in this fiscal year. He and his colleagues would like to carry out SR experiments using the Japanese third-generation SR facility of the SPring-8, for which our group will help the SR experiments.

4. Comments/suggestions about IROAST (programs).

Since the balance of e.g., JSPS Grant-in-Aid can carry forward to the next fiscal year, I wonder why the university budget cannot be made. The period of fiscal year is different from the foreign countries, it would be important for, in particular, international divisions of universities. There are many chances to visit foreign researchers and collaborate with them from the end of March to the beginning of April.



|                    |   |       |  |
|--------------------|---|-------|--|
| No. 5-3            | Study on remediation mechanism of Volatile Organic compounds in ground using X-ray CT method and Lattice Boltzmann method |       |  |
| Name               | Toshifumi Mukunoki  |       |  |
| Affiliation        | Faculty of Advanced Science and Technology<br>Email: mukunoki@kumamoto-u.ac.jp  | Title | Associate Professor                              |
| Research Field     | Environmental Science   |       |  |
| Period of Travel   | November 7, 2017-November 20, 2017  |       |  |
| Visited Researcher | 1. Anne-Julie, Tinet<br>2. Fabrice, Golfer  |       |  |
| Affiliation        | GeoResources, University of Lorraine, France  | Title | 1. Associate Professor<br>2. Associate Professor |

The purposes of this business trip are:

- 1) To promote publication work as an actual proof of research collaboration;
- 2) To discuss the development of experimental setup to improve current methodology; and
- 3) To learn simulation of two phase flow using Lattice Boltzmann Method (LBM).

As for item 1), considerably, we could analyze results together and found some errors to improve the data quality. For this situation, I could have a chance to meet the technician for image analysis in GeoResources. Then, for item 2), Experimental setup developed in GeoResources was introduced and I could get some idea how to improve our current experimental setup. In the last item 3), I could learn how to change the parameters and boundary condition to get accurate results about two phase flow.

My future plans for the international joint research based on the above results are:

- 1) We will publish one journal paper in 2018.
- 2) GeoResources members are interested in our experimental work, so they will visit my laboratory next summer.
- 3) We had an idea to combine our image analysis technique and their numerical technique so we will make one more publication with respect to two phase flow in porous media.

In this time, I made two new connections to Rock engineering and Geology. They seem to visit Kumamoto University to extend their carrier so I will be able to reinforce the agreement between Kumamoto University and University of Lorraine.

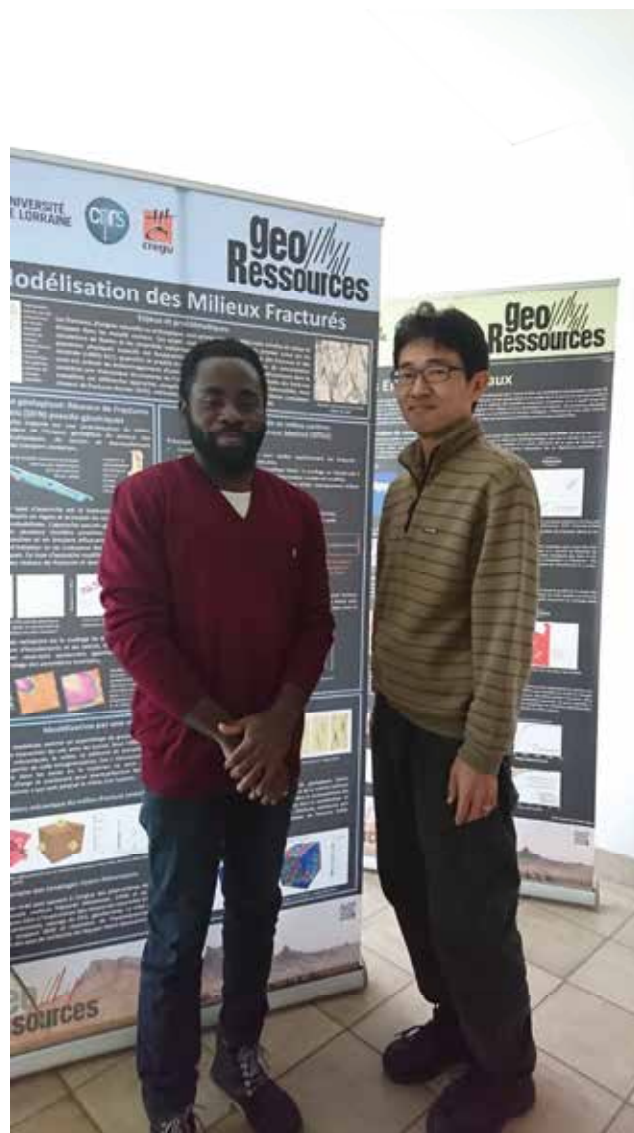


Meeting with collaborators





After my Ph.D. student (intern at University of Lorraine)'s presentation



With a Ph.D. student who will work in my lab for two months this year as an intern.

|                    |  |       |                     |
|--------------------|--|-------|---------------------|
| No. 5-4            | Climate System in the Indonesian Maritime Continent and its Variability                                      |       |                     |
| Name               | Tomohiko Tomita  |       |                     |
| Affiliation        | Faculty of Advanced Science and Technology<br>Email: t-tomita@kumamoto-u.ac.jp                               | Title | Associate Professor |
| Research Field     | Environmental Science  |       |                     |
| Period of Travel   | December 26, 2017-January 7, 2018  |       |                     |
| Visited Researcher | Heri Kuswanto  |       |                     |
| Affiliation        | Research Center for Earth, Disaster and Climate Change, Institut Teknologi Sepuluh Nopember (ITS), Indonesia | Title | Associate Professor |

During the research trip of 2017/12/26 – 2018/01/07, a MOU of research collaboration was concluded between Tomohiko Tomita, Kumamoto University (KU), and Heri Kuswanto, Institut Teknologi Sepuluh Nopember (ITS), about the climate change in the Indonesian maritime continent (IMC) and its impacts on the mid- and high-latitudes' climate including that in Japan. A start up research has already performed by Ms. Kiki Ferawati in KU, who is an exchange graduate student of master degree from ITS's Kuswanto laboratory to KU's Tomita laboratory. The target of her study is heavy precipitation events in eastern Java and the forcing and environmental factors. During this research trip, Tomita and Kuswanto first discussed the concrete research flow of her study, and concluded that we would combine the data of precipitation at ITS and of the weather radar in eastern Java, both of which have very high temporal resolution. As the methodology, they plan to apply machine learning techniques to such big data of meteorology and climatology.

Then, Tomita and Kuswanto had two research meetings in Jakarta for future extension of their research activity: one is with Prof. Aldrian of BPPT, and the other is with Dr. Urip and his colleagues in BMKG.

A future plan for the international joint research of Tomita and Kuswanto is first to publish Ms. Ferawati's ongoing work on an international journal with impact factor as a product of this collaboration. Then, her work will be developed as a future plan. Since the latent heating due to precipitation in the IMC controls not only the Asian monsoon but also the El Niño/La Niña events, they will still focus on the variability of precipitation in this unique equatorial region. More specifically, the three targets are considered at the present: (1) to develop Ms. Ferawati's work for short term prediction of heavy precipitation events in eastern Java, (2) to investigate the modulation of local meridional circulations from the IMC to mid-latitude Japan, which is led by the change of latent heating in the equatorial region, (3) to examine further impacts of the latent heating in the IMC on the global climate. Tomita and Kuswanto are looking for new students or researchers following her.

Tomita and Kuswanto are expecting the continuous support of IROAST for their collaboration, in particular, for its future extension.

|                    |   |       |                                       |
|--------------------|---|-------|---------------------------------------|
| No. 5-5            | Biofuel and Omega-3 Fatty Acid Green Electro-Extraction from Microalgae |       |                                       |
| Name               | Hamid Hosano  |       |                                       |
| Affiliation        | Institute of Pulsed Power Science<br>Email: hosseini@kumamoto-u.ac.jp   | Title | Professor                             |
| Research Field     | Green Energy, Advanced Green Bio  |       |                                       |
| Period of Travel   | March 12, 2018-March 21, 2018   |       |                                       |
| Visited Researcher | Firuz Zare  |       |                                       |
| Affiliation        | The University of Queensland, UK  | Title | Professor (IROAST Visiting Professor) |

The objective of the visit was to facilitate scientific collaboration and a Memorandum of Understanding (MoU) for Academic Co-operation between Kumamoto University (Institute of Pulsed Power Science IPPS), and the University of Queensland (School of Information Technology and Electrical Engineering), Australia.

The visit was also served to initiate a collaboration program with RMIT University, Melbourne, Australia.

The required coordination with Prof. Firuz Zare (the University of Queensland) and Prof. Fard (RMIT University) were arranged for the visit.

Monday March 12<sup>th</sup>: The whole day was spent for travel.

Tuesday March 13<sup>th</sup>: Orientation at Brisbane and the School of Information Technology and Electrical Engineering, the University of Queensland; visit to Prof. Zare office and discussion to apply for a joint Australian Research Council (ARC) research budget.

Wednesday March 14<sup>th</sup>: Visiting Prof. Zare in his office. Morning: Meeting with Prof. Peer Schenk and his colleagues about pulsed electric field extraction of nutrition compounds (omega 3) and Biofuel from microalgae. Afternoon: Meeting with Dr. Alireza Naderian, Geotechnical Leader and Associate Director of AECOM, about application of pulsed power in mining to reduce environmental and risk of tailing (mine dumps). Discussion with the University of Queensland International Office about the MOU with Kumamoto University and completing the process of the MOU.

Thursday March 15<sup>th</sup>: Morning: Visiting Dr. Negareh Ghasemi at Queensland University of Technology and discussion with her about pulsed electric field activities at Queensland University of Technology. Afternoon: Visiting Prof. Zare at his office in the University of Queensland with Dr. Ghasemi. Visit to new power electronics lab of Prof. Zare in a nearby campus. Discussion and writing the ARC research proposal.

Friday March 16<sup>th</sup>: Visit with Prof. Zare and Prof. Schenk to microalgae farm of the University of Queensland, which Prof. Schenk is running. The microalgae farm was very impressive and they have variety of microalgae that they grow in industrial scale. Discussion about application of pulsed electric field after the visit. Discussion about the MOU and ARC proposal and completing the process.

Saturday March 17<sup>th</sup>: Travel from Brisbane to Melbourne. Orientation at Melbourne and the School of Engineering, RMIT University.

Sunday March 18<sup>th</sup>: Visiting Prof. Fard and discussion about joint collaborative research program between Kumamoto University and RMIT University.

Monday March 19<sup>th</sup>: Visiting Prof. Fard office. Morning: Meetings with Prof. Fard's laboratory member and Ph.D. students. Meeting Prof. John Andrews at School of Engineering. Afternoon: Meeting with Prof. Jazar, Associate Dean, Mechanical and Automotive Engineering, RMIT

University. Discussion about further joint research and exchange activities between Kumamoto University and RMIT University.

Tuesday March 20<sup>th</sup>: Travel from Melbourne to Narita, Tokyo.

Wednesday March 21<sup>st</sup>: Travel from Narita, Tokyo to Kyushu.

Conclusion: The objectives of the proposal and visit was achieved. The MOU between Kumamoto University (Institute of Pulsed Power Science IPPS), and the University of Queensland (School of Information Technology and Electrical Engineering) is being approved and signed.



Photo 1



Photo 2



Photo 3



Photo 4

Photo 1: Meeting with Prof. Zare at the University of Queensland.

Photo 2: The University of Queensland's microalgae farm with Prof. Zare and Prof. Schenk.

Photo 3: Meeting Prof. Fard at the School of Engineering, RMIT University.

Photo 4: Meeting Prof. Fard's Ph.D. students



|                    |  |       |                   |
|--------------------|--|-------|-------------------|
| No. 5-6            | Construction of a geothermal conceptual model at Oguni, Kumamoto |       |                   |
| Name               | Toshiyuki Tosha  |       |                   |
| Affiliation        | IROAST<br>Email: tosha@kumamoto-u.ac.jp                          | Title | Project Professor |
| Research Field     | Green Energy   |       |                   |
| Period of Travel   | February 7, 2018-February 17, 2018                               |       |                   |
| Visited Researcher | Sabodh Garg  |       |                   |
| Affiliation        | Leidos, USA  | Title | Professor         |

Geothermal energy development in Japan has a history of over 50 years since the first geothermal power plant commenced operation in 1966. As geothermal energy is an underground resource, there are still unknown evidences and risks, causing the cost increase for the development. Also, in the beginning of 2000, geothermal energy was put out of governmental policy target for the development and the budget and the subsidy were reduced, making it impossible to continue the will to develop and to inherit technology. That has been a big negative legacy for the current development.

Dr. Sabodh Garg and Dr. John Pritchett, with whom I made discussion this time, are developers of the STAR simulator for calculating geothermal fluid flow, and since the 1980s, their team has undertaken the work of resource quantity evaluation by simulating the fluid flow and estimating geothermal resources at several geothermal fields in Japan, including Oguni in Kumamoto Prefecture. They also carried out the evaluation of the geothermal reservoir in geothermal fields in the Philippines as well as in USA. They are, therefore, familiar with various geothermal fields not only in Japan and also other countries. It is very important to discuss with them on the simulation for resource evaluation in Oguni in order to estimate how much resources are still remained and how to develop them. This is the greatest purpose of my visit.

The discussion began on general idea of simulation. Geothermal reservoirs and systems in Japan are very small compared in US and expand in several square kilometers with complicated geological structure. We discussed a simulation model that dominated fractures. In the case of a fracture system, some modification is required for the simulation used in petroleum fields. One of them, geothermal field is dominated by vertical type fracture although the fracture is not dominant and plays a less important role in the production of oil and natural gas. The fracture is of importance in the geothermal exploration. Especially it is necessary to estimate how far this vertical fracture extends in the construction of the model for the simulation. An old strata called basement rocks are often found at the relatively shallow strata in Japan. The basement rocks were altered and metamorphosed and they are recognised as hard rocks in the outcrops. We exchanged opinions on whether the fracture forming the geothermal system is



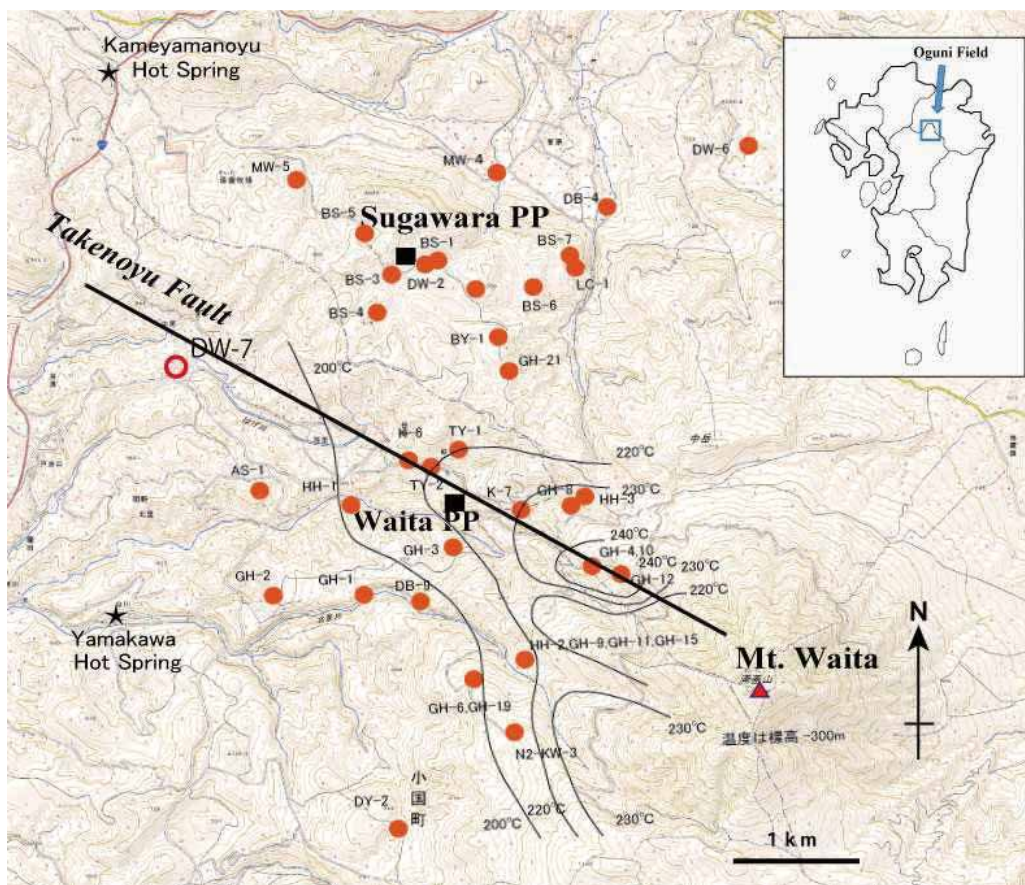
Dr. Sabodh Garg (leftmost), the author (middle), and Dr. John Pritchett (rightmost)

extending within this basement formation. This discussion of the extension of the geothermal fracture is also important related to “supercritical geothermal resources”, which is debating in recent years.

Regarding the Oguni geothermal field, a conceptual model was proposed based on the published data where geothermal fluid rises from the heat source underneath Mt. Waita and flows westward along the Takanoyu fault. At the conceptual model the direction of flow is changed and it moves northward to Sugawara. The point to be explained in this model is the question why the flow path changes north on the way. In this regard, they made a comment that a well test confirmed northward flow in the field but the reason why the flow changes its direction is unclear.

The analysis of aerial geophysical exploration using the gravity gradient meter suggested the faults extending linearly to Sugawara from the heat source of Mt. Waita, and a new conceptual model that mainly conducts geothermal fluid flow along this fault is currently being studied at Kumamoto University. Their comment to this model is that the model of the reservoir is not unique, but has various possibilities. Therefore, the model of Kumamoto University is also one of the possible models, and we will proceed the calculation based on the model. The model would be good if we can explain various phenomena in the Oguni geothermal field using the model.

Regarding MOU with Kumamoto University, they said that Leidos is unfortunately a private company, so it is not suitable for concluding MOU. It is, however, possible to give opinions and suggestions personally, we decided to keep discussion on the subject. In other days I attended Stanford Geothermal Workshop and made a presentation titled “Geothermal Development in Oguni, Central Kyushu”.



Map of the Oguni Geothermal Field with location of wells and estimated temperature contours at 300m BSL

Takenoyu fault is estimated as a major geothermal fluid pass from the heat source beneath Mt. Waita. Fluid flows along the fault but change its direction toward north to Sugawara at somewhere on the way.

|                    |  |       |                         |
|--------------------|--|-------|-------------------------|
| No. 5-7            | Integrated Computational Materials Engineering of Advanced Mg alloys   |       |                         |
| Name               | Donald S. Shih   |       |                         |
| Affiliation        | Magnesium Research Center<br>Email: donaldshih@kumamoto-u.ac.jp  | Title | Distinguished Professor |
| Research Field     | Nanomaterial Science, Environmental Science  |       |                         |
| Period of Travel   | March 8-March 23, 2018   |       |                         |
| Visited Researcher | 1. Greg Olson<br>2. Kristin Persson, Andy Minor<br>3. Tresa Pollock<br>4. Sean Agnew<br>5. Hamid Garmestani, Steven Liang<br>6. Dave McDowell<br>7. Min Zhou   |       |                         |
| Affiliation        | 1. Northwestern University, USA<br>2. University of California at Berkeley, USA<br>3. University of California at Santa Barbara, USA<br>4. University of Virginia, USA<br>5. Georgia Tech, USA<br>6. Georgia Tech, USA<br>7. Georgia Tech, USA | Title | 1-7. Professor          |

### 1. Progress of International Research Collaboration

The progress of this international research plan is summarized below during my trip in March 2018 to visit the University of California at Berkeley, to meet with many potential collaborators during the annual meeting of The Materials Society (TMS 2018) in Phoenix, Arizona, USA, and to visit Georgia Institute of Technology (Georgia Tech) in Atlanta, Georgia:

\* Initiated proposal research collaboration with Northwestern University (NU), the University of California at Berkeley (Cal), the University of California at Santa Barbara (UCSB), University of Virginia (UVA), and Georgia Tech in the U.S.

We discussed about preparing for PIRE proposals for JST in Japan and NSF in the U.S.

NU - Advanced Mg design using computational materials science

Cal - Data science and data-mining of advanced Mg alloys

UCSB - Three-dimensional microstructure of fine features in advanced Mg alloys

UVA - Twinning and kinking deformation of Mg alloys

Georgia Tech - Multiscale modeling approach to deformation and fracture.

\* Began MOU discussion at the department (MSE and ME) and research center (Institute of Materials) levels with Professor Dave McDowell at Georgia Tech. The details of the potential MOU are being discussed.

\* The research collaboration ideas include:

1) NU - a. ICME-based materials design is a strongest merit for NU's MSE department (Profs Olson, Wolverton and Voohee). I plan to transfer some of those strong points to KU.

2) Cal - Profs Persson and Cedar are top experts in data sciences. Our collaboration will be focused on developing some data science methodology aimed at enhancing R&D of advanced Mg alloys.



3) UCSB - In order to achieve ICME, 3D microstructure and EBSD are key for integrating microstructure and texture to predict property. I plan to use it for analyzing and understanding better the fine features of Long Periodical Stacking Order in KUMADAI Mg alloys. Prof Pollock is the best.

4) UVa - Deformation by twinning and kinking plays a key role in mechanical behavior of Mg alloys. Micromechanical modeling using crystal plasticity is an excellent methodology to treat and predict the deformation. Prof Agnew is a top expert in this area.

5) Georgia Tech - Georgia Tech is specially rich in talent in the subject area of multiscale modeling approach to deformation and fracture. The professors in both MSE and ME, Profs Dave McDowell, Steven Liang, Hamid Garmenstani, and Min Zhou, are world-leading experts in this area whom I had worked with closely when I was in America.

## 2. Future Prospects

My future plan, in working with my colleagues in MRC, includes several important points, as follows, in three major subject areas:

- \* Crystal plasticity - micromechanics of LPSO and MFS integrating dislocation motion and modeling and simulation of the LPSO-containing Mille-Feuille structures in Mg alloys and possibly others.

- \* Data science - data mining methodology, statistics-based approach to integrate with physics-based computational materials science.

- \* Materials by Design - aim to educate and research on Integrated Computational Materials Engineering (ICME)

1) Form an alliance of research collaboration, including formally executing an MOU, with the Georgia Tech, the University of California at Berkeley and the Northwestern University.

2) Consider to bring in Japanese institutions, such as NIMS, as domestic partners.

3) Organize international symposia at Kumadai, taking advantage of upcoming international conferences, such as MMM 2018, which is to be held in Osaka in late Oct - early Nov 2018.

4) Continue to follow up on the international collaborators in the USA and EU.

## 3. Comment for IROAST International Joint Research Travel Support Program

The support of IROAST for me during is greatly appreciated. I experienced a tremendous sense of support and responsibility.

|                    |   |       |                     |
|--------------------|---|-------|---------------------|
| No. 5-8            | Development of hybrid downscaling method over Shira River Basin                 |       |                     |
| Name               | Kei Ishida  |       |                     |
| Affiliation        | Faculty of Advanced Science and Technology<br>Email: keiishida@kumamoto-u.ac.jp | Title | Assistant Professor |
| Research Field     | Environmental Science   |       |                     |
| Period of Travel   | March 11, 2018-March 21, 2018   |       |                     |
| Visited Researcher | Van-Thanh-Van Nguyen  |       |                     |
| Affiliation        | McGill University, Canada   | Title | Professor           |

The purpose of this international collaborative research with Professor Nguyen is to develop a hybrid downscaling method over the Shira River basin. Downscaling is an approach to obtain atmospheric variables such as temperature and precipitation at a finer temporal and spatial resolution from the coarse global atmospheric data. The hybrid downscaling is a method of the downscaling that integrates the dynamical downscaling and the statistical downscaling to obtain advantages from both of the methods. While I've been working on the dynamical downscaling, Professor Nguyen is an expert of the statistical downscaling. The main objective of this collaborative research is to integrated experiences and knowledge of both.

During this research period, Professor Nguyen and his Ph.D. candidate explained advantages and disadvantages of the statistical downscaling, and provided some presentations about their studies on the statistical downscaling. On the other hand, I also explained advantages and disadvantages of the dynamical downscaling to them, and showed my previous and current studies that utilize the dynamical downscaling. After understanding the advantages and the limitations of both methods, we discuss more details to develop a hybrid downscaling method. Then, we decided to develop a method over the Ishikari River basin as a study area before applying it to the Shira River basin because the required data are already available. Then, we selected a statistical downscaling method which is integrated with the dynamical downscaling.

Based on the discussions at McGill University, we will continue the collaborative research to develop a hybrid downscaling method. We will contact each other on email and/or phone to have more discussions. Moreover, Professor Nguyen plans to come to Kyoto this year. We will have a discussion in Kyoto. Finally, we will write some journal papers based on this collaborative research.

I sincerely appreciate the support by IROAST on this international collaborative research.





## IROAST Symposiums

| No. | Title   | Organizer  | Date       |
|-----|---|--|------------|
| 1   | IROAST Kickoff Symposium “Cutting-edge Research with International Collaboration for Advanced Science and Technology” | <b>Takashi Hiyama</b>  | 03/24/2017 |
| 2   | The 1st IROAST Symposium "Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems"                  | <b>Mitsuhiro Aida</b><br><b>Takumi Higaki</b><br><b>Takashi Ishida</b> | 11/14/2017 |

### IROAST Symposium Report 1

|   |   |  |       |          |
|---|---|--|-------|----------|
| Organizer   | Name  | Takashi Hiyama                           |       |          |
|   | Affiliation   | IROAST                                   | Title | Director |
| Symposium Title   | IROAST Kickoff Symposium–Cutting-edge Research with International Collaboration for Advanced Science and Technology   |  |       |          |
| Venue   | 100 <sup>th</sup> Anniversary Hall, Faculty of Engineering  |  |       |          |
| Time & Date   | 9:30-17:15, March 23, 2017  |  |       |          |
| Speaker’s Name/<br>Title/Affiliation  | Jorge Beltramini, IROAST Visiting Professor, The University of Queensland, Australia<br>Ramesh Shanmughom Pillai, IROAST Visiting Professor, University of Geneva, Switzerland<br>Josep-Lluís Barona-Vilar, IROAST Visiting Professor, Universidad de Valencia, Spain<br>Paul Bowen, Professor, The University of Birmingham, UK<br>Konstantinos Kontis, IROAST Visiting Professor, University of Glasgow, UK<br>Supri Soengkono, IROAST Visiting Professor, GNS Science, New Zealand<br>Atsushi Sainoki, Associate Professor, IROAST<br>Aeju Lee, Associate Professor, IROAST<br>Takashi Ishida, Assistant Professor, IROAST |  |       |          |
| Number of<br>Participants   | From KU   | Faculty: 40<br>(Int'l participants: 10)  | Total | 72       |
|   |   | Students: 25<br>(Int'l participants: 11) |       |          |
|   | From outside KU   | Faculty: 7<br>(Int'l participants: 7)    |       |          |
|   |   | Students:<br>(Int'l participants: 0)     |       |          |
| <p>The IROAST Kickoff Symposium was held at the 100th Anniversary Hall on March 23, 2017. The theme of the symposium was “Cutting-edge Research with International Collaboration for Advanced Science and Technology.” Six distinguished researchers from overseas institutions were invited to give keynote lectures, and three young researchers from IROAST also gave talks on their research. Despite the rain, some 70 individuals attended the symposium.</p> <p><u>Overview of the Kickoff Symposium</u></p> <p>9:30 - Opening remarks by Shinji Harada, President of Kumamoto University:</p> |   |  |       |          |



9:40 - Introduction of IROAST by Takashi Hiyama, Director of IROAST:



10:00 - Dr. Jorge Beltramini, The University of Queensland, Australia

Visiting Professor, IROAST (Host: Prof. Shinya Hayami)

“Multi-scale Material Synthesis and Catalyst Engineering for Sustainable production of Chemicals and Fuels”



10:40 - Dr. Ramesh Pillai, University of Geneva, Switzerland

Visiting Professor, IROAST (Host: Prof. Tokio Tani)

“Small Noncoding RNAs in Germline Genome Defense”





11:30 - Dr. Josep-Lluís Barona-Vilar, University of Valencia, Spain

Visiting Professor, IROAST (Host: Prof. Hirotaka Ihara)

“The social organization of scientific research: A historical perspective”



12:10 - Dr. Pawl Bowen, The University of Birmingham, UK

Invited Keynote Speaker (Host: Prof. Kazuki Takashima)

“Research at the University of Birmingham-Industrial Partnerships, International Activities and Strategies”



13:40 - Dr. Konstantinos Kontis, University of Glasgow, UK

Visiting Professor, IROAST (Host: Prof. Seyed Hamid Hosseini)

“Cross-disciplinary approaches to challenges in Engineering: Driving Forward Fluid Dynamics Research”



14:20 - Dr. Supri Soengkono, GNS Science, New Zealand

Visiting Professor, IROAST (Host: Prof. Toshiyuki Tosha)

“Geothermal Energy – past and future”



15:10 - Dr. Atsushi Sainoki, Associate Professor, IROAST

“Prevention and Application of Induced Seismicity for Sustainable Energy Development”



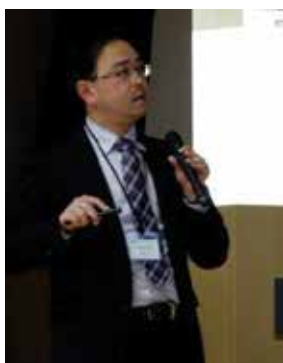
15:50 - Dr. Aeju Lee, Associate Professor, IROAST

“Polymeric Nanoconstructs for Combination Therapy and Multimodal Imaging”



16:30 - Dr. Takashi Ishida, Assistant Professor, IROAST

“Molecular insights into robustness and flexibility in plant morphogenesis”



17:05 - Closing remarks by Jun Otani, Vice-Director of IROAST



A few shots during coffee breaks:



# IROAST Kickoff Symposium

**"Cutting-edge Research with International Collaboration  
for Advanced Science and Technology"**

9:30-17:15 March 23, 2017  
100th Anniversary Hall

## Keynote speakers

**Jorge Beltrami** The University of Queensland, Australia

Multi-Scale Material Synthesis and Catalyst Engineering for Sustainable Production  
of Chemicals and Fuels

**Ramesh Shanmughom Pillai** University of Geneva, Switzerland

Small Noncoding RNAs in Germline Genome Defense

**Josep-Lluís Barona-Vilar** Universidad de Valencia, Spain

The social organization of scientific research. A historical approach.

**Paul Bowen** The University of Birmingham, UK

Research at the University of Birmingham- Industrial Partnerships,  
International Activities and Strategies

**Konstantinos Kontis** University of Glasgow, UK

Cross-disciplinary approaches to challenges in Engineering:  
Driving Forward Fluid Dynamics Research

**Supri Soengkono** GNS Science, New Zealand

Geothermal Energy-past and future

## Young researchers

**Atsushi Sainoki** IROAST, Kumamoto University, Japan

Prevention and Application of Induced Seismicity for Sustainable Energy Development

**Aeju Lee** IROAST, Kumamoto University, Japan

Polymeric Nanoconstructs for Combination Therapy and Multimodal Imaging

**Takashi Ishida** IROAST, Kumamoto University, Japan

Molecular insights into robustness and flexibility in plant morphogenesis

## Organized by

International Research Organization for Advanced Science and Technology (IROAST)

## Contact information

International Research Organization for Advanced Science and Technology (IROAST)  
Kumamoto University  
2-39-1, Kurokami, Chuo-Ku, Kumamoto City, 860-8555 JAPAN  
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## IROAST Symposium Report 2

|                                      |   |   |       |                     |
|--------------------------------------|---|---|-------|---------------------|
| Organizer 1                          | Name  | Mitsuhiro Aida                          |       |                     |
|                                      | Affiliation   | IROAST                                  | Title | Professor           |
| Organizer 2                          | Name  | Takumi Higaki                           |       |                     |
|                                      | Affiliation   | IROAST                                  | Title | Associate Professor |
| Organizer 3                          | Name  | Takashi Ishida                          |       |                     |
|                                      | Affiliation   | IROAST                                  | Title | Assistant Professor |
| Symposium Title                      | The 1st IROAST Symposium "Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems"  |   |       |                     |
| Venue                                | 100 <sup>th</sup> Anniversary Hall, Faculty of Engineering  |   |       |                     |
| Time & Date                          | 8:30-17:10, November 14, 2017   |   |       |                     |
| Speaker's Name/<br>Title/Affiliation | Brad Day, Professor, Michigan State University, USA<br>Bo Liu, Professor, University of California Davis, USA<br>Christian Hardtke, Professor, University of Lausanne, Switzerland<br>Yuling Jiao, Research Group Leader, Chinese Academy of Sciences, China<br>Gohta Goshima, Professor, Nagoya University<br>Junko Kyozuka, Professor, Tohoku University<br>Takashi Hashimoto, Professor, Nara Institute of Science and Technology<br>Masaaki Umeda, Professor, Nara Institute of Science and Technology<br>Shinichiro Sawa, Professor, Kumamoto University<br>Hiroyoshi Takano, Professor, Kumamoto University<br>Tokio Tani, Professor, Kumamoto University |   |       |                     |
| Number of<br>Participants            | From KU   | Faculty: 27<br>(Int'l participants: 5)  | Total | 80                  |
|                                      |   | Students: 41<br>(Int'l participants: 2) |       |                     |
|                                      | From outside KU   | Faculty: 11<br>(Int'l participants: 4)  |       |                     |
|                                      |   | Students: 1<br>(Int'l participants: 1)  |       |                     |

### 1. Seminar overview

Biological systems involve complicated interactions among factors of multiscale, ranging from molecules to macromolecular complexes, organelles to cells and tissues to whole organisms. To understand behaviors of such systems, combinatorial approaches using molecular biology, genetics, biochemistry, chemical biology, informatics, imaging and mathematical modeling are effective. The aim of the symposium was to invite leading scientists in the field of plant cell and developmental biology, to share recent progress of their research and to discuss better approaches for deep understanding on how biological systems work at various levels.

The symposium gathered 80 audiences including 12 international participants, and 12 of them are from outside Kumamoto University. Fourteen speakers, four from overseas institutes and ten from Japanese universities gave exciting talks on various topics covering a wide-range of



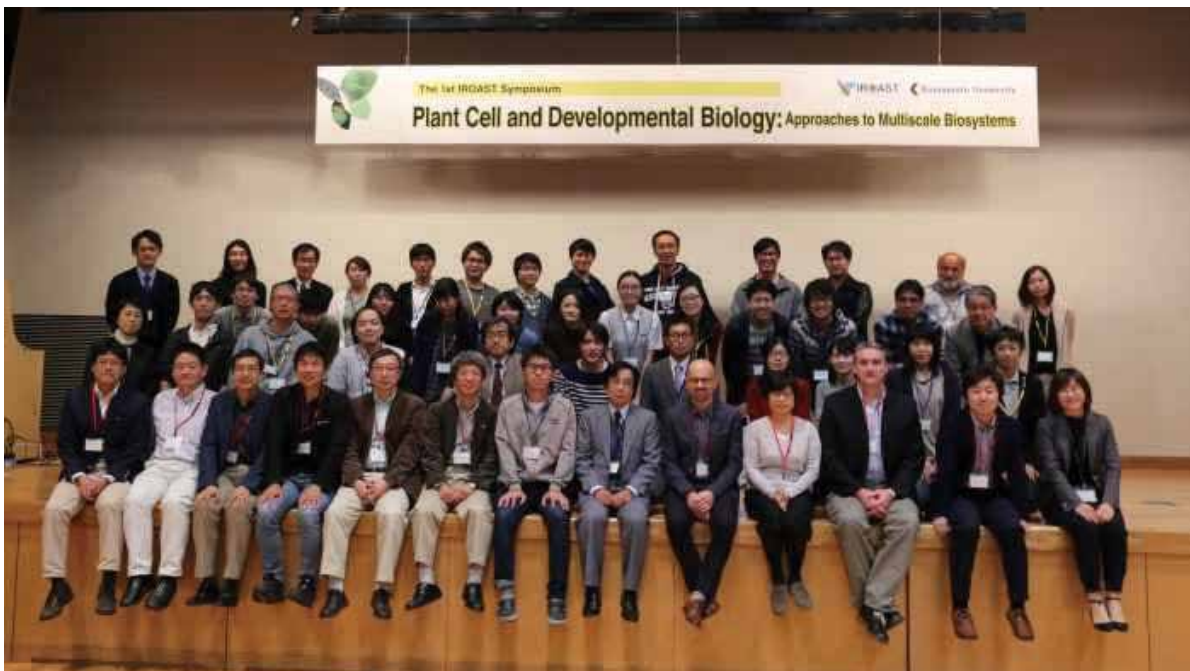
multiscale biological systems, such as cell shape and division control, organellar evolution, shoot and root development, cell differentiation, and plant-pathogen interactions. In addition, several rounds of poster sessions with 21 posters, mainly of students and post-docs of Kumamoto University, were held during coffee breaks and banquet, providing excellent opportunities for face to face interactions among young researchers, students and guest speakers in a friendly atmosphere.

## 2. Future Prospects

The symposium facilitated intellectual communication among students, young researchers and established scientists. This will provide them with opportunities for future research collaborations and personal exchanges, contributing to the progress in our understanding of complex biological systems in plants.

## 3. Others

After the symposium, a Memoranda of Understanding between Kumamoto University (through IROAST) and University of California, Davis (through Department of Plant Biology) was concluded, thanks to the effort of symposium speakers, Associate Professor Takumi Higaki (IROAST) and Professor Bo Liu (UC Davis).



The 1st IROAST Symposium

# Plant Cell and Developmental Biology: Approaches to Multiscale Biosystems

8:30-17:10 November 14, 2017

100th Anniversary Hall of Engineering Faculty, Kumamoto University

## Guest Speakers

**Brad DAY**

Michigan State University

**Gohta GOSHIMA**

Nagoya University

**Christian HARDTKE**

University of Lausanne

**Takashi HASHIMOTO**

Nara Institute of Science and Technology

**Yuling JIAO**

Chinese Academy of Sciences

**Junko KYOZUKA**

Tohoku University

**Bo LIU**

University of California, Davis

**Shinichiro SAWA**

Kumamoto University

**Hiroyoshi TAKANO**

Kumamoto University

**Tokio TANI**

Kumamoto University

**Masaaki UMEDA**

Nara Institute of Science and Technology

Free Admission

## Organized by

Mitsuhiro AIDA, Takumi HIGAKI and Takashi ISHIDA (IROAST)

## Contact Information

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Kumamoto University

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<http://iroast.kumamoto-u.ac.jp/>









## IROAST Seminars

| No.           | Title  | Organizer                 | Date       |
|---------------|--|---------------------------|------------|
| <b>FY2016</b> |  |                           |            |
| 1             | The 1st IROAST Seminar – Combinations of Molecular Dynamics simulations and Reverse Monte Carlo modeling for molecular liquids | <b>Shinya Hosokawa</b>    | 11/30/2016 |
| 2             | The 2nd IROAST Seminar – 7th IWX: Challenge of Medicine-Engineering Collaboration  | <b>Jun Otani</b>          | 12/02/2016 |
| 3             | The 3rd IROAST Seminar – 局在化した受容体シグナル経路を介したカスパリー線形成機構  | <b>Takashi Ishida</b>     | 12/05/2016 |
| 4             | The 4th IROAST Seminar – 植物表層微少管のマイナス端制御機構   | <b>Takashi Ishida</b>     | 12/12/2016 |
| 5             | The 5th IROAST Seminar – Noncoding genome and germline small RNAs in suppression of transposable elements                      | <b>Tokio Tani</b>         | 12/20/2016 |
| 6             | The 6th IROAST Seminar – Indonesia's Geothermal Energy: Barrier and proposed solutions for geothermal development              | <b>Toshiyuki Tosha</b>    | 02/01/2017 |
| 7             | The 7th IROAST Seminar – Kumamoto Symposium on Therapeutic/Diagnosis Techniques and Medical Devices                            | <b>Aeju Lee</b>           | 03/15/2017 |
| 8             | The 8th IROAST Seminar – Synthesis and characterization of ordered mesoporous materials for clean energy technologies          | <b>Shinya Hayami</b>      | 03/21/2017 |
| <b>FY2017</b> |  |                           |            |
| 9             | The 9th IROAST Seminar – the 4th ISKSR4  | <b>Shinya Hosokawa</b>    | 05/15/2017 |
| 10            | The 10th IROAST Seminar – International Symposium on PROTINUS  | <b>Toshifumi Mukunoki</b> | 07/07/2017 |
| 11            | The 11th IROAST Seminar – The Spindle Assembly Checkpoint in Plants  | <b>Takashi Ishida</b>     | 08/07/2017 |
| 12            | The 12th IROAST Seminar – Magnesium Alloys Designed as Degradable Metallic Biomaterials  | <b>Shinji Ando</b>        | 10/12/2017 |
| 13            | The 13th IROAST Seminar – Solute segregation at grain boundaries and their embrittlement; Czech footprint                      | <b>Sadahiro Tsurekawa</b> | 10/17/2017 |
| 14            | The 14th IROAST Seminar – Use of renewable energy sources for mine energy system   | <b>Atsushi Sainoki</b>    | 10/18/2017 |

|    |   |                                   |                           |
|----|---|-----------------------------------|---------------------------|
| 15 | The 15th IROAST Seminar – Annual Meeting 2017 of the LIA-CNPA in Kumamoto, jointed with the IROAST and the JST-ANR projects       | <b>Hirotaka Ihara</b>             | 10/14/2017                |
| 16 | The 16th IROAST Seminar – 5th International Symposium on Kumamoto Synchrotron Radiation (ISKSR5)                                  | <b>Shinya Hosokawa</b>            | 11/02/2017                |
| 17 | The 17th IROAST Seminars – History of Science & Medicine in Valencia  | <b>Hirotaka Ihara</b>             | 11/16/2017                |
| 18 | The 18th IROAST Seminars – History of Science & Medicine in Valencia  | <b>Hirotaka Ihara</b>             | 11/22/2017                |
| 19 | The 19th IROAST Seminar – Road Condition Measurement and Suspension / Traction Control for Active Safety and Autonomous Driving   | <b>Makoto Kumon</b>               | 11/28/2017                |
| 20 | The 20th IROAST Seminar – Hydrogen Production and Storage with Carbon Dioxide Hydrogenation                                       | <b>Yutaka Kuwahara</b>            | 12/05/2018                |
| 21 | The 21st IROAST Seminar – Tunable graphene oxide membranes  | <b>Shinya hayami</b>              | 12/06/2017                |
| 22 | The 22nd IROAST Seminar – Development of polymeric nano/micro-particles for cancer theranostics                                   | <b>Aeju Lee</b>                   | 12/21/2017                |
| 23 | The 23rd IROAST Seminar – IPPS Lecture & Seminar No.36  | <b>Hamid Hosano (Hosseini)</b>    | 12/20/2017                |
| 24 | The 24th IROAST Seminar – Advanced Science and Technology in Hydrology  | <b>Kei Ishida</b>                 | 01/09/2018-<br>01/10/2018 |
| 25 | The 25 <sup>th</sup> IROAST Seminar – IROAST&IRCMS Joint Seminar on Bioengineering – Cutting Edge Collaborations                  | <b>Jun Otani<br/>Yufeng Zheng</b> | 01/22/2018                |
| 26 | The 26th IROAST Seminar – Seismicity-permeability coupling in gas shales, CO <sub>2</sub> storage and deep geothermal energy      | <b>Atsushi Sainoki</b>            | 02/02/2018                |
| 27 | The 27th IROAST Seminar – IPPS Lecture & Seminar No. 38   | <b>Hamid Hosano (Hosseini)</b>    | 02/15/2018                |
| 28 | The 28th IROAST Seminar – Efficient Valorization of Biomass to Chemicals and Biofuels through Bifunctional Solid Catalytic Design | <b>Shinya Hayami</b>              | 03/30/2018                |

## IROAST Seminar Report 1

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Shinya Hosokawa                            |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 1st IROAST Seminar—Combinations of Molecular Dynamics simulations and Reverse Monte Carlo modeling for molecular liquids<br><i>(The 3rd International Symposium on Kumamoto Synchrotron Radiation (ISKSR3))</i> |  |       |           |
| Venue                                | C122 Lecture Room, Faculty of Science   |  |       |           |
| Time & Date                          | 10:20-5:00, November 30, 2016   |  |       |           |
| Speaker's Name/<br>Title/Affiliation | László Pusztai, Group Leader, Hungarian Academy of Sciences (IROAST Visiting Professor) and others  |  |       |           |



Opening address by Dr. Hiyama



Prof. Pusztai

## **3rd International Symposium on Kumamoto Synchrotron Radiation (ISKSR3): Data Analysis and Data-Driven Science**

Sponsor: International Research Organization for Advanced Science and Technology (IROAST), Kumamoto University

Co-sponsor: Kumamoto University Advanced Research Project A “Precise atomic level structure observation and physical property of condensed matter under extreme condition”

Date and Time: **30 November 2016 (Wed), 10:20 am – 5:00 pm (tentative)**

Place: C122 Lecture Room, Faculty of Science, Kumamoto University

Address: 2-39-1 Kurokami, Chuo-ku, Kumamoto 860-8555, Japan

### **Scope**

We are planning to build a new synchrotron radiation (SR) beamline (Kumamoto University MACro-MOlecular Nano- Pico-Time-Resolved BeamLine, KUMAMON-PTR-BL) at Saga Light Source in Tosu, Japan. This symposium is the third *international* scientific meeting concerning the SR related scientific area.

Recent developments of SR and X-ray free electron laser facilities produce 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. Thus, combined and integrated works of solid-state physics and computer science are essential for the data analysis 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 very promising tools for handling the data.

For this symposium, we invited five distinguished researchers who are investigating such data analyses and data-driven science. Some other young scientists also present their own works concerning the data analysis and data-driven science.

**Program**

Chair: S. Hosokawa

10:20-10:30

Opening address

10:30-11:10

Prof. Laszlo Pusztai, Invited (Hungarian Academy of Sciences)

11:10-11:50

Dr. Shinji Kohara, Invited (NIMS/SPring-8)

11:50-12:10

Dr. Jens Rüdiger Stelhorn (Department of Physics, Kumamoto University)

(Lunch and Poster session)

Chair: F. Shimojo

14:00-14:40

Prof. Koji Hukushima, Invited (The University of Tokyo)

14:10-14:50

Prof. Ichiro Akai, Invited (Institute of Pulsed Power Science, Kumamoto University)

14:50-15:10

Dr. Kazunori Iwamitsu (Department of Physics, Kumamoto University)

(Break)

Chair: I. Akai

15:30-16:10

Dr. Tomohiro Matsushita (JASRI/SPring-8) Invited

16:10-16:30

Dr. Tomotaka Nakatani (RIKEN/SPring-8)

16:30-16:50

Dr. Yoichi Nakajima (Department of Physics, Kumamoto University)

16:50-17:00

Closing remarks



**Participants: Poster presentations**

Mr. Takuya Hiraoka (Department of Physics, Kumamoto University)

Mr. Shingo Aihara (Department of Physics, Kumamoto University)

Mr. Yuki Ideguchi (Department of Physics, Kumamoto University)

And some others.

**Organizers**

S. Hosokawa, I. Akai, F. Shimojo, A. Yoshiasa

Kumamoto University

**Correspondence**

Shinya Hosokawa, [hosokawa@sci.kumamoto-u.ac.jp](mailto:hosokawa@sci.kumamoto-u.ac.jp), Tel: 096-342-3353

## IROAST Seminar Report 2

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Jun Otani                                  |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 2nd IROAST Seminar—7th IWX: Challenge of Medicine-Engineering Collaboration                   |  |       |           |
| Venue                                | 100 <sup>th</sup> Anniversary Hall, Faculty of Engineering  |  |       |           |
| Time & Date                          | 13:00-17:50, December 1, 2016<br>9:00-14:40, December 2, 2016                                     |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Patrice Delmas, Professor, The University of Auckland, New Zealand<br>(IROAST Visiting Professor) |  |       |           |

### 7th IWX PROGRAM

Date: December 1st – December 2nd, 2016

Place: 100 Years Anniversary Memorial Hall, Kumamoto University

#### Challenge of Medicine-Engineering Collaboration



| DAY 1 (Dec. 1st)                  | time        | Presenters  |
|-----------------------------------|-------------|---|
| Opening Address                   | 13:00-13:10 | Prof. Shinji Harada, President of Kumamoto University, Japan  |
| Introduction                      | 13:10-13:20 | Prof. Yuzo Obara, Vice Chair of 7th IWX, Kumamoto University, Japan   |
| <b>Bio-Engineering</b>            |             |   |
|                                   | 13:30-14:20 | Prof. Pilhan Kim, KAIST, Korea<br>"Real-time intravital microscopy for in vivo cellular visualization: seeing is believing"                         |
|                                   | 14:20-15:10 | Dr. James Pearson, National Cerebral and Cardiovascular Center, Japan<br>"Insights into vascular dysfunction mechanisms in small animals"           |
|                                   | 15:10-16:00 | Prof. Hitoshi Takizawa, IRCMS, Kumamoto University, Japan<br>"Bone forming stem cell"   |
| break                             | 16:00-16:10 |   |
| <b>Imaging and quantification</b> |             |   |
|                                   | 16:10-17:00 | Prof. Patrice Delmas, The University of Auckland, New Zealand<br>"Image processing in the context of CT-scan data"                                  |
|                                   | 17:00-17:50 | Prof. Yosuke Higo, Kyoto University, Japan<br>"Imaging and quantifying microstructures of partially saturated sands"                                |
| Welcome Party                     | 18:00-20:00 | at FORICO   |
| DAY 2 (Dec. 2nd)                  | time        | Presenters  |
| <b>Activities by our group</b>    |             |   |
|                                   | 9:00-9:40   | Prof. Yoshitaka Nakanishi, Kumamoto University, Japan<br>"Biomechanics of bone"   |
|                                   | 9:40-10:20  | Dr. Naoki Ikegami, Mifune Dinosaur Museum, Kumamoto, Japan<br>"Application of microfocus X-ray CT and 3-D visualization in vertebrate paleontology" |
| break                             | 10:20-10:30 |   |
| <b>Engineering Applications</b>   |             |   |
|                                   | 10:30-11:20 | Prof. Tae Sup Yun, Yonsei University, Korea<br>"Quantification of heterogeneity and fluid flow in geomaterials"                                     |
|                                   | 11:20-12:00 | Dr. Shi Yi, University of Hong Kong, Hong Kong<br>"Image processing and microscopic measurements of calcareous particles under compression"         |
| Lunch                             | 12:00-13:00 |   |
| <b>Industry</b>                   |             |   |
|                                   | 13:00-13:40 | Mr. Atsushi Ishii, Hamamatsu Photonics K.K., Japan<br>"Microfocus X-ray source : the latest technology and future"                                  |
| <b>Activities by our group</b>    |             |   |
|                                   | 13:40-14:20 | Dr. Yuichiro Arima, Kumamoto University, Japan<br>"Quantitative assessment of the arterial remodeling using micro X-ray CT"                         |
| Final Report&Closing              | 14:20-14:40 | Prof. Jun Otani, Chair of 7th IWX, Kumamoto University, Japan<br>"Review of three years activities in X-Earth Center"                               |

### IROAST Seminar Report 3

|                                      |  |                |       |                     |
|--------------------------------------|--|----------------|-------|---------------------|
| Organizer                            | Name   | Takashi Ishida |       |                     |
|                                      | Affiliation  | IROAST         | Title | Assistant Professor |
| Seminar Title                        | The 3rd IROAST Seminar－局在化した受容体シグナル経路を介したカスパーリー線形成機構                 |                |       |                     |
| Venue                                | C227, Faculty of Science Bldg. 1,2                                   |                |       |                     |
| Time & Date                          | 15:00- , December 5, 2016  |                |       |                     |
| Speaker's Name/<br>Title/Affiliation | Dr. Satoshi Fujita, doctoral research fellow, University of Lausanne |                |       |                     |

### IROAST Seminar Report 4


|                                      |  |                |       |                     |
|--------------------------------------|--|----------------|-------|---------------------|
| Organizer                            | Name   | Takashi Ishida |       |                     |
|                                      | Affiliation  | IROAST         | Title | Assistant Professor |
| Seminar Title                        | The 4th IROAST Seminar－植物表層微少管のマイナス端制御機構   |                |       |                     |
| Venue                                | C227, Faculty of Science Bldg. 1,2   |                |       |                     |
| Time & Date                          | 15:00-, December 12, 2016  |                |       |                     |
| Speaker's Name/<br>Title/Affiliation | Dr. Masayoshi Nakamura, doctoral research fellow, Carnegie Institution for Science |                |       |                     |

### IROAST Seminar Report 5

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Tokio Tani                                 |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 5th IROAST Seminar—Noncoding genome and germline small RNAs in suppression of transposable elements                             |  |       |           |
| Venue                                | School of Science   |  |       |           |
| Date                                 | December 20, 2016   |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Ramesh Shanmughom Pillai, Professor, Department of Molecular Biology, University of Geneva, Switzerland (IROAST Visiting Professor) |  |       |           |



### IROAST Seminar Report 6

|  |   |                                     |       |                   |
|--|---|-------------------------------------|-------|-------------------|
| Organizer  | Name  | Toshiyuki Tosha                     |       |                   |
|  | Affiliation   | IROAST                              | Title | Project Professor |
| Seminar Title  | The 6th IROAST Seminar — Indonesia’s Geothermal Energy: Barrier and proposed solutions for geothermal development   |                                     |       |                   |
| Venue  | #204, IROAST Bldg.  |                                     |       |                   |
| Time & Date  | February 1, 2017  |                                     |       |                   |
| Speaker’s Name/<br>Title/Affiliation   | Tony Rahadinata, PhD, Geophysicist, Geothermal Division, Center for Mineral Coal and Geothermal Resource, Indonesia |                                     |       |                   |
| Number of<br>Participants  | From KU   | Faculty:<br>(Int'l participants: )  | Total | 7                 |
|  |   | Students:<br>(Int'l participants: ) |       |                   |
|  | From outside KU   | Faculty:<br>(Int'l participants: )  |       |                   |
|  |   | Students:<br>(Int'l participants: ) |       |                   |
|  |   |                                     |       |                   |

### IROAST Seminar Report 7

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Takuro Niidome                             |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 7th IROAST Seminar — Kumamoto Symposium on Therapeutic/Diagnosis Techniques and Medical Devices   |  |       |           |
| Venue                                | Miyamoto Memorial Hall, School of Pharmacy  |  |       |           |
| Time & Date                          | 9:00-11:55, March 15, 2017  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Ick Chan Kwon, Professor, Korea Institute of Science and Technology, Korea (IROAST Visiting Professor)<br>Aeju Lee, Associate Professor, IROAST<br>and others |  |       |           |





# Kumamoto Symposium on Therapeutic/Diagnosis Techniques and Medical Devices

Organized by IROAST

Co-organized by GSST Research Core and Group for Research B, Magnesium Research Center

March 15th, 2017

Miyamoto Memorial Hall (School of Pharmacy)



9:00-9:05

Opening remarks (Prof. Takashi Hiyama, Director of IROAST)

9:05-9:20 (Chair, Takuro Niidome)

Prof. Yuichiro Arima (Department of Cardiovascular Medicine, Kumamoto University)

Recent Advance in the Bioresorbable Vascular Scaffolds

9:20-9:35 (Chair, Aeju Lee)

Prof. Takuro Niidome (Department of Applied Science and Technology, Kumamoto University)

Drug Delivery System Controlled by Near Infrared Light

9:35-9:50 (Chair, Takuro Niidome)

Prof. Hidetoshi Arima (School of Pharmacy: Drug delivery system)

Potential Use of Cyclodextrins as Drug Carriers and Active Pharmaceutical Ingredients

Break

9:50-10:10

10:10-10:40 (Chair, Takuro Niidome)

Prof. Aeju Lee (International Research Organization for Advanced Science & Technology)

Protease Activatable Imaging Sensor and Theranostic Polymeric Nanoparticles

10:40-10:55 (Chair, Aeju Lee)

Prof. Yoshihiro Komohara (Department of Cell Pathology, Kumamoto University)

Multiple Functions of Macrophages in Human Diseases

10:55-11:55 Invited speakers (Chair, Takuro Niidome)

Prof. Ick Chan Kwon (Korean Institute of Science and Technology)

Theragnosis as a New Paradigm of Personalized Medicine



### IROAST Seminar Report 8

|                                      |  |  |       |           |
|--------------------------------------|--|--|-------|-----------|
| Organizer                            | Name   | Shinya Hayami                              |       |           |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 8th IROAST Seminar — Synthesis and characterization of ordered mesoporous materials for clean energy technologies  |  |       |           |
| Venue                                | School of Science  |  |       |           |
| Time & Date                          | Mar 21, 2017   |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Jorge Norberto Beltramini<br>Associate Professor/Senior Research Fellow, Nanomaterials Centre (NANOMAC); Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Australia, AND<br>Adjunct Professor, Department of Chemistry, Physics and Engineering, Queensland University of Technology, Australia<br>(IROAST Visiting Professor) |  |       |           |

Co-organized by the University's "Group for Research B" projects conducting the "Center of Mesoscopic Science" research.



## IROAST Seminar Report 9

|                                      |  |  |       |           |
|--------------------------------------|--|--|-------|-----------|
| Organizer                            | Name   | Shinya Hosokawa                            |       |           |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 9th IROAST Seminar—the 4th ISKSR   |  |       |           |
| Venue                                | D201, Faculty of Science Building 3  |  |       |           |
| Time & Date                          | 13:00-17:50, May 15, 2017  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | László Pusztai, Distinguished Professor/Scientific Advisor, IROAST/<br>Hungarian Academy of Science<br>Ichiro Akai, Professor, Institute of Pulsed Power Science<br>Shinya Hosokawa, Professor, Faculty of Advanced Science and Technology (FAST)<br>Jens R. Stellhorn, JSPS Fellow, Department of Physics, FAST |  |       |           |
| Number of<br>Participants            | From KU  | Faculty: 3<br>(Int'l participants: 2)      | Total | 44        |
|                                      |  | Students: 40<br>(Int'l participants: 2)    |       |           |
|                                      | From outside KU  | Faculty: 0<br>(Int'l participants: 0)      |       |           |
|                                      |  | Students: 1<br>(Int'l participants: 1)     |       |           |

Recent developments of synchrotrons radiation (SR) and X-ray free electron laser facilities produce 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. Thus, combined and integrated works of solid-state physics and computer science are essential for the data analysis using, e.g., Inverse problem, Bayesian inference with Metropolis' algorithm (reverse Monte Carlo (RMC) modeling) and some others. Furthermore, the data-driven science such as sparse modeling is a very promising tool for handling the data.

For this symposium, we invited four distinguished researchers who are investigating such data analyses and data-driven science.

Prof. L. Pusztai (IROAST Distinguished Professor; Hungarian Academy of Sciences)  
*“Determining the structure of hydrogenous materials by polarized neutron diffraction”*

He showed the difficulties in determining the structures of molecular liquids, in particular, those containing hydrogen atoms, and introduced a RMC method combining molecular dynamics simulation to solve such difficulties.

Dr. Jens Rüdiger Stellhorn (Department of Physics, Kumamoto University, JSPS fellow)  
*“A combination of anomalous x-ray scattering and x-ray absorption fine structure experiments with reverse Monte Carlo modeling for the characterization of amorphous GeCuTe”*

He presented the use of a RMC model based on the structural data of anomalous x-ray scattering and x-ray absorption fine structure (XAFS) data on a new and exotic phase change material for computational memories.

Prof. Ichiro Akai (Institute of Pulsed Power Science, Kumamoto University)

*“Sparse modeling of extended x-ray absorption fine structures”*

He introduced a basic feature of sparse modeling, and then, presented his recent work to apply it to XAFS data.

Prof. Shinya Hosokawa (Department of Physics, Kumamoto University)

*“Analysis of x-ray fluorescence holography data using sparse modeling on Mn-doped  $\text{Bi}_2\text{Te}_3$  topological insulator”*

He presented an application of sparse modeling for determining the impurity site in a transition metal-doped topological insulator.

Four young scientists also present their own works concerning cooperation of experiments and computer sciences. Totally, more than 40 participants enjoyed the invited and contributed talks. See Fig. 1 for the photographs of poster and the speakers. We would like to continue this series of seminar soon to effectively improve our scientific level for materials science using SR experiments and computer science.

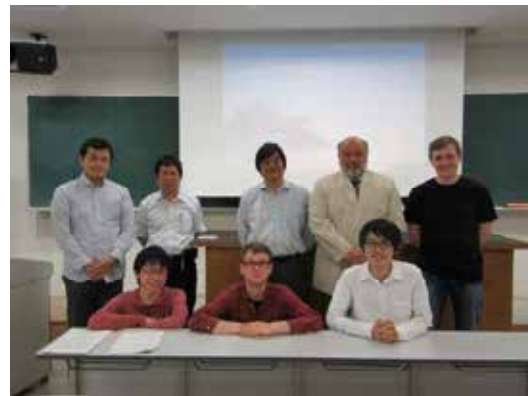
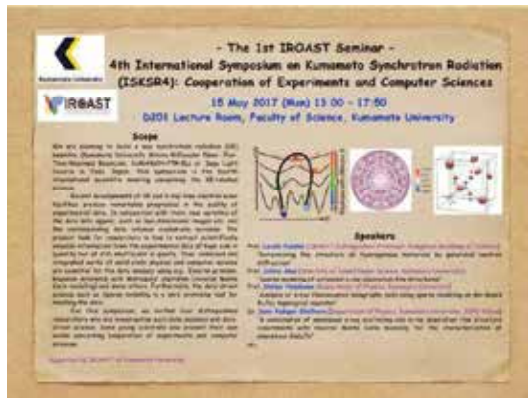


Fig. 1. The poster (left) and invited and contributed speakers (right) of the seminar.

### IROAST Seminar Report 10

|                                      |   |  |       |                     |
|--------------------------------------|---|--|-------|---------------------|
| Organizer                            | Name  | Toshifumi Mukunoki                         |       |                     |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Associate Professor |
| Seminar Title                        | The 10th IROAST Seminar—International Symposium on PROTINUS   |  |       |                     |
| Venue                                | #905, Faculty of Engineering Research Building 1  |  |       |                     |
| Time & Date                          | 9:30-16:30, July 7, 2017  |  |       |                     |
| Speaker's Name/<br>Title/Affiliation | Patrice Delmas, Associate Professor, University of Auckland, New Zealand (IROAST Visiting Professor)<br>Jun Otani, Professor, X-Earth Center, Kumamoto University, Japan<br>Celine Duwig, IRD, Grenoble University Alpes, France<br>Patricia Ortega, Laurent Oxarango LTHE, Grenoble University Alpes, France<br>Fabrice Golfier, GeoRessources, Université de Lorraine (UL), France<br>Anne-Julie Tinet, GeoRessources, Université de Lorraine (UL), France<br>Toshifumi Mukunoki, Ryo Takenaka and Erika Shiota, X-Earth Center, Kumamoto University, Japan |  |       |                     |
| Number of<br>Participants            | From KU   | Faculty: 2<br>(Int'l participants: 0)      | Total | 30                  |
|                                      |   | Students: 23<br>(Int'l participants: 1)    |       |                     |
|                                      | From outside KU   | Faculty: 5<br>(Int'l participants: 5)      |       |                     |
|                                      |   | Students: 0<br>(Int'l participants: 0)     |       |                     |

1.Seminar Overview

International symposium of PROTINUS on IROAST at 7/7, 2017

Organizer Toshifumi Mukunoki and Jun Otani

International symposium of PROTINUS auspices by IROAST was held in Kumamoto University on July 7, 2017. Totally, 30 people joined (see Photo 1 and 2). Prof. Patrice Delmas attended and gave his lecture. Topic of this symposium was how to do upscale modeling from micro to macro in porous media. Seven speakers gave their presentations as follows:

*Analysis of the porous structure of an Andosol and the relationship on SPH simulated flow*  
Celine Duwig, IRD, Grenoble University Alpes, France

*Assessment of soil permeability based on X-ray CT imaging: Definition of a geometrical criterion*  
Patricia Ortega, Laurent Oxarango LTHE, Grenoble University Alpes, France

*Pore-scale modeling of biofilm growth in porous media*  
Fabrice Golfier, GeoRessources, Université de Lorraine (UL), France

*Comparison between 3D printing methods for granular medium reconstruction*  
Anne-Julie Tinet, GeoRessources, Université de Lorraine (UL), France

*Image analysis of LNAPL recovery in sand due to injecting air using X-ray CT*

Toshifumi Mukunoki, Ryo Takenaka and Erika Shiota, X-Earth Center, Kumamoto University, Japan

*Development of a new system of anchorages learned from plants roots structures using X-ray Computed Tomography*

Bertoni Serena, Jun Otani, X-Earth Center, Kumamoto University, Japan

*Kriging in the context of soil science*

Patrice Delmas, University of Auckland, New Zealand



Photo 1

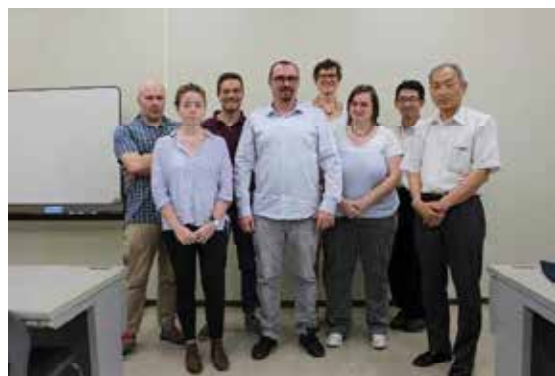


Photo 2

## 2. Future Prospects

PROTINUS is the selected project by HORIZON 2020. PROTINUS has made a great network between France, Italy, Japan and New Zealand. This fund will finish by the end of December, 2018. PROTINUS has produced many papers and research issues so it will be able to apply new fund based on our achievement in 4 years to develop new innovation for image analysis and clarify the constitutive law of micro-macro phenomena. Also, IROAST can invite them as adjunctive professor such as Prof. Delmas to develop more human resources in Kumamoto University.





## International Symposium on PROTINUS - The 10th IROAST Symposium -

Date: 7/7/2017

Place: Engineering Research Tower I 905

MC: Toshifumi Mukunoki

Registration: Free (Please contact Prof. Mukunoki: mukunoki@kumamoto-u.ac.jp)

|             |  |
|-------------|--|
| 9:30-9:40   | Welcome Speech by Jun Otani as a vice-leader of IROAST   |
| 9:40-9:50   | Introduction of IROAST by Jun Otani  |
| 9:50-10:00  | Introduction of PROTINUS by Celine Duwig as a project leader of PROTINUS   |
| 10:00-10:30 | <i>Analysis of the porous structure of an Andosol and the relationship on SPH simulated flow</i><br>Celine Duwig, IRD, Grenoble University Alpes, France   |
| 10:30-11:00 | <i>Assessment of soil permeability based on X-ray CT imaging: Definition of a geometrical criterion</i><br>Patricia Ortega, Laurent Oxarango LTHE, Grenoble University Alpes, France                               |
| 11:00-11:30 | <i>Pore-scale modeling of biofilm growth in porous media</i><br>Fabrice Golfier, GeoRessources, Université de Lorraine (UL), France  |
| 11:30-13:00 | Lunch break  |
| 13:00-13:30 | <i>Comparison between 3D printing methods for granular medium reconstruction</i><br>Anne-Julie Tinet, GeoRessources, Université de Lorraine (UL), France   |
| 13:30-14:30 | <i>Image analysis of LNAPL recovery in sand due to injecting water with different temperatures using X-ray CT</i><br>Toshifumi Mukunoki, Ryo Takenaka and Erika Shiota, X-Earth Center, Kumamoto University, Japan |
| 14:30-14:40 | Break  |
| 14:40-15:10 | TBD<br>Jun Otani, X-Earth Center, Kumamoto University, Japan   |
| 15:10-15:40 | TBD<br>Patrice Delmas, University of Auckland, New Zealand   |
| 15:40-16:30 | PROTINUS Meeting and Closing   |





### IROAST Seminar Report 11

|                                      |   |   |       |                     |
|--------------------------------------|---|---|-------|---------------------|
| Organizer                            | Name  | Takashi Ishida                          |       |                     |
|                                      | Affiliation   | IROAST                                  | Title | Assistant Professor |
| Seminar Title                        | The 11th IROAST Seminar–The spindle assembly checkpoint in plants                                       |   |       |                     |
| Venue                                | C122, Faculty of Science Building 2   |   |       |                     |
| Time & Date                          | 15:00-16:00, August 7, 2017   |   |       |                     |
| Speaker's Name/<br>Title/Affiliation | Shinichiro Komaki, Assistant Professor, Nara Institute of Science and Technology of Biological Sciences |   |       |                     |
| Number of<br>Participants            | From KU   | Faculty: 4<br>(Int'l participants: 0)   | Total | 60                  |
|                                      |   | Students: 55<br>(Int'l participants: 0) |       |                     |
|                                      | From outside KU   | Faculty: 1<br>(Int'l participants: 0)   |       |                     |
|                                      |   | Students: 0<br>(Int'l participants: 0)  |       |                     |

Dr. Komaki gave a talk about the spindle assembly checkpoint in plants. Cell cycle checkpoints were known to be fundamental molecular mechanism in establishing eukaryotic cells and historical studies with yeast and animal cells have identified many proteins that are involved in the check points, however, the spindle assembly checkpoint in plants were yet to be elucidated. He discussed characteristic behavior of spindle assembly checkpoint in plant cells and his view on following researches for the check point machineries. After his presentation, more than 10 questions on the plant cell cycle and/or the checkpoint proteins were raised and discussed that in detail.

Dr. Komaki also discussed about technical issues on recent advances in bioimaging for plant cell, and introduce equipment used in his ex-lab in Germany.

This IROAST seminar was held as joint seminar with “project seminar”, an open seminar in the department of biology, Faculty of Science. 55 students of the department have attended this seminar.



## IROAST Seminar Report 12

|                                      |   |   |       |                     |
|--------------------------------------|---|---|-------|---------------------|
| Organizer                            | Name  | Shinji Ando                             |       |                     |
|                                      | Affiliation   | Magnesium Research Center               | Title | Associate Professor |
| Seminar Title                        | The 12th IROAST Seminar — Magnesium Alloys Designed as Degradable Metallic Biomaterials |   |       |                     |
| Venue                                | Multipurpose Hall, 2F, Magnesium Research Center  |   |       |                     |
| Time & Date                          | 14:30-16:00, October 12, 2017   |   |       |                     |
| Speaker's Name/<br>Title/Affiliation | Yufeng Zheng, Distinguished Professor, IROAST/<br>Professor, Peking University, China   |   |       |                     |
| Number of<br>Participants            | From KU   | Faculty: 16<br>(Int'l participants: 6)  | Total | 35                  |
|                                      |   | Students: 19<br>(Int'l participants: 0) |       |                     |
|                                      | From outside KU   | Faculty: 0<br>(Int'l participants: 0)   |       |                     |
|                                      |   | Students: 0<br>(Int'l participants: 0)  |       |                     |

### 1. Seminar Overview

This seminar aimed to present the most important aspects of biodegradable magnesium alloys, including the design of new alloy systems (Mg-Ca, Mg-Zn, Mg-Sr, Mg-Si, Mg-Li, Mg-RE, etc) from the viewpoint of materials science, how to control the biodegradation rate to match with the healing rate of the recovering tissues, with various surface modification techniques (mechanical, physical and chemical treatments) and novel structure (porous, composite, nanocrystalline and glassy structures), biocompatibility evaluation at toxicology, cell and molecular biology, animal testing and clinical trial levels. The update research findings of world-wide experimental studies, biodegradable Mg alloys/aqueous solution interface theoretical model and potential application prototypes such as cardiology and orthopedic surgery products, had also been presented. Finally, the speaker comprehensively discussed the directions of future development and the challenges of transitioning biomedical Mg alloys from raw materials to semi-products, to final medical devices.



### 2. Future Prospects

For the Mg alloys for biomedical application, fast degradation rates and hydrogen evolution for Mg alloys are obstacles to overcome before they become widespread for the clinical use. Single crystal Mg with specific crystallographic orientations is confirmed to exhibit high corrosion

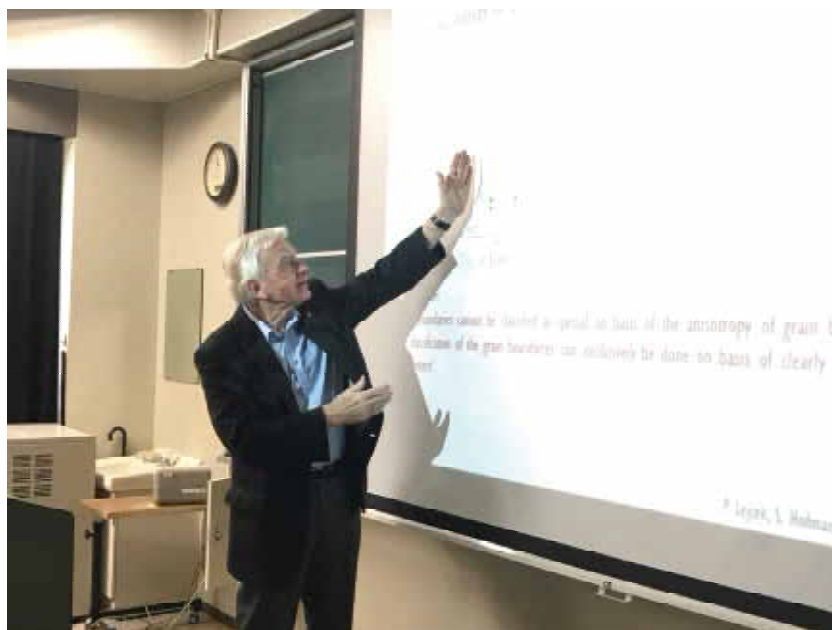
resistance. Mg–Zn–Ca glasses had been reported without clinically observable hydrogen evolution. Moreover, additive manufacturing (AM) technology, usually referred to 3D printing, has been gaining great attention for fabricating directly Mg alloy biomedical devices that have similar structures or properties to those of natural body tissues.

### 3. Others

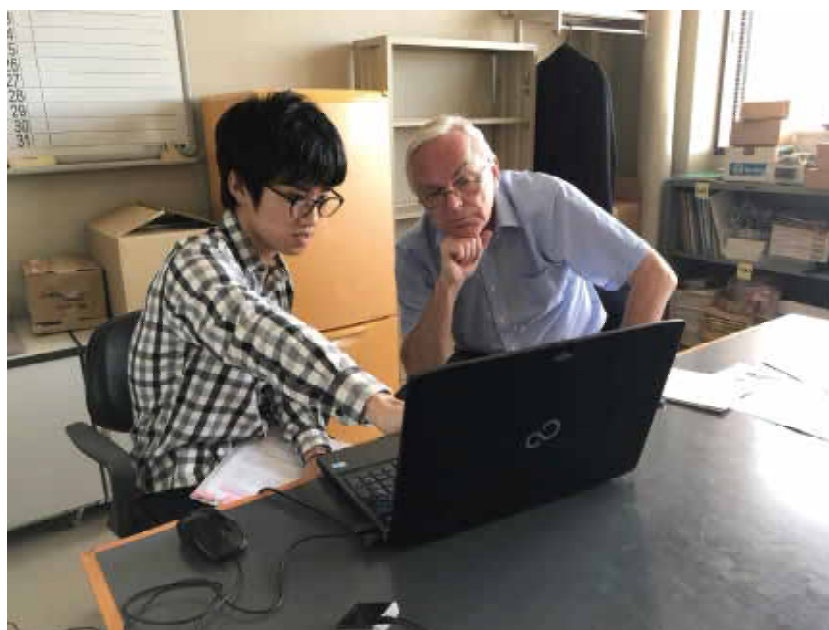
There are quite strong research teams at Kumamoto University working on magnesium alloy for industrial and biomedical applications. This topic was welcomed by the faculty members and graduate students. During this seminar, many interesting and useful comments and discussion were raised from the audience, including how to control the degradation rate with surface modification technique, and the future research direction in this field, etc.

### IROAST Seminar Report 13

|  |   |  |       |           |
|--|---|--|-------|-----------|
| Organizer  | Name  | Sadahiro Tsurekawa                         |       |           |
|  | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title  | The 13 <sup>th</sup> IROAST Seminar– Solute segregation at grain boundaries and their embrittlement; Czech footprint  |  |       |           |
| Venue  | #308, Faculty of Engineering Research Building I  |  |       |           |
| Time & Date  | 10:20-11:50, October 17, 2017   |  |       |           |
| Speaker's Name/<br>Title/Affiliation   | Pavel Lejček, Professor, Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic, AND<br>University of Chemistry and Technology, Prague, Czech Republic |  |       |           |
| Number of<br>Participants  | From KU   | Faculty: 2<br>(Int'l participants: 0)      | Total | 70        |
|  |   | Students: 67<br>(Int'l participants: 2)    |       |           |
|  | From outside KU   | Faculty: 1<br>(Int'l participants: 1)      |       |           |
|  |   | Students: 0<br>(Int'l participants: 0)     |       |           |
| <p>Prof. P. Lejček delivered a special lecture on “<i>Solute segregation at grain boundaries and their embrittlement; Czech footprint</i>” on October 17, 2017. More than 50 audiences including academic staffs and graduate students in Kumamoto University attended his lecture (<i>see photo 1</i>). The abstract of his lecture is as follows:</p> <p>One of the most dangerous technical failures of materials is intergranular brittle fracture (temper embrittlement) as it proceeds very quickly and its appearance is often hardly predictable. It is known that this phenomenon is closely related to the chemistry (solute segregation) of grain boundaries and free surfaces. To elucidate the effect of individual solutes on embrittlement of various materials such as steels and nickel-base superalloys, grain boundary and surface segregations were extensively studied in many laboratories throughout the world: an indisputable contribution to this database was also provided by the groups from the Czech Republic (Prague and Brno). In this lecture we summarize the fundamentals of the grain boundary segregation and changes of the cohesion caused by this phenomenon and document them for examples of our effort. Individual points to be presented and discussed are (1) Anisotropy of grain boundary segregation and classification of high angle grain boundaries; (2) Grain boundary segregation diagram; (3) Enthalpy/entropy compensation effect; (4) Prediction of grain boundary segregation; and (5) Segregation volume. Finally, we will also discuss (6) Comparison of calculated data and experimental results on grain boundary segregation and embrittlement and discuss the differences between them.</p> |   |  |       |           |



*Photo 1*



*Photo 2*



### IROAST Seminar Report 14

|                                      |  |  |       |                     |
|--------------------------------------|--|--|-------|---------------------|
| Organizer 1                          | Name   | Atsushi Sainoki                            |       |                     |
|                                      | Affiliation  | IROAST                                     | Title | Associate Professor |
| Organizer 2                          | Name   | Yuzo Obara                                 |       |                     |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor           |
| Seminar Title                        | The 14th IROAST Seminar–Use of Renewable Energy Sources for Mine Energy System                     |  |       |                     |
| Venue                                | #905, Faculty of Engineering Research Building 1   |  |       |                     |
| Time & Date                          | 12:50-14:20, October 18, 2017  |  |       |                     |
| Speaker's Name/<br>Title/Affiliation | Agus Pulung Sasmito, Assistant Professor, Mining & Materials Department, McGill University, Canada |  |       |                     |
| Number of<br>Participants            | From KU  | Faculty: 4<br>(Int'l participants: 0)      | Total | 50                  |
|                                      |  | Students: 45<br>(Int'l participants: 11)   |       |                     |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 1)      |       |                     |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |                     |

#### 1. Seminar Overview

Canada is actively undertaking the development of underground mines. Compared to open-pit mines, underground mining operation requires much more energy mainly because it needs to control the underground temperature, i.e. high cooling load in summer and heating requirement in winter for maintaining underground working environment. Professor Sasmito has been intensively conducting research on the efficient use of energy for deep subterranean mine development. In this seminar, he introduced his research on especially how to boost energy efficiency through the use of renewable energy. He showed the result, regarding an underground uranium mine being excavated with a ground freezing method, that controlling the timing of freezing sufficiently improved the energy efficiency. He also introduced his research on the use of underground warm rocks for heating the intake air in the underground mine. In addition to the great accomplishments, an innovative result on large scale rock-pit seasonal thermal energy storage was shown, suggesting the possibility of heating and cooling the intake air efficiently by utilizing a rock-pit as seasonal energy storage, if there is an abandoned open-pit mine located on the top of the underground mine.



Prof. Sasmito



Seminar

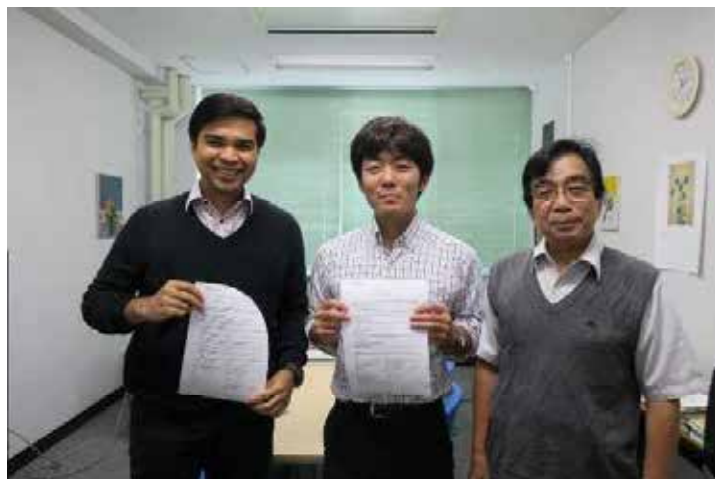


After the seminar



## 2. Future Prospects

After the seminar, on October 20, Professor Sasmito's and my research groups concluded an MOU. Professor Sasmito is conducting his research mainly through experiments and simulations on heat transfer in the rock and soil, but he has not done much research yet about how the heat transfer has physical impact on the rock. Prof. Sasmito and I agreed on our collaboration regarding the subject. I am planning to hold a symposium focusing on the renewable energy (mainly geothermal heat) and hoping that Prof. Sasmito will be able to attend the symposium as a speaker again.



(From left) Prof. Sasmito, Prof. Sainoki, IROAST Director Hiyama

## 3. Others

On October 19, I took Professor Sasmito and a senior student on a field trip to the Hacchobaru Power Plant. Unfortunately we were not allowed to enter the plant due to the periodic inspection, but they let us watch a video and talked to us details about the plant. Prof. Sasmito was greatly interested in their talk.

# The 14th IROAST SEMINAR

## Use of Renewable Energy Sources for Mine Energy System

### Details:

Artificial ground freezing / Ventilation heating and cooling / Slurry transport

Speaker



Dr. Agus Sasmito

assistant professor,

Department of Mining and Materials Engineering, McGill University, Canada

Free Admission

Date

2017.10/18

Wed

12:50~14:20

Venue

Kumamoto University Kurokami South Campus  
Kurokami South C3( Faculty of Engineering Research Building 1)  
Room 905

<http://ewww.kumamoto-u.ac.jp/en/about/access/campus/> C3 building

Organizer

Atsushi SAINOKI , associate professor, IROAST  
[atsushi\\_sainoki@kumamoto-u.ac.jp](mailto:atsushi_sainoki@kumamoto-u.ac.jp)



**IROAST**  
International Research Organization  
for Advanced Science & Technology

Contact for IROAST seminar:

Email: [szk-kiko@jimu.kumamoto-u.ac.jp](mailto:szk-kiko@jimu.kumamoto-u.ac.jp)

### IROAST Seminar Report 15

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Hirotaka Ihara                             |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 15th IROAST Seminar—Annual meeting 2017 of the LIA-CNPA in Kumamoto, jointed with the IROAST and the JST-ANR projects   |  |       |           |
| Venue                                | International Seminar Room, 2F, Faculty of Engineering Research Building II-2 (Department of Applied chemistry and Biochemistry)  |  |       |           |
| Time & Date                          | 9:00-10:30, October 24, 2017  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Directed by Reiko Oda, Research Director, CBMN UMR5248, CNRS, Université de Bordeaux, France (IROAST Visiting Professor)<br>Dario Bassani, Research Director, CNRS, Université de Bordeaux, France<br>Birgit Habenstein, Associate Scientist, CNRS, Université de Bordeaux, France<br>Brice Kauffmann, Engineering Researcher, CNRS, Université de Bordeaux, France<br>Antonie Loquet, Group leader, CNRS, Université de Bordeaux, France, France |  |       |           |
| Number of<br>Participants            | From KU   | Faculty: 11<br>(Int'l participants: 3)     | Total | 17        |
|                                      |   | Students: 2<br>(Int'l participants: 2)     |       |           |
|                                      | From outside KU   | Faculty: 4<br>(Int'l participants: 4)      |       |           |
|                                      |   | Students: 0<br>(Int'l participants: 0)     |       |           |

Dr. Reiko Oda, who is a Visiting Professor of IROAST, and 4 researchers of CNRS (University of Bordeaux), France, have visited Prof. H. Ihara's group on Oct. 23-25 based on the France-Japan Laboratoire International Associé on "Chiral Nanostructures for Photonic Applications" (LIA-CNPA) between University of Bordeaux and Kumamoto University. In this term, the 15th IROAST Seminar on Oct. 24th was organized by Dr. R. Oda of CNRS and by Prof. H. Ihara. There were four lectures from Dr. Dario Bassani, Dr. Birgit Habenstein, Dr. Brice Kauffmann and Dr. Antonie Loquet. After the seminar, the French visitors joined four research groups in the Department of Applied Chemistry and Biochemistry to begin their future international collaboration.



## IROAST Seminar Report 16

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Shinya Hosokawa                            |       |           |
|                                      | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 16th IROAST Seminar — 5th International Symposium on Kumamoto Synchrotron Radiation   |  |       |           |
| Venue                                | Main Hall, 100th Anniversary Memorial Hall, Faculty of Engineering  |  |       |           |
| Time & Date                          | 13:00-15:15, November 1, 2017<br>13:00-15:15, November 2, 2017  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | László Pusztai, Distinguished Professor, IROAST/ Scientific Advisor, Hungarian Academy of Science, Hungary<br>Aravind Krishnamoorthy, Researcher, University of Southern California, USA and others |  |       |           |
| Number of<br>Participants            | From KU   | Faculty: 8<br>(Int'l participants: 3)      | Total | 55        |
|                                      |   | Students: 40<br>(Int'l participants: 0)    |       |           |
|                                      | From outside KU   | Faculty: 7<br>(Int'l participants: 3)      |       |           |
|                                      |   | Students: 0<br>(Int'l participants: 0)     |       |           |

### 1. Seminar Overview

Recent developments of SR and X-ray free electron laser facilities produce 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. Thus, combined and integrated works of solid-state physics and computer science are essential for the data analysis 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 or to confirm the experimental results, first principles computer simulations are also indispensable.



Fig. 1: Group photograph of the ISKSR5 symposium

In this symposium, we invited 11 distinguished researchers who are investigating such data analyses, data-driven sciences, and computer simulations. Some young scientists in Kumamoto University also present their own works concerning cooperation of experiments and computer sciences. See the group photograph in Figure 1.

The role of Dr. Krishnamoorthy's presentation in this symposium is to review his recent works of *ab initio* molecular dynamics simulations on the phase transition in optically excited low-



dimensional materials. See his photograph in Figure 2. His theoretical work is based on the original *ab initio* molecular dynamics algorithm, and applied to the recent topic of structural phase change in two-dimensional layers. His works open a window of the field of phase transitions in materials science using an outstanding technique of *ab initio* molecular dynamics simulation.



Fig. 2: Photograph of Dr. Krishnamoorthy

The IROAST distinguished professor, Laszlo Pusztai, also made an invited talk to discuss a detailed current problems of the data analysis on atomic structure of non-crystalline materials.

The new concept of this symposium is that we prepare Special Issue of this symposium in *Physica Status Solidi (b)* published by Wiley in Germany. This is not the journal for very short proceedings papers, but for regular articles. For the Special Issue, the invited speakers are recommended to write their original or review papers with about 12 pages, and the contributed speakers and poster presenters their original ones with about 6 pages. Our policy for the investigations is that the scientists should record their results in writing, and otherwise, the studies are only for self-satisfactions.

## 2. Future Prospects

At present, Dr. Krishnamoorthy belongs to the University of Southern California at Los Angeles in US, and collaborates with one of the symposium organizers, Prof. F. Shimojo of Kumamoto University. They have a number of coauthored papers, and will further make intimate collaborations with him and his supervisor, Prof. P. Vashishta. Some of Prof. Shimojo's students have regularly visited the University of Southern California for more than half year, and such a strong relation will surely continue for a long time.

For other participants of this symposium, it is needless to say that the cooperation between the theoretical and experimental studies are very important for the understandings of natures of materials. In particular, the theory can easily investigate the physical properties of materials under extreme conditions such as high pressure, high temperature, high magnetic field, and so on, and the combinations of the state-of-art synchrotron radiation facilities and x-ray free electron laser, and the developments of the excellent techniques for the extreme conditions enable experimentalists to cut into such difficult conditions. Thus, it is dispensable to make good collaborations of the theorists who know the experiments well and the experimentalists who can understand the theoretical efforts. For this, it is necessary to organize the international symposium with the similar aims to that in this symposium. We will continuously organize the symposium for the developments of the materials science fields.

## 3. Others

For organizing this symposium, we are grateful for the financial support by Kumamoto University and International Research Organization for Advanced Science and Technology, Kumamoto University.

**The 16th IROAST Seminar:  
5th International Symposium on Kumamoto Synchrotron Radiation  
(ISKSR5)  
Progress of Data Analysis, Data-Driven Science, and Theory for Science**



November 1(Wed.) 13:00 - November 2(Thur.) 15:15, 2017

**Invited Speakers**

**Tomohiro Matsushita,**  
JASRI/SPring-8

**Jens Rüdiger Stellhorn,**  
Department of Physics, Kumamoto University

**Satoshi Ohmura,**  
Hiroshima Institute of Technology

**Laszlo Pusztai,**  
IROAST, Kumamoto University and Hungarian Academy of Science

**Edgar Galicia-Andrés,**  
National Autonomous University of Mexico

**Markus Hermann,**  
Georg-August-Universität Göttingen

**Koji Hukushima,**  
The University of Tokyo

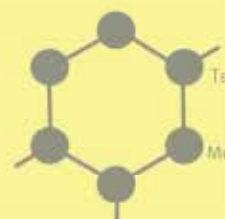
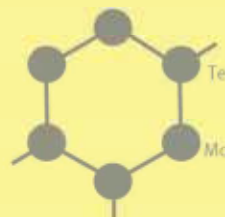
**Kazunori Iwamitsu,**  
Department of Physics, Kumamoto University

**Kenji Nagata,**  
AIST

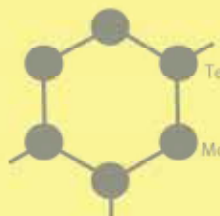
**Aravind Krishnamoorthy,**  
University of Southern California

**Masaaki Misawa,**  
Department of Physics, Kumamoto University

**Akira Yoshiasa,**  
Department of Earth Science, Kumamoto University



**Free Admission**



**The 16th IROAST Seminar contents inquiries**  
Graduate School of Science and Technology,  
Professor HOSOKAWA Shinya  
hosokawa@sci.kumamoto-u.ac.jp

**IROAST Seminar inquiries**  
Chen (ext.3362-3303)  
szk-kiko@jimu.kumamoto-u.ac.jp



## IROAST Seminar Report 17&18

|  |   |  |       |           |
|--|---|--|-------|-----------|
| Organizer                              | Name  | Hirotaka Ihara                             |       |           |
|  | Affiliation   | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                          | The 17th & 18th IROAST Seminars —History of Science & Medicine in Valencia  |  |       |           |
| Venue                                  | International Seminar Room, 2F, Faculty of Engineering Research Building II-2 (Department of Applied chemistry and Biochemistry)<br>Department Meeting Room, 2F, Faculty of Engineering Research Building II-2 (Department of Applied chemistry and Biochemistry) |  |       |           |
| Time & Date                            | 13:30-14:30, November 16, 2017<br>9:00-10:00, November 22, 2017   |  |       |           |
| Speaker's Name/<br>Title/Affiliation   | Josep-Lluís Barona-Vilar, Professor, Instituto de Historia de la Medicina y de la Ciencia López Piñero (IHMC), Universidad de Valencia, Spain   |  |       |           |
| Number of<br>Participants<br>(Nov. 16) | From KU   | Faculty: 3<br>(Int'l participants: 0)      | Total | 32        |
|  |   | Students: 13<br>(Int'l participants: 10)   |       |           |
|  | From outside KU   | Faculty: 6<br>(Int'l participants: 6)      |       |           |
|  |   | Students: 10<br>(Int'l participants: 10)   |       |           |
| Number of<br>Participants<br>(Nov. 22) | From KU   | Faculty: 3<br>(Int'l participants: 0)      | Total | 17        |
|  |   | Students: 13<br>(Int'l participants: 10)   |       |           |
|  | From outside KU   | Faculty: 1<br>(Int'l participants: 1)      |       |           |
|  |   | Students: 0<br>(Int'l participants: 0)     |       |           |

Prof. Josep Lluís Barona-Vilar, an IROAST visiting professor, from Instituto de Historia de la Medicina y de la Ciencia López Piñero (IHMC), Universidad de Valencia, Spain, gave a talk for the faculty members, the graduate and undergraduate students on November 16 and 22, 2017. The seminars were organized by the Prof. H. Ihara in the Department of Applied Chemistry and Biochemistry. In the seminars, Prof. Barona-Vilar talked about “History of Science & Medicine in Valencia” and the students listened to his talk attentively. The attendants of the seminar on 16 included young teachers, researchers and students from Bangladesh and Malaysia who came to Kumamoto in the Japan-Asia Youth Exchange Program in Science, “SAKURA Science.”

During his stay at Kumamoto University, we discussed with him for further enhancement of the academic exchange between Kumamoto University and Universidad de Valencia.

As a result, JSPS accepted our joint research proposal on “Development of photo-sensing polymer hybrid with nano-dispersed photo-functional molecular gels” for two years from September 2018.



Photographs at the seminars

## IROAST Seminar Report 19

|                                      |  |  |       |                     |
|--------------------------------------|--|--|-------|---------------------|
| Organizer                            | Name   | Makoto Kumon                               |       |                     |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Associate Professor |
| Seminar Title                        | The 19th IROAST Seminar—Road Condition Measurement and Suspension / Traction Control for Active Safety and Autonomous Driving  |  |       |                     |
| Venue                                | #309, Faculty of Engineering Research Building 1   |  |       |                     |
| Time & Date                          | 16:10-17:40, November 28, 2017   |  |       |                     |
| Speaker's Name/<br>Title/Affiliation | Tomonari Furukawa, Professor, Department of Mechanical Engineering<br>Virginia Polytechnic Institute and State University, USA |  |       |                     |
| Number of<br>Participants            | From KU  | Faculty: 9<br>(Int'l participants: 0)      | Total | 30                  |
|                                      |  | Students: 20<br>(Int'l participants: 0)    |       |                     |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 0)      |       |                     |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |                     |

### 1. Seminar Overview

The seminar entitled “Road Condition Measurement and Suspension/Traction Control for Active Safety and Autonomous Driving” was given by Prof. Furukawa on Nov. 28 at Kumamoto University, Rm 309, Bldg. I. The talk showed how the road state can be measured, and how the information is utilized for the next-gen driving system following the introduction of his other research activities and his University. The seminar attracted more than 30 participants including Professors, master course students, undergraduates and others.

### 2. Future Prospects

As an autonomous driving is the cutting-edge technology in Japan, the talk gave a good start point for the future collaboration. The sensing system in the real field seems to have various technological challenges, and it may attract researchers at Kumamoto University to join.



# The 19<sup>th</sup> IROAST Seminar

- Road Condition Measurement and Suspension/Traction Control  
for Active Safety and Autonomous Driving -

**Prof. Tomonari Furukawa**

Virginia Polytechnic Institute and State University, USA

**Time & Date:** 16:10 – 17:40, November 28, 2017

**Venue:** Room 309, Faculty of Engineering Bldg.1

**Organizer:** Prof. Makoto Kumon  
Faculty of Advance Science and Technology  
E-mail: [kumon@gpo.kumamoto-u.ac.jp](mailto:kumon@gpo.kumamoto-u.ac.jp)



## IROAST Seminar Report 20

|                                      |  |  |       |                     |
|--------------------------------------|--|--|-------|---------------------|
| Organizer                            | Name   | Yutaka Kuwahara                            |       |                     |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Assistant Professor |
| Seminar Title                        | The 20th IROAST Seminar—Hydrogen Production and Storage with Carbon Dioxide Hydrogenation with CO <sub>2</sub> Hydrogenation |  |       |                     |
| Venue                                | #203, Faculty of Engineering Research Building II  |  |       |                     |
| Time & Date                          | 10:30-11:50, December 5, 2017  |  |       |                     |
| Speaker's Name/<br>Title/Affiliation | Etsuko Fujita, Senior Chemist, Chemistry Division, Brookhaven National Laboratory, USA                                       |  |       |                     |
| Number of<br>Participants            | From KU  | Faculty: 7<br>(Int'l participants: 0)      | Total | 35                  |
|                                      |  | Students: 27<br>(Int'l participants: 0)    |       |                     |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 0)      |       |                     |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |                     |

The 20th IROAST Seminar was held at room 203 in bldg. W3 of Kurokami south campus on December 5th, 2017 by IROAST Visiting Professor Fujita Etsuko, a Senior Chemist of Brookhaven National Laboratory, USA. Based on collaboration in the Bilateral Joint Research Projects by JSPS from 2017, she was invited by Assistant Professor Yutaka Kuwahara of Prof. Ihara Group, Faculty of Advanced Science and Technology. Dr. Fujita gave a talk about “Hydrogen Production and Storage with CO<sub>2</sub> Hydrogenation,” which was organized by Dr. Kuwahara. About 35 students and faculty members attended the seminar. This inviting fee was supported by IROAST.

She will come to Kumamoto University again next year, 2018 as a Visiting Professor and a collaborator of the JSPS project.



Photograph at the seminar

# The 20<sup>th</sup> IROAST Seminar

Hydrogen Production and Storage  
with CO<sub>2</sub> Hydrogenation

**Dr. Etsuko Fujita**

Brookhaven National Laboratory, USA

**Time & Date:** 10:30 -, December 5, 2017

**Venue:** Room 203, Faculty of Engineering Bldg.2

**Contact:** Assistant Prof. Yutaka Kuwahara  
Faculty of Advance Science and Technology  
E-mail: [kuwahara@kumamoto-u.ac.jp](mailto:kuwahara@kumamoto-u.ac.jp)



## IROAST Seminar Report 21

|                                      |  |  |       |           |
|--------------------------------------|--|--|-------|-----------|
| Organizer                            | Name   | Shinya Hayami                              |       |           |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | The 21st IROAST Seminar—Tunable graphene oxide membranes   |  |       |           |
| Venue                                | C122, Faculty of Science Building 2  |  |       |           |
| Time & Date                          | 16:00-17:45, December 6, 2017  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Rahul Raveendran Nair, Professor, Materials Physics, National Graphene Institute and School of Chemical Engineering and Analytical Science, The University of Manchester, UK |  |       |           |
| Number of<br>Participants            | From KU  | Faculty: 19<br>(Int'l participants: 1)     | Total | 50        |
|                                      |  | Students: 30<br>(Int'l participants: 5)    |       |           |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 1)      |       |           |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |           |

Permeation through nanometre-pore materials has been attracting unwavering interest due to fundamental differences in governing mechanisms at macroscopic and molecular scales, the importance of water permeation in living systems, and relevance for filtration and separation techniques. Latest advances in the fabrication of artificial channels and membranes using two-dimensional (2D) materials have enabled the prospect of understanding the nanoscale and sub-nm scale permeation behaviour of water and ions extensively. In particular, GO membrane containing 2D graphene capillaries shows unique permeation properties such as ultrafast permeation of water and molecular sieving. In his talk, he discussed our recent results on molecular and ionic permeation properties of GO membranes and its prospect for several applications.

Prof. Rahul Nair research about GO and other 2D materials. Now we collaborate with him about GO pressure effect and GO ion permeation and will submit our paper asap. Furthermore, we discussed about international collaboration and research grant. 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 IROST for our research collaborations.





# The 21<sup>st</sup> IROAST Seminar

-Tunable graphene oxide membranes-

**Prof. Rahul R. Nair**

University of Manchester

**Time & Date:** 16:00 -, December 6, 2017

**Venue:** Room C122, Faculty of Science Building 2

**Organizer:** Prof. Shinya Hayami

Faculty of Advance Science and Technology

E-mail: hayami@kumamoto-u.ac.jp



## IROAST Seminar Report 22

|                                      |  |   |       |                     |
|--------------------------------------|--|---|-------|---------------------|
| Organizer                            | Name   | Aeju Lee                                |       |                     |
|                                      | Affiliation  | IROAST                                  | Title | Associate Professor |
| Seminar Title                        | The 22nd IROAST Seminar– Development of polymeric nano/micro-particles for cancer theranostics   |   |       |                     |
| Venue                                | #203, Kurokami South W3 Academic Commons Kurokami Bldg. 1  |   |       |                     |
| Time & Date                          | 15:00-16:00, December 21, 2017   |   |       |                     |
| Speaker's Name/<br>Title/Affiliation | Jaehong Key, Assistant Professor, Department of Biomedical Engineering, Yonsei University, Korea |   |       |                     |
| Number of<br>Participants            | From KU  | Faculty: 4<br>(Int'l participants: 2)   | Total | 39                  |
|                                      |  | Students: 34<br>(Int'l participants: 9) |       |                     |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 1)   |       |                     |
|                                      |  | Students: 0<br>(Int'l participants: 0)  |       |                     |

### 1. Seminar Overview

In the seminar, there were almost 40 attendants from the Engineering and Literature Departments. His talk was quite easy to understand even for those who don't have deep knowledge in our field. Dr. Key showed interesting results and three professors asked questions about his work.



## 2. Future Prospects

Dr. Key and I have had experience working together since we were Ms.c students. Since we studied in the same lab, our subjects were similar in imaging modality therapeutic reagent. His major is MRI and PET-CT imaging. So that, I can get help from him to learn synthesis method of MRI (SPION, Iron oxide) materials. We also submitted Korea-Japan collaboration grant in last August. We will be working on development of nano/micro particles for lung cancer diagnosis and therapy. To control drug release, we have plan to embedding my nanoparticles into Dr. Key's microparticles.


I'm sure that, our collaboration will be on going up to our retirement (We are currently under 40 years of age.) and synergistic in both Universities and countries.

## 3. Other

We went to typical Japanese restaurant with Prof. Takuro Niidome after the seminar. At that time, we discussed about our future collaboration with Yonsei University and MOU.



(Attended: From left side-Dr. Lee, Dr. Key, Visiting Researcher Lee, Ph.D. candidate Kaung, Prof. Niidome)



# The 22nd IROAST Seminar

## Development of polymeric nano/ micro-particles for cancer theranostics

Free Admission

Speaker



Jaehong Key, Ph.D.  
Assistant Professor  
Department of Biomedical Engineering, Yonsei University

Date

2017.12/21

Thu

15:00~16:00

Venue

Kumamoto University Kurokami South Campus  
W3 Kurokami South W3 Academic Commons Kurokami Bldg. 1  
(Center for Policy Study, Social Academic Collaboration Division,  
Research Promotion Division, Region Creation Promotion Office) 203 room  
<http://ewww.kumamoto-u.ac.jp/en/about/access/campus/>

Organizer

Aeju Lee, associate professor, IROAST  
[aeju-lee@kumamoto-u.ac.jp](mailto:aeju-lee@kumamoto-u.ac.jp)



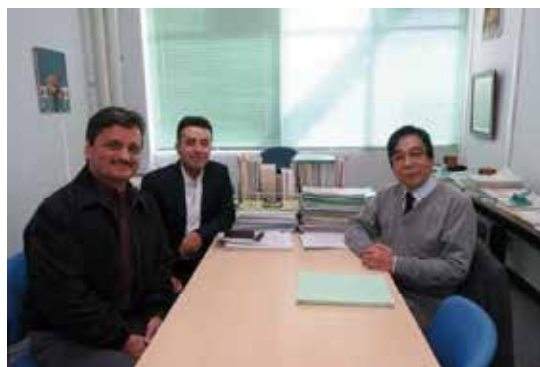
**IROAST**  
International Research Organization  
for Advanced Science & Technology

Contact for IROAST seminar:  
Email: [szk-kiko@jimu.kumamoto-u.ac.jp](mailto:szk-kiko@jimu.kumamoto-u.ac.jp)

### IROAST Seminar Report 23

|                                      |   |   |       |           |
|--------------------------------------|---|---|-------|-----------|
| Organizer                            | Name  | Hamid Hosano                            |       |           |
|                                      | Affiliation   | Institute of Pulsed Power Science       | Title | Professor |
| Seminar Title                        | The 23rd IROAST Seminar–IPPS Lecture & Seminar No.36  |   |       |           |
| Venue                                | #516, Academic Commons Kurokami Bldg. 3 (Center for Marine Environment Studies)   |   |       |           |
| Time & Date                          | 16:00-17:00, December 20, 2017  |   |       |           |
| Speaker's Name/<br>Title/Affiliation | Amir A. Farajian, Associate Professor, Department of Mechanical and Materials Engineering, Wright State University, USA |   |       |           |
| Number of<br>Participants            | From KU   | Faculty: 3<br>(Int'l participants: 2)   | Total | 16        |
|                                      |   | Students: 12<br>(Int'l participants: 0) |       |           |
|                                      | From outside KU   | Faculty: 1<br>(Int'l participants: 1)   |       |           |
|                                      |   | Students: 0<br>(Int'l participants: 0)  |       |           |

Prof. Farajian visited Kumamoto University during Dec. 16-27, 2017. The main purpose of his visit was to meet Prof. Hosano to discuss research collaboration. They discussed a few research subjects, and determined possible steps for collaboration. During his visit, Prof. Farajian also met with IROAST Director, Prof. Hiyama, and gave a presentation as “The 23rd IROAST Seminar—IPPS Lecture & Seminar No.36—held on December 20, 2017” (pictures below).







## **IPPS Lecture & Seminar No.36**

### **- The 23<sup>rd</sup> IROAST Seminar -**

**Title: Modelling electronic and thermal currents in nanosystems for sensor and energy applications**

**Lecturer:** Prof. Amir Farajian (Wright State University, USA  
IROAST Visiting Professor, Kumamoto Univ.)

**Date & Time:** Dec. 20, 2017 (Wed.) 16:00~17:00

**Venue:** Kurokami South C7

(Academic Commons Kurokami Bldg. 3 (Center for Marine environment studies)), 5<sup>th</sup> Floor, 516 (Seminar room)

<http://ewww.kumamoto-u.ac.jp/en/about/access/campus/>

**Abstract:** Current trends in development of sensors and energy applications demand novel systems capable of going beyond conventional solutions. In this regard, nanosystems possess unique potentials. In order to design efficient nanosystems for these applications, a basic understanding of electronic and thermal currents is essential. We present a summary of accurate simulation approaches that take into account the atomistic nature of nanosystems to understand their response under electric and thermal stimuli. Simulation results for some nanosystems are presented, and relevance to sensor and energy applications are discussed.

**Supported by Intentional Research Organization  
for Advanced Science and Technology (IROAST)**



## IROAST Seminar Report 24

|                                      |  |  |       |                     |
|--------------------------------------|--|--|-------|---------------------|
| Organizer                            | Name   | Kei Ishida                                 |       |                     |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Assistant Professor |
| Seminar Title                        | The 24th IROAST Seminar— Advanced Science and Technology in Hydrology  |  |       |                     |
| Venue                                | Studio, Temporary Engineering School Building F  |  |       |                     |
| Time & Date                          | 13:30-16:00, January 9, 2018<br>13:30-16:00, January 10, 2018  |  |       |                     |
| Speaker's Name/<br>Title/Affiliation | Van-Thanh-Van Nguyen, Department Chair Professor, McGill University, Canada<br>Ali Ercan, Research Professor, University of California, Davis, USA<br>Noriaki Ohara, Assistant Professor, University of Wyoming, USA |  |       |                     |
| Number of<br>Participants            | From KU  | Faculty: 4<br>(Int'l participants: 0)      | Total | 39                  |
|                                      |  | Students: 32<br>(Int'l participants: 10)   |       |                     |
|                                      | From outside KU  | Faculty: 3<br>(Int'l participants: 2)      |       |                     |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |                     |

### 1. Seminar Overview

The 24th IROAST Seminar was held on January 9 and 10, 2018. The seminar was organized by Assistant Professor Kei Ishida from the Faculty of Advanced Science and Technology. There were three talks given by invited speakers: “Linking Climate Change of Hydrological Impact and Adaptation Studies: Recent Advances in Modelling of Extreme Hydrologic Processes” by Professor Van-Thanh-Van Nguyen from McGill University, Canada; “Self-Similarity in Two- and Three-Dimensional Incompressible Navier-Stokes Equations” by Research Professor Ali Ercan from University of California, Davis, USA; and “Estimation of Riparian Groundwater in Alluvium Deposit of Mountainous Region from Topography using Biharmonic Function” by Assistant Professor Noriaki Ohara from the University of Wyoming, USA. About 35 faculty members and students attended the seminar.





## 2. Future Prospects

The attendees learned advanced sciences and technologies in hydrologic engineering at the seminar. They might also get some new inspirations from the talks by the three invited speakers. It will support to improve their studies.

During the seminar, and also after and before the seminar, furthermore, students had opportunities to have a talk and a discussion with the Professors. It would help the students to improve their English skills and their communication abilities with international academic people.

Another valuable thing is that we had discussions on collaborative studies with each of the invited speakers during, after and before the seminar. Those discussions will be a beginning of international collaborative studies.

## 3. Others

Thank you to the Professors for coming from abroad to Kumamoto, Japan. We sincerely appreciate their valuable, attractive, and wonderful talks. Similarly, thank you to the students and the faculty members for attending the seminar. Both made this seminar successful.

# The 24th IROAST SEMINAR

Free Admission

## Advanced Science and Technology in Hydrology

### Details:

Linking Climate Change to Hydrological Impact and Adaptation Studies /  
Estimation of Riparian Groundwater /  
Self-Similarity in Two- and Three-Dimensional Incompressible Navier-Stokes  
Equations



Van-Thanh-Van NGUYEN  
Department Chair  
Professor, McGill University,  
Canada



Noriaki OHARA  
Assistant Professor,  
University of Wyoming,  
USA



Ali ERCAN  
Research Professor  
University of California,  
Davis, USA

Date

2018

1/9 Tue. 13:30 ~ 16:00

1/10 Wed. 13:30 ~ 16:00

Venue

Kumamoto University Kurokami South Campus

<http://ewww.kumamoto-u.ac.jp/en/about/access/campus/>

Engineering Temporary School Building : F 1F Studio  
(Building between W12 and W14)

Organizer

KEI Ishida

Assistant Professor, Faculty of Advanced Science and Technology  
[keiishida@kumamoto-u.ac.jp](mailto:keiishida@kumamoto-u.ac.jp)



Contact for IROAST seminar:

Email: [szk-kiko@jimu.kumamoto-u.ac.jp](mailto:szk-kiko@jimu.kumamoto-u.ac.jp)

### IROAST Seminar Report 25

|                                      |  |  |       |                         |
|--------------------------------------|--|--|-------|-------------------------|
| Organizer 1                          | Name   | Jun Otani                                  |       |                         |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor               |
| Organizer 2                          | Name   | Yufeng Zheng                               |       |                         |
|                                      | Affiliation  | IROAST                                     | Title | Distinguished Professor |
| Seminar Title                        | The 25th IROAST Seminar — IROAST and IRCMS Joint Seminar on Bioengineering<br>-Cutting Edge Collaborations-  |  |       |                         |
| Venue                                | Conference Room, Medical Education Library Building 6F, Honjo North Campus   |  |       |                         |
| Time & Date                          | 13:00-16:30, January 22, 2018  |  |       |                         |
| Speaker's Name/<br>Title/Affiliation | <p>Lectures:</p> <p>Koichi Nishiyama, Associate Professor, International Research Center for Medical Sciences (IRCMS)</p> <p>Yorifumi Satou, Associate Professor, IRCMS</p> <p>Yufeng Zheng, Distinguished Professor/Professor, IROAST/Peking University</p> <p>Aeju Lee, Associate Professor, IROAST</p> <p>Shinya Hayami, Professor, Faculty of Advanced Science and Technology (FAST)</p> <p>Speakers in Discussion session:</p> <p>Toshifumi Mukunoki, Associate Professor, FAST</p> <p>Toshitaka Yamakawa, Assistant Professor, FAST</p> <p>Gou Koutaki, Assistant Professor, FAST</p> <p>Yuta Nakashima, Associate Professor, FAST</p> <p>Hayato Ishikawa, Associate Professor, FAST</p> |  |       |                         |
| Number of<br>Participants            | From KU  | Faculty: 28<br>(Int'l participants: 5)     | Total | 35                      |
|                                      |  | Students: 7<br>(Int'l participants: 4)     |       |                         |
|                                      | From outside KU  | Faculty: 0<br>(Int'l participants: 0)      |       |                         |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |                         |



We had total of 5 distinguished lectures which are two of them from IRCMS and three others are from IROAST and Faculty of Advanced Science and Technology. Then we had so called “Discussion Session” which is the informal discussion on the topic of bioengineering and also the enhancement of collaboration between IROAST and IRCMS. Following is the program of the seminar:

Opening Address by Dr. Y. Zheng 13:00-13:10

Presentation from IRCMS 13:10-13:50

/ Dr. K. Nishiyama: Interdisciplinary approaches to understanding of the underlying mechanisms of angiogenesis

/ Dr. Y. Satou: Application of next generation DNA sequencing technology for viral research

Coffee Break 13:50-14:05

Presentation from IROAST 14:05-14:50

/ Dr. Y. Zheng: Metallic Biomaterials used in Medicine

/ Dr. A. Lee: Multifunctional nanoparticles for imaging and therapy

/ Dr. S. Hayami: Multi-function materials-Aiming for collaboration between medicine and engineering-

Coffee Break 14:50-15:05

Discussion Session 15:05-16:25

/ Chair by Dr. J. Otani

/ Speakers:

Dr.T.Mukunoki: Application of micro-focused X-ray CT scanner for geoenvironmental engineering  
Dr.T.Yamakawa: Wearable and implantable sensor electronics for health and clinical care

Dr.G.Koutaki: Image processing through pharmacy-engineering collaboration

Dr.Y.Nakashima: Microdevices and micro-nano technology for bio-medical application

Dr.H.Ishikawa: Isolation, total synthesis and medicinal chemistry of biologically active natural product

Closing Address by Dr. J.Otani 16:25-16:30

We found that there are a lot of interests for bioengineering collaborative researches between IROAST and IRCMS and both associations can play an important role as a bridging interface for all the life science faculty and science and engineering faculty. And at the discussion session, Prof. Zheng showed us the example of collaboration between Engineering and Medicine at Peking University, China and this is very interesting for us. And Based on all the discussion, we finally reached two of action plans as follows:

- (1) To try to have any collaborative actions periodically between IROAST and IRCMS, and
- (2) To try to get any grants for supporting each individual collaborations and this is not only from IROAST or IRCMS but we may ask the university.

I hope many of faculty members can join the research topic on bioengineering from both Faculty of life science and Faculty of science and technology.







# IROAST & IRCMS Joint Seminar on Bioengineering —Cutting Edge Collaborations— - The 25th IROAST Seminar -

**2018.1.22 Mon 13:00 - 16:35**

Honjo North Campus, Medical Education Library Building, 6F Conference room  
[http://www.kumamoto-u.ac.jp/en/about/access/campus/Honjo\\_Campus](http://www.kumamoto-u.ac.jp/en/about/access/campus/Honjo_Campus) No 12, Honjo North 2

Bus Pre-Registration is required  
**Bus Information Guide**  
 1.22 Departure time **12:20**  
 Meeting time **12:15**  
 Kurokami South Campus  
 100th Anniversary Hall of  
 Engineering Faculty

## Lecture Session

**13:10 - 13:50**

**Koichi Nishiyama**

Associate Professor, IRCMS

Interdisciplinary approaches to understanding of the underlying mechanisms of angiogenesis

**Yorifumi Satou**

Associate Professor, IRCMS

Application of next generation DNA sequencing technology for viral research

**14:05 - 14:50**

**Yufeng Zheng**

Distinguished Professor, IROAST  
 Metallic Biomaterials used in Medicine

**Aeju Lee**

Associate Professor, IROAST

Multifunctional nanoparticles for imaging and therapy

**Shinya Hayami**

Professor, FAST

Multi-function materials -Aiming for collaboration between medicine and engineering-

## Discussion Session

**15:05 - 16:25**

**Toshifumi Mukunoki**

Associate Professor, FAST

Application of micro-focused X-ray CT scanner for geoenvironmental engineering

**Toshitaka Yamakawa**

Assistant Professor, FAST

Wearable and implantable sensor electronics for health and clinical care

**Gou Koutaki**

Assistant Professor, FAST

Image processing through pharmacy-engineering collaboration

**Yuta Nakashima**

Associate Professor, FAST

Microdevices and micro-nano technology for bio-medical application

**Hayato Ishikawa**

Associate Professor, FAST

Isolation, total synthesis and medicinal chemistry of biologically active natural product

## Welcome to join us!

Bioengineering is a fast-growing career. This trend is expected to continue over the next decade.

### Goals

- Stimulate research at the interface between **medicine/pharmacy and engineering /science** leading to innovative applications in **bioengineering research and the quality of healthcare.**
- Better understand the **mutual research**
- Pursue **opportunities for collaborative research**
- Gather ideas to fix a target bioengineering system to ultimately improve the **quality of healthcare**

## Organizer

**Yufeng Zheng**

Distinguished Professor, IROAST  
 Professor, Peking University

**Jun Otani**

Vice Director, IROAST  
 Professor, FAST



Contact for IROAST seminar:  
 Email: [szk-kiko@jimu.kumamoto-u.ac.jp](mailto:szk-kiko@jimu.kumamoto-u.ac.jp)

## IROAST Seminar Report 26

|                                  |  |  |       |                     |
|----------------------------------|--|--|-------|---------------------|
| Organizer                        | Name   | Sainoki Atsushi                        |       |                     |
|                                  | Affiliation  | IROAST                                 | Title | Associate Professor |
| Seminar Title                    | The 26th IROAST Seminar—Seismicity-permeability coupling in gas shales, CO <sub>2</sub> storage and deep geothermal energy |  |       |                     |
| Venue                            | #905, Faculty of Engineering Research Building 1   |  |       |                     |
| Time & Date                      | 15:00-16:30, February 2, 2018  |  |       |                     |
| Speaker's Name/Title/Affiliation | Derek Elsworth, Professor, The Pennsylvania State University, USA  |  |       |                     |
| Number of Participants           | From KU  | Faculty: 9<br>(Int'l participants: 3)  | Total | 15                  |
|                                  |  | Students: 5<br>(Int'l participants: 0) |       |                     |
|                                  | From outside KU  | Faculty: 1<br>(Int'l participants: 1)  |       |                     |
|                                  |  | Students: 0<br>(Int'l participants: 0) |       |                     |

This seminar was aimed to give an idea to students of Kumamoto University as to CO<sub>2</sub> reduction schemes that we need to take, mainly focusing on geothermal energy development and CO<sub>2</sub> sequestration. Prof. Elsworth presented the latest research works related to induced seismicity caused by fluid injection and its relationship with permeability change in the geological structure. The topics pertain to sustainable energy development that can alleviate public concern and maximize the efficiency of the geothermal energy system.

Prof. Elsworth will become a visiting professor of IROAST, so that a long-term relationship can be expected. Also, Prof. Sainoki is planning to apply for JSPS grant for collaborative research with Prof. Elsworth, especially aiming to conduct research on CO<sub>2</sub> sequestration, which will play a primary role in reducing CO<sub>2</sub> emission in the near future. Therefore, collaborating with Prof. Elsworth is of paramount importance for Kumamoto University to become one of the leading institutions for realizing sustainable energy development.

Professors of Kumamoto University gave questions to Prof. Elsworth whilst enjoying the discussion. I believe that this seminar has given the attendance an idea about the importance of CO<sub>2</sub> reduction and its relation with seismic activity, although the number of attendance was less than we had expected, unfortunately, mainly because of the date just before the deadline of Bachelor's and Master's degree thesis.



## The 26<sup>th</sup> IROAST Seminar

Seismicity-permeability coupling in gas shales,  
CO<sub>2</sub> storage and deep geothermal energy

**Derek Elsworth, Ph.D.Eng.**

The Pennsylvania State University

**Time & Date:** 15:00-16:30, February 2, 2018

**Venue:** #905, Faculty of Engineering Bldg.1

**Contact:** Atsushi Sainoki

Associate Professor, IROAST

E-mail: atsushi\_sainoki@kumamoto-u.ac.jp

### IROAST Seminar Report 27

|                                      |   |  |       |           |
|--------------------------------------|---|--|-------|-----------|
| Organizer                            | Name  | Hamid Hosano                           |       |           |
|                                      | Affiliation   | Institute of Pulsed Power Science      | Title | Professor |
| Seminar Title                        | The 27th IROAST Seminar—IPPS Lecture & Seminar No. 38   |  |       |           |
| Venue                                | #516, Kurokami South C7 (Academic Commons Kurokami Bldg. 3)   |  |       |           |
| Time & Date                          | 11:00-12:00, February 15, 2018  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Viren Menezes, Professor, Department of Aerospace Engineering, Indian Institute of Technology Bombay, India |  |       |           |
| Number of<br>Participants            | From KU   | Faculty: 3<br>(Int'l participants: 2)  | Total | 9         |
|                                      |   | Students: 5<br>(Int'l participants: 1) |       |           |
|                                      | From outside KU   | Faculty: 1<br>(Int'l participants: 1)  |       |           |
|                                      |   | Students: 0<br>(Int'l participants: 0) |       |           |

Prof. Menezes visited Kumamoto University during Feb. 9-18, 2018. He met Prof. Hosano to discuss research collaboration on Needle-free drug delivery systems. They discussed a few research subjects, and determined possible steps for collaboration. During his visit, Prof. Menezes also met with IROAST Director, Prof. Hiyama, and gave a presentation as “The 27th IROAST Seminar—IPPS Lecture & Seminar No. 38—held on February 15, 2018” (picture below).



Seminar at Kumamoto University





## **IPPS Lecture & Seminar No.38**

### **- The 27th IROAST Seminar -**

Title: Effect of surface roughness on the hypersonic nose-tip transition control

Lecturer: Prof. Viren Menezes  
(Indian Institute of Technology Bombay, India  
IROAST Visiting Professor, Kumamoto Univ.)

Date & Time: Feb. 15, 2018 (Thu.) 11:00~12:00

Venue: Kurokami South C7 (Academic Commons  
Kurokami Bldg. 3, 5<sup>th</sup> Floor, 516 (Seminar room))

Abstract: Influence of large surface roughness on nose-tip transition delay was investigated on blunt hypersonic models, in a freestream of Mach 8. The model surface was loaded with sand grits, the height of which was of the order of boundary layer thickness on the surface. The test models results indicated a delay in the nose-tip transition, which was supported by flow visualizations. The research has relevance to ablative thermal protection systems used on hypersonic vehicles.

**Supported by International Research Organization for  
Advanced Science and Technology (IROAST)**

## IROAST Seminar Report 28

|                                      |  |  |       |           |
|--------------------------------------|--|--|-------|-----------|
| Organizer                            | Name   | Shinya Hayami                              |       |           |
|                                      | Affiliation  | Faculty of Advanced Science and Technology | Title | Professor |
| Seminar Title                        | Efficient Valorization of Biomass to Chemicals and Biofuels through Bifunctional Solid Catalytic Design  |  |       |           |
| Venue                                | C122, Faculty of Science Building 2  |  |       |           |
| Time & Date                          | 15:00-17:00, March 30, 2018  |  |       |           |
| Speaker's Name/<br>Title/Affiliation | Jorge Norberto Beltramini, Associate Professor/ Senior Research Fellow, Nanomaterials Centre (NANOMAC)/ Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Australia |  |       |           |
| Number of<br>Participants            | From KU  | Faculty: 29<br>(Int'l participants: 0)     | Total | 60        |
|                                      |  | Students: 30<br>(Int'l participants: 5)    |       |           |
|                                      | From outside KU  | Faculty: 1<br>(Int'l participants: 1)      |       |           |
|                                      |  | Students: 0<br>(Int'l participants: 0)     |       |           |

### 1. Seminar Overview

Efficient Valorization of Biomass to Chemicals and Biofuels through Bifunctional Solid Catalytic Design Nanostructured functional materials are used for the critical design of heterogeneous catalysts to deliver products from multiple step reactions that are required for energy and environmental applications. An emerging trend is to integrate catalytic transformations, reaction engineering and product separations into a single operation wherein catalyst design is considered as the key approach to develop efficient, low energy and environmentally friendly reaction systems. Bifunctional solid catalysts open a door for carrying out domino/cascade and tandem/sequential type reactions in a single reactor, for which the number of isolation or purification steps can be decreased or eliminated so the removal of unwanted products becomes unnecessary. This presentation discusses bifunctional materials used in a single pot conversion of biomass into related chemicals and biofuels. Emphasis is placed on the assessment of the bifunctionality of catalytic materials, including Bronsted-Lewis acid, acid-base, and metal particles combinations. Plausible reaction mechanisms for key pathways are shown. Relevant auxiliaries to boost catalytic activity and product selectivity, such as reaction media, heating modes and morphological properties of the catalytic materials are discussed. Use of appropriate bifunctional catalytic materials provides many opportunities for design of highly efficient reaction systems and simplified processing for producing biofuels and chemicals from lignocellulosic biomass.

### 2. Future Prospects

Prof. Jorge Beltramini research about catalysis, and he is a world-leading researcher in the research area. And he stayed in Kumamoto University for 2 months, and we could discuss about catalysis by using our GO and 2D materials. Furthermore, he has many idea, we also discussed about magnesium 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 for our research collaborations.





# The 28<sup>th</sup> IROAST Seminar

**-Efficient Valorization of Biomass to Chemicals and Biofuels  
through Bifunctional Solid Catalytic Design-**

**Jorge Norberto Beltramini, Ph.D.**

AIBN, The University of Queensland, Australia

**Time & Date** 15:00 -, March 30, 2018  
**Venue** Room C122, Faculty of Science Building 2  
**Organizer** Prof. Shinya Hayami  
 Faculty of Advanced Science and Technology  
[hayami@kumamoto-u.ac.jp](mailto:hayami@kumamoto-u.ac.jp)









## Agreements

| No. | Kumamoto University | Partner University/Institute   | Date of Conclusion |
|-----|---------------------|--------------------------------|--------------------|
| 1   | FAST<br>IROAST      | Michigan State University, USA | 03/07/2018         |

## Memorandums of Understanding

| No. | IROAST Members                   | Partner University/Institute  | Date of Conclusion |
|-----|----------------------------------|---|--------------------|
| 2   | <b>Takashi Hiyama</b>            | <b>Dr. Greg Bignall</b><br>Institute of Geological and Nuclear Sciences Limited (GNS Science), New Zealand  | 06/08/2016         |
| 3   | <b>Shinichiro Sawa</b><br>(FAST) | <b>Research Director Oliver Hamant</b><br>INRA in the Plant Reproduction and Development Laboratory, ENS Lyon, France                                   | 11/22/2016         |
| 4   | <b>Takashi Hiyama</b>            | <b>Professor Carlos Esplugues</b><br><b>Professor Silvia Barona</b><br>Universitat de València, Spain   | 01/19/2017         |
| 5   | <b>Atsushi Sainoki</b>           | <b>Assistant Professor Agus Pulung Sasmito</b><br>Mine Multiphysics Laboratory, McGill University, Canada   | 10/20/2017         |
| 6   | <b>Tomohiko Tomita</b><br>(FAST) | <b>Associate Professor Heri Kuswanto</b><br>Research Center for Earth, Disaster and Climate Change, Institut Teknologi Sepuluh Nopember(ITS), Indonesia | 12/29/2017         |
| 7   | <b>Takumi Higaki</b>             | <b>Professor Bo Liu</b><br>Liu Laboratory, Department of Plant Biology, University of California, Davis, USA  | 12/20/2017         |
| 8   | <b>Atsushi Sainoki</b>           | <b>Professor Derek Elsworth</b><br>G3 Center, The Pennsylvania State University, USA  | 02/07/2018         |

FAST: Faculty of Advanced Science and Technology, Kumamoto University

GENERAL INTERNATIONAL AGREEMENT FOR ACADEMIC COOPERATION  
BETWEEN

MICHIGAN STATE UNIVERSITY  
East Lansing, Michigan, U.S.A.

AND

KUMAMOTO UNIVERSITY  
FACULTY OF ADVANCED SCIENCE AND TECHNOLOGY  
AND  
INTERNATIONAL RESEARCH ORGANIZATION FOR  
ADVANCED SCIENCE AND TECHNOLOGY  
Kumamoto, Japan

Michigan State University (MSU) and The Faculty of Advanced Science and Technology (FAST) and The International Research Organization for Advanced Science and Technology (IROAST) at Kumamoto University (KU) establish this General Agreement to foster international cooperation in education and research.

This General Agreement encourages the exchange of faculty, scholars, students, academic information, and materials in belief that the research and educational processes at both parties will be enhanced and that mutual understanding between respective faculty, scholars, and students will be increased by the establishment of this Agreement.

1. Both parties agree to encourage the following activities, in particular to promote international academic cooperation:
  - (a) Exchange of materials in education and research, publications, and academic information;
  - (b) Exchange of faculty and research scholars;
  - (c) Joint research and meetings for education, research and outreach;
  - (d) Technical assistance;

Before these activities can be implemented, both parties shall discuss the problems involved to the satisfaction of each party and enter into specific activity agreements based on the mutually agreed objectives and outcomes of the relationship.

2. This General Agreement shall be applicable to educational and research organizations attached to each party.
3. This Agreement constitutes the entire agreement between the parties, and all prior discussions, agreements, and understandings, whether verbal or in writing, is merged in this agreement.



4. This Agreement is not considered to be a contract creating legal and financial relationships between the parties. Rather, it is designed to facilitate and develop a genuine and mutually beneficial exchange process for teaching, research and outreach activities.
5. This General Agreement shall become effective as of the date of signatures of both parties.
6. The parties intend to review this General Agreement every five years to evaluate the progress and the quality of the mutual cooperation. This General Agreement may be amended only by the written consent of the parties.
7. This Agreement may be terminated by either party with a minimum of 180 days written notice. Activities in progress at the time of termination of this Agreement shall be permitted to conclude as planned unless otherwise agreed.
8. Both institutions subscribe to a policy of equal opportunity, non-discrimination and affirmative action. University programs, activities and facilities are available to all without regard to race, color, gender, religion, national origin, political persuasion, sexual orientation, marital status, disability, height, weight, veteran status, age or familial status.
9. Each party shall designate a person or office to serve as liaison for implementing this Agreement.

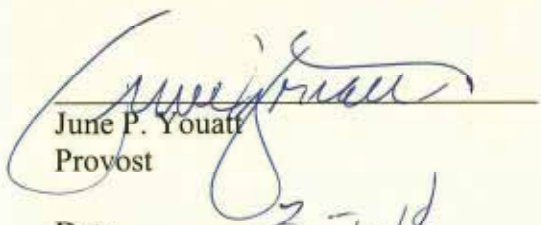
For MSU, the contact person will be Dr. Brad Day, Professor & Associate Chair for Research, Department of Plant, Soil & Microbial Sciences, 1066 Bogue Street, Room 4200, East Lansing MI 48823, U.S.A., Telephone: +517-353-7991, Email: bday@msu.edu

For KU, the contact person will be Dr. Takumi Higaki, Ph. D., International Research Organization for Advanced Science and Technology (IROAST), Room 307 Kumamoto University, Kumamoto 860-8555, Japan, Telephone: +81-96-342-3404 Email: thigaki@kumamoto-u.ac.jp

10. This Agreement is written in English only.


Signing for MSU:

Signing for KU:


  
June P. Youatt  
Provost

Date

3-7-18

  
Shinji Harada  
President

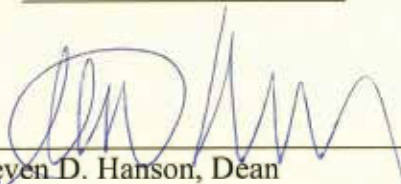
Date 24 Jan 2018

 3-5-18  
OFFICE OF THE GENERAL COUNSEL DATE  
APPROVED AS TO FORM




Ronald L. Hendrick, Dean  
College of Agriculture & Natural Resources

Date 2/9/18



Steven D. Hanson, Dean  
International Studies and Programs

Date 3/5/18



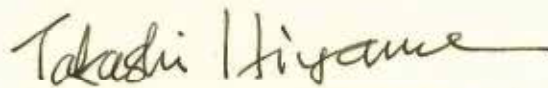
Tsuyoshi Usagawa, Dean  
FAST

Date 22 Jan, 2018



Fusao Ichikawa, Vice Dean  
FAST

Date 22 Jan. 2018



Takashi Hiyama, Director  
IROAST

Date January 22, 2018

**Memorandum of Understanding**  
**between**  
**Institute of Geological and Nuclear Sciences Limited**  
**(GNS Science) New Zealand**  
**and**  
**International Research Organization for Science and Technology,**  
**Kumamoto University, Japan (IROST Kumamoto University)**

GNS Science and International Research Organization for Science and Technology are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship in the geothermal area on the following basis.

**1. GNS Science International**

IROST Kumamoto University acknowledges and agrees that, to the extent any future engagement under the umbrella of this MOU is to be undertaken outside of New Zealand or contracted other than in accordance with New Zealand law, that engagement will be contracted through GNS Science's subsidiary GNS Science International Limited.

**2. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation and agreement.

**Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publications, journals and other relevant references where possible and appropriate and on terms to be agreed..

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities where it is mutually beneficial to the parties. The subject, content and conditions of each activity will be decided through mutual consultation and agreement.

**4. Copyright Information**

Copyright information used by either party shall remain the property of the owner of the copyright in the information.



#### 5. Confidentiality

Both parties shall not disclose any confidential information of the other party to any third party. If a party wishes to disclose information which is the confidential information of the other party, it shall do so only after consultation and with the prior written consent of other party.

#### 6. Duration of MOU


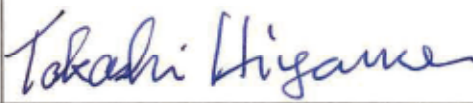
This MOU shall be effective for a period of 3 years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

#### 7. Amendment/Termination

This MOU may be modified or terminated by either party, upon 3 months' prior written notice to other party.

#### 8. Language

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

| Institute of Geological and Nuclear Sciences<br>Limited |   | Kumamoto University |  |
|---|---|---------------------|--|
| (Title)   | Dr.   | (Title)             | Prof.  |
| (Name)  | Greg Bignall  | (Name)              | Takashi Hiyama   |
| (Signature)   |  | (Signature)         |  |
| (Date)  | 05/06/16  | (Date)              | 08/06/16   |

**MEMORANDUM OF UNDERSTANDING**  
**Between**  
***Shinichiro Sawa lab. and Olivier Hamant lab.***

**1. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

**2. Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

**4. Copyright Information**

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

**5. Confidentiality**

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

**6. Duration of MOU**

This MOU shall be effective for a period of 3 years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

**7. Amendment/Termination**

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon 3 months prior written notice to other party.

**8. Language**

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

Shinichiro SAWA

Olivier Hamant

Professor, Graduate School of Science &  
Technology, Kumamoto University

(Signature)



(Signature)



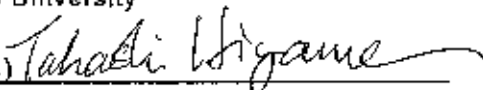
Date: 1/11/2016

Date: 10.11.2016

Takashi HIYAMA

Distinguished Professor & Director  
International Research Organization for  
Advanced Science and Technology,  
Kumamoto University

(Signature)



Date: 22/11/2016

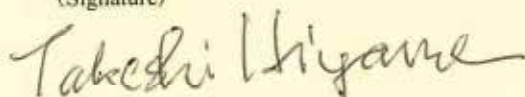


## **Memorandum of Understanding for the Establishment of Valencia-Kumamoto International Laboratory for Education and Research**

This memorandum of understanding is concern with promotion of international education and research collaboration between the Universitat de València (Spain) and Kumamoto University, which is facilitated by Prof. Carlos Esplugues, from Universitat de València, and Associate Prof. Kenichiro Kawano, from Kumamoto University.

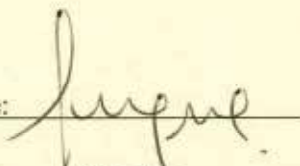
- 1) Kumamoto University is willing to establish Valencia-Kumamoto International Laboratory for Education and Research (hereinafter called 'VKL'). VKL will be in charge of organizing, administering, designing, fostering the presence of Kumamoto University in Europe and, as far as possible, in Latin America.
- 2) Kumamoto University is willing to appoint Prof. Carlos Esplugues and Prof. Silvia Barona as directors of VKL, in the name of the Director of International Research Organization for Advanced Science and Technology (IROAST).
- 3) Prof. Carlos Esplugues and Prof. Silvia Barona will be in charge of directing VKL and organizing, preparing and fostering all activities undertaken by VKL always in accordance with the support from Kumamoto University. In particular when available, they will seek to promote the exchange of researchers and the development of common research and academic projects by Kumamoto University, which will also enhance the exchange of students between Kumamoto University and other Universities of Europe and Latin America.
- 4) This memorandum of understanding will be developed by one or several annexes in accordance with the financial situation and plans of Kumamoto University.

Professor Takashi Hiyama  
Director of IROAST  
Kumamoto University (Japan)  
(Signature)



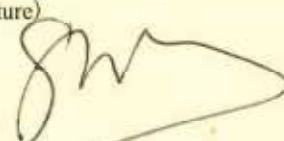
Date: 1.19.2017

Professor Carlos Esplugues  
Universitat de València (Spain)  
(Signature)

Date: 

19.1.2017

Professor Silvia Barona  
Universitat de València (Spain)  
(Signature)



Date: 

19.1.2017

# MEMORANDUM OF UNDERSTANDING

## between

### *IROAST and Mine Multiphysics Laboratory*

Following the academic agreement between McGill University, Canada and Kumamoto University, Japan, IROAST and Mine Multiphysics Laboratory are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship for the following items between two parties.

**1. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

**2. Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

**4. Copyright Information**

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

**5. Confidentiality**

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

**6. Duration of MOU**

This MOU shall be effective for a period of 4 years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

**7. Amendment/Termination**

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon 2 months prior written notice to other party.

**8. Language**

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

IROAST-1

Affiliation: Kumamoto University

Title: Associate Professor

Name: Atsushi Sainoki

Signature: Atsushi Sainoki

Date: 2017/10/20

Mine Multiphysics Laboratory-1

Affiliation: McGill University

Title: Assistant Professor

Name: Agus Pulung Sasmito

Signature: Agus Pulung Sasmito

Date: 2017/10/20

IROAST-2

Affiliation: Kumamoto University

Title: Director of IROAST

Name: Prof. Takashi Hiyama

Signature: Takashi Hiyama

Date: 2017/10/20

Partner A-2 (If necessary)

Affiliation: \_\_\_\_\_

Title: \_\_\_\_\_

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**MEMORANDUM OF UNDERSTANDING**  
*between*  
**Partner A and Partner B**

Following the academic agreement between Heri Kuswanto, Research Center for Earth, Disaster and Climate Change, Institut Teknologi Sepuluh Nopember (ITS), Indonesia (A) and Tomohiko Tomita, Faculty of Advanced Science and Technology, Kumamoto University, Japan (B), Partner A and Partner B are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship for the following items between two parties.

**1. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

**2. Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

**4. Copyright Information**

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

**5. Confidentiality**

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

**6. Duration of MOU**

This MOU shall be effective for a period of FIVE (5) years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

**7. Amendment/Termination**

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon THREE (3) months prior written notice to other party.

**8. Language**


This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

**Partner A**

Affiliation: Research Center for Earth,  
Disaster and Climate Change, Institut  
Teknologi Sepuluh Nopember (ITS)

Title: Associate Professor, Dr.

Name: Heri Kuswanto

Signature: 

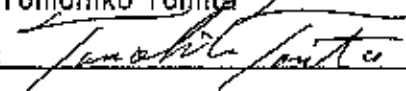
Date: 29/12/2017

**Partner B**

Affiliation: Faculty of Advanced Science and  
Technology, Kumamoto University

Title: Associate Professor, Ph. D.

Name: Tomohiko Tomita

Signature: 

Date: 29/12/2017



**MEMORANDUM OF UNDERSTANDING**  
*between*  
**Partner B and Partner A**

Following the academic agreement between Tomohiko Tomita, Faculty of Advanced Science and Technology, Kumamoto University, Japan (B) and Heri Kuswanto, Center for Earth, Disaster and Climate Change, Institut Teknologi Sepuluh Nopember (ITS), Indonesia (A), Partner A and Partner B are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship for the following items between two parties.

**1. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

**2. Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

**4. Copyright Information**

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

**5. Confidentiality**

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

**6. Duration of MOU**

This MOU shall be effective for a period of FIVE (5) years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

**7. Amendment/Termination**

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon THREE (3) months prior written notice to other party.

**8. Language**

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

**Partner B**

**Affiliation:** Faculty of Advanced Science and Technology, Kumamoto University

**Title:** Associate Professor, Ph. D.

**Name:** Tomohiko Tomita

**Signature:** 

**Date:** 29/12/2017

**Partner A**

**Affiliation:** Research Center for Earth, Disaster and Climate Change, Institut Teknologi Sepuluh Nopember (ITS)

**Title:** Associate Professor, Dr.

**Name:** Heri Kuswanto

**Signature:** 

**Date:** 29/12/2017

**MEMORANDUM OF UNDERSTANDING**  
**Between Higaki and Liu laboratories**  
**For Joint Research on Plant Microtubules**

Takumi Higaki and Bo Liu are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship for the following items between two parties.

**1. Exchange of Research Personnel**

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

**2. Exchange of Technical Information and Materials**

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

**3. Promotion of Joint Research**

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

**4. Copyright Information**

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

**5. Confidentiality**

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

**6. Duration of MOU**

This MOU shall be effective for a period of (Years) from the date of signing. It may be renewed by mutual consent, if proposed by either party.

**7. Amendment/Termination**

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon (Months) prior written notice to other party.

**8. Language**

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

Liu laboratory, Dept. of Plant Biology  
University of California, Davis

Title: Professor

Name: Bo Liu


Signature: 

Date: December 20, 2017

Higaki laboratory, IROAST  
IROAST, Kumamoto University

Title: Associate Professor

Name: Takumi Higaki

Signature: 

Date: December 12, 2017

Title: Chair of Dept. of Plant Biology

Name: S.P. Dinesh-Kumar

Signature: 

Date: December 20, 2017

Title: Director of IROAST

Name: Takashi Hiyama

Signature: 

Date: December 12, 2017

# MEMORANDUM OF UNDERSTANDING

## between

### G3 Center and Sainoki's Lab

Partner A and Partner B are both signing this Memorandum of Understanding (MOU) to establish a mutually beneficial cooperative relationship for the following items between two parties.

#### 1. Exchange of Research Personnel

Both parties agree to exchange research personnel. The purpose, timing, duration of the exchange and other details shall be decided on a case basis through mutual consultation.

#### 2. Exchange of Technical Information and Materials

Both parties agree to exchange technical information and materials such as publication, journals and other relevant references where possible and appropriate.

#### 3. Promotion of Joint Research

Both parties agree to promote and conduct joint research activities when it is found mutually beneficial. The subject, content and conditions of each activity will be decided through mutual consultation.

#### 4. Copyright Information

Copyright information used by either party should remain the property of the originator, or the party offering the materials.

#### 5. Confidentiality

Both parties shall not disclose any confidential information of the other party or of mutual activities to any third party. If a party wishes to disclose information considers to be confidential or proprietary, it shall do so only after consultation of other party.

#### 6. Duration of MOU

This MOU shall be effective for a period of 4years from the date of signing. It may be renewed by mutual consent, if proposed by either party.

#### 7. Amendment/Termination

This MOU may be modified or terminated by mutual consent, if proposed by either party, upon (Months) prior written notice to other party.

#### 8. Language

This MOU is written in English and signed in duplicate by both parties. It may be translated into other languages for reference purposes.

G3 Center

Affiliation: Pennsylvania State University

Title: Professor

Name: Derek Elsworth

Signature: Derek Elsworth

Date: 2018-02-07

Sainoki's Lab

Affiliation: Kumamoto University

Title: Associate Professor

Name: Atsushi Sainoki

Signature: Atsushi Sainoki

Date: 2018-02-07







## IROAST Researcher Publications

### **László Pusztai**

Orsolya Gereben, László Pusztai, “Cluster Formation and Percolation in Ethanol-Water mixtures,” Chemical Physics, 496, 1-8, 2017.

### **Yufeng Zheng**

Hongtao Yang, Zinhua Qu, Wenjiao Lin, Cong Wang, Donghui Zhu, Kerong Dai, Yufeng Zheng, “In vitro and in vivo studies on zinc-hydroxyapatite composites as novel biodegradable metal matrix composite for orthopedic applications,” Acta Biomaterialia, 71, 200-214, 2018.

Hongtao Yang, Cong Wang, Chaoqiang Liu, Houwen Chen, Yifan Wu, Jintao Han, Zichang Jia, Wenjiao Lin, Deyuan Zhang, Wenting Li, Wei Yuan, Hui Guo, Huafang Li, Guangxin Yang, Deling Kong, Donghui Zhu, Kazuki Takashima, Liqun Ruan, Jianfeng Nie\*, Xuan Li\*, Yufeng Zheng\*, “Evolution of the degradation mechanism of pure zinc stent in the one-year study of rabbit abdominal aorta model,” Biomaterials, 145, 92-105, 2017. (\*corresponding author)

### **Toshiyuki Tosha**

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### **Takumi Higaki**

Kae Akita, Seiichiro Hasezawa, Takumi Higaki, “Cortical microtubules and fusicoccin response in clustered stomatal guard cells induced by sucrose solution immersion,” Plant Signaling & Behavior, 13:4, 2018.

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### **Atsushi Sainoki**

Izumi Tanikura, Ren Shintani, Atsushi Sainoki\*, Shinya Watanabe, Yuzo Obara, “Quantitative comparison of chipping- and hydrodemolition-induced microscopic damage evolution in concrete substrates,” Construction and Building Materials, 164, 193-205, 2018. (\*corresponding author)

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### **Takashi Ishida**

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### **Armando T. Quitain**

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### **Satoshi Hinokuma**

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copper oxides supported on aluminum silicates and silicon oxides,” *Journal of Catalysis*, 361, 267-277, 2018.

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International Collaborative Publications  
from IROAST Visiting Professors and their Host Professors

**Paul Bowen & Kazuki Takashima**

Yin Htwe, Kwangsik Kwak, Daichi Kishi, Yoji Mine, Rengen Ding, Paul Bowen, Kazuki Takashima, “Anisotropy of <a> slip behaviour in single-colony lamellar structures of Ti–6Al–4V,” Materials Science and Engineering A, 715, 315-319, 2018.

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**Tomonari Furukawa & Makoto Kumon**

Odo, W., Kimoto, D., Kumon, M., Furukawa, T., “Active sound source localization by Pinnae with recursive Bayesian estimation,” Journal of Robotics and Mechatronics, 29 (1), 49-58, 2017.

**Yang Kim & Shinya Hayami**

Tsukiashi A, Nakaya M, Kobayashi F, Ohtani R, Nakamura M, Harrowfield JM, Kim Y, Hayami S, “Intermolecular Interaction Tuning of Spin-Crossover Iron(III) Complexes with Aromatic Counteranions,” Inorganic Chemistry, 57(5), 2834-2842, 2018.

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Lee Young Hoon, Shin Jong Won, Sekimoto Yusuke, Hayami Shinya, Harrowfield Jack, Kim Yang, “Crystal Structure of a Heterometallic Luminophore: The Ru<sup>II</sup> Complex of a Ferrocenyl-Terpyridine with a Flexible Linkage,” Australian Journal of Chemistry, 70(5), 632-636, 2017.

**Viren Ivor Menezes & Hamid Hosano (Hosseini)**

Battula, N., Menezes, V., Bhalekar, S., Bhalekar, S.H., Nejad, S.M., Hosseini, H., “Impulse-powered needle-free syringe for vaccine/drug injection,” Technology and Health Care, 25(6), 1131-1138, 2017.

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**Dmitri Aleks Molodov & Sadahiro Tsurekawa**

Y. Tokuda, S. Tsurekawa, D. Molodov, “Local mechanical properties in the vicinity of (110) $\Sigma$ 3/[111] symmetric tilt grain boundary in aluminum bicrystal,” Materials Science and Engineering A, 716, 37-41, 2018.

### **Reiko Oda & Hirotaka Ihara**

N. Ryu, Y. Okazaki, E. Pouget, M. Takafuji, S. Nagaoka, H. Ihara, R. Oda, “Fluorescence emission originated from the H-aggregated cyanine dye with chiral gemini surfactant assemblies having a narrow absorption band and a remarkably large Stokes shift,” Chemical Communications, 53(63), 8870-8873, 2017.

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Y. Okazaki, T. Buffeteau, T. Siurdyban, D. Talaga, N. Ryu, R. Yagi, E. Pouget, M. Takafuji, H. Ihara, R. Oda, “Direct Observation of Siloxane Chirality on Twisted and Helical Nanometric Amorphous Silica,” Nano Letters, 16 (10), 6411-6415, 2016.

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### **Zoran Ren & Kazuyuki Hokamoto**

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**Thomas Waitz & Mitsuhiro Matsuda**

Tulic, S., Kerber, M., Matsuda, M., Waitz, T., “Phase transformations of severely plastically deformed Ti-Ni-Pd high temperature shape memory alloys,” Functional Materials Letters, 10 (1), 1740012, 2017.









## External Funds

\*Obtained at previous affiliations

### **Toshiyuki Tosha**

Donated Fund, Mitsui Mineral Development Engineering Co., Ltd., 200,000 JPY (2016)

Donated Fund, West Japan Engineering Consultants, Inc., 1,000,000 JPY (2016)

Donated Fund, Hakuei Sangyo Co., Ltd., 500,000 JPY (2017)

Donated Fund, Mitsui Mineral Development Engineering Co., Ltd., 500,000 JPY (2017)

Donated Fund, West Japan Engineering Consultants, Inc., 1,000,000 JPY (2017)

### **Mitsuhiro Aida**

\*Grant-in-Aid for Scientific Research (C), Japan Society for the Promotion of Science (JSPS), 5,070,000 JPY (04/01/2016-03/31/2019)

\*Grant-in-Aid for Scientific Research on Innovative Areas, The Ministry of Education, Culture, Sports, Science and Technology (MEXT), Co-investigator, 126,880,000 JPY (06/28/2012-03/31/2017)

### **Takumi Higaki**

\*"Creation of Industrial Infrastructure" Research Grant Program, The Canon Foundation, 13,000,000 JPY (04/2017-03/2019)

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\*Grant-in-Aid for Challenging Exploratory Research, Japan Society for the Promotion of Science (JSPS), 6,500,000 JPY (06/30/2017-03/31/2019)

\*Grant-in-Aid for Young Scientists (A), Japan Society for the Promotion of Science (JSPS), 19,890,000 JPY (04/01/2013-03/31/2017)

### **Atsushi Sainoki**

Donated Fund, Fujita Corporation, 500,000 JPY (2017)

Grant-in-Aid for Research Activity Start-up, Japan Society for the Promotion of Science (JSPS), 2,340,000 JPY (08/25/2017-03/31/2019)

**Takashi Ishida**

Grant-in-Aid for Scientific Research (C), Japan Society for the Promotion of Science (JSPS), 5,330,000 JPY (04/01/2013-03/31/2017)

**Quitain T. Armando**

Grant-in-Aid for Scientific Research (C), Japan Society for the Promotion of Science (JSPS), 4,940,000 JPY (04/01/2015-03/31/2018)

JASTIP-Net, Japan-ASEAN Science, Technology and Innovation Platform (JASTIP), 500,000 JPY (10/2017-09/2018)

Grant-in-Aid for Scientific Research (B), Japan Society for the Promotion of Science (JSPS), Co-investigator, 16,380,000 JPY (04/01/2014-03/31/2018)

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**Satoshi Hinokuma**

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**Yasuko Matsubara**

Grant-in-Aid for Young Scientists (A), Japan Society for the Promotion of Science (JSPS), 15,080,000 JPY (04/01/2017-03/31/2020)

Grant-in-Aid for Young Scientists (B), Japan Society for the Promotion of Science (JSPS), 3,770,000 JPY (04/01/2014-03/31/2017)

Contracted Research, Strategic Basic Research Program (PRESTO), Japan Science and Technology Agency (JST), 15,834,000 JPY (12/16/2016-3/31/2018)

Contracted Research, Strategic Information and Communications R&D Promotion Programme (SCOPE), The Ministry of Internal Affairs and Communications (MIC), 15,535,000 JPY (05/27/2016-03/31/2017)







## Publications Supported by IROAST Publication Support Program

| No. | Name                         | Publication Information   |
|-----|------------------------------|---|
| 1   | <b>Shinya Hayami</b><br>FAST | Nurun Nahar Rabin, Shintaro Ida, Mohammad Razaul Karim, Md. Saidul Islam, Ryo Ohtani, Masaaki Nakamura, Michio Koinuma, Leonard F. Lindoy, and Shinya Hayami, “Super Dielectric Materials of Two-Dimensional TiO <sub>2</sub> or Ca <sub>2</sub> Nb <sub>3</sub> O <sub>10</sub> Nanosheet Hybrids with Reduced Graphene Oxide,” ACS Omega, 3 (2), 2074–2083, 2018. |
| 2   | <b>Tetsuya Kida</b><br>FAST  | Pramata, A. D., Suematsu, K., Quitain, A. T., Sasaki, M., & Kida, T., “Synthesis of Highly Luminescent SnO <sub>2</sub> Nanocrystals: Analysis of their Defect-Related Photoluminescence Using Polyoxometalates as Quenchers,” Advanced Functional Materials, 28(4), 1704620, 2018.   |
| 3   | <b>Shinya Hayami</b><br>FAST | Saliu Alao Amolegbe, Yui Hirano, Joseph Oluwatope Adebayo, Olusegun George Ademowo, Elizabeth Abidemi Balogun, Joshua Ayoola Obaleye, Antoniana Ursine Krettli, Chengzhong Yu & Shinya Hayami, “Mesoporous silica nanocarriers encapsulated antimalarials with high therapeutic performance,” Scientific Reports, 8, 3078, 2018.                                    |

FAST: Faculty of Advanced Science and Technology, Kumamoto University







## 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 and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)     |
| 5   | Guidelines for Tenure Review of Tenure-track Professors and Associate Professors at the Kumamoto University International Research Organization for Advanced Science and Technology (IROAST)          |
| 6   | Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Visiting Professors   |
| 7   | Handling of Granting the Title of “Visiting Professor” for the International Research Organization for Advanced Science and Technology (IROAST)   |
| 8   | Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Distinguished Professors  |
| 9   | Selecting Distinguished Professors for the International Research Organization for Advanced Science and Technology (IROAST)   |
| 10  | Outline of International Advisory Board of International Research Organization for Advanced Science and Technology (IROAST)   |

**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 and Associate 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 and Associate Professors 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 Tenure-track Professors and Associate Professors 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 Professors and Associate Professors 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 and Associate 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 and Associate Professors 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 Tenure-track Professors and Associate Professors 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 Professors and Associate Professors.
- (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.

## **Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Visiting Professors**

September 25, 2017

Approved by the IROAST Steering Committee

The agreement of the International Research Organization for Advanced Science and Technology (hereinafter referred to as “IROAST”) for visiting professors are as follows.

### **(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 the promotion and expansion of Kumamoto University’s research activities with an international perspective.

### **(Duties)**

The main tasks of a visiting professor are as follows:

1. Hold international seminars. When he/she is invited to 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(s) 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 of 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.

**Handling of Granting the Title of "Visiting Professor" for the  
International Research Organization for Advanced Science and Technology (IROAST)**

February 9, 2018

Approved by the IROAST Steering Committee

1. Subject persons

The title of "Visiting Professor" shall be granted to persons, based on the recommendation by faculty members in the science and technology area, who are top world-level researchers and 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 assertive by international joint research with researchers of the University.

2. Selection

The granting of the title of "Visiting Professor" shall be decided by the University President from among recommended candidates after deliberation by the IROAST Steering Committee.

3. Grant period

The grant period shall be from April 1 to March 31 of the following year of each fiscal year.

If the title is granted during a fiscal year, the title grant period shall be the period from a month following the month in which office tasks for granting the title were completed to March 31 of the year following the fiscal year in question; provided, however, that if the grant period is shorter than three (3) months, taking into account the timing of the recommendation and the time required for office tasks, the title shall be granted in the next fiscal year.

4. Renewal

The renewal of title granting shall be checked on or before the last day of January in each fiscal year to each recommending faculty member.

If each recommending faculty member desires the renewal based on activities during the fiscal year, he/she shall obtain the consent of each visiting professor and request to the Director of IROAST for the renewal.

The Director of IROAST shall examine based on the request from the recommending faculty member and, if the renewal is appropriate, shall request that the University President renew the appropriate person.

The Director of IROAST shall report the names of renewed visiting professors at the IROAST Steering Committee meeting, which is held the first time in the next fiscal year.

5. Restriction on renewal period

The renewal shall not be extended beyond March 31, 2021 (the first-phase period of the Research Organization.)

## **Agreement of the International Research Organization for Advanced Science and Technology (IROAST) for Distinguished Professors**

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.

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.

## **Selecting Distinguished Professors for the International Research Organization for Advanced Science and Technology (IROAST)**

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.

(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.







International Research Organization for  
Advanced Science and Technology

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