

## 4-2. IROAST Seminars

No. (Invitation Program No.)	Title	IROAST Speaker
	Date	Organizer
4-2-1	The 119th IROAST Seminar - Population Balance Modelling- Fundamentals and Applications	<b>Stelios RIGOPOULOS</b> Imperial College of London, UK
	May 7, 2024	<b>Hamid HOSANO</b> IINa
4-2-2	The 120th and 121st IROAST Seminar - Migration of grain Boundaries	<b>Dmitri Aleks MOLODOV</b> RWTH Aachen University, Germany
	May 21 & 23, 2024	<b>Sadahiro TSUREKAWA</b> FAST
4-2-3	The 122nd IROAST Seminar - Shock wave driven drug injector	<b>Viren MENEZES</b> Indian Institute of Technology Bombay, India
	May 28, 2024	<b>Hamid HOSANO</b> IINa
4-2-4 (3-1-1)	The 123rd IROAST Seminar - Electrocatalysis for resolving energy & environmental issues	<b>Mohammad Abul HASNAT</b> University of Science and Technology, Bangladesh
	June 13, 2024	<b>Shintaro IDA</b> IINa
4-2-5 (3-1-2)	The 124th IROAST Seminar - Visualization of EGFR Internalization as a Theranostic Approach	<b>Ick Chan KWON</b> Korea Institute of Science and Technology (KIST), Korea
	July 8, 2024	<b>Takuro NIIDOME</b> FAST <b>Ruda LEE</b> IINa
4-2-6 (3-1-3)	The 125th IROAST Seminar - AI & Computer vision for geo- materials	<b>Patrice DELMAS</b> The University of Auckland, New Zealand
	July 12, 16 & 17, 2024	<b>Toshifumi MUKUNOKI</b> FAST
4-2-7	The 126th IROAST Seminar - Beyond critical point: Creation of supercritical fluid technology	<b>Youn-Woo LEE</b> Seoul National University, Korea
	July 26, 2024	<b>Mitsuru SASAKI</b> IINa
4-2-8	The 127th IROAST Seminar - Presentations of Research Results by IROAST Postdoctoral Researchers	<b>Reetu Rani</b> IROAST <b>Prafulla Bahadur MALLA</b> IROAST <b>Jonas Karl N. AGUTAYA</b> IROAST
	August 21, 2024	IROAST

4-2-9 (3-1-4)	The 128th IROAST Seminar - Multifunctional Reactor: The Key to Sustainable Production	<b>Suttichai ASSABUMRUNGRAT</b> Chulalongkorn University, Thailand
	October 8, 2024	<b>Tetsuya KIDA</b> FAST <b>Armando T. QUITAIN</b> Headquarters for Admissions and Education
4-2-10 (3-1-5)	The 129th IROAST Seminar - Contributions to the Decarbonization of Industry through the Transformation of Biomass into Chemical Products	<b>Maria Jose COCERO</b> The University of Valladolid, Spain
	October 24, 2024	<b>Tetsuya KIDA</b> FAST <b>Armando T. QUITAIN</b> Headquarters for Admissions and Education
4-2-11 (3-1-6)	The 130th IROAST Seminar - Design Strategies for Developing Heavy-Atom-Free Photoredox Catalysts	<b>Tomoyasu MANI</b> University of Connecticut, USA
	October 24, 2024	<b>Yutaka KUWAHARA</b> FAST
4-2-12	The 131st IROAST Seminar - Mechanics of rooted soils: recent advances	<b>Anthony LEUNG</b> The Hong Kong University of Science & Technology (HKUST), China
	October 28, 2024	<b>Toshifumi MUKUNOKI</b> FAST
4-2-13 (3-1-7)	The 132nd IROAST Seminar - Microstructure of metallic materials produced by additive manufacturing	<b>Pavel LEJČEK</b> Institute of Physics, Czech Academy of Sciences, Czech Republic
	November 7, 2024	<b>Sadahiro TSUREKAWA</b> FAST
4-2-14 (3-1-8)	The 133rd IROAST Seminar - Historical Origins of Vaccines. Achievements and Controversies	<b>Josep Lluís BARONA-VILAR</b> University of Valencia, Spain
	November 8, 2024	<b>Makoto TAKAFUJI</b> FAST
4-2-15 (3-1-9)	The 134th IROAST Seminar - Recent advances in MOX-based electro-optical chemical sensors and fuel cells	<b>Dario ZAPPA</b> The University of Brescia, Italy
	November 22, 2024	<b>Tetsuya KIDA</b> FAST
4-2-16 (3-1-10)	The 135th IROAST Seminar - Development of chemical vapor sensors their potential applications	<b>Tung Thanh TRAN</b> The University of Adelaide, Australia
	November 22, 2024	<b>Tetsuya KIDA</b> FAST



4-2-17	The 136th IROAST Seminar - Neutron scattering methods in condensed matter physics, chemistry and materials sciences	<b>László PUSZTAI</b> HUN-REN Wigner Research Center for Physics, Hungary
	November 22, 2024	<b>Yoichi NAKAJIMA</b> FAST
4-2-18	The 137th IROAST seminar - Development of High Strength Biodegradable Metals for Regenerative Medicine	<b>Yufeng ZHENG</b> Peking University, China
	December 11, 2024	<b>Yoji MINE</b> FAST
4-2-19 (3-1-11)	The 138th IROAST Seminar - Transferring Chiral Information between Objects with different dimensions	<b>Reiko ODA</b> CNRS-University of Bordeaux, France
	December 17, 2024	<b>Makoto TAKAFUJI</b> FAST
4-2-20 (3-1-12)	The 139th IROAST Seminar - Meshfree Modelling of Ocean Waves, Landslides and Soil-Water Interactions	<b>Dongfang LIANG</b> University of Cambridge, UK
	December 20, 2024	<b>Hiroshi CHO</b> FAST
4-2-21 (3-1-13)	The 140th IROAST Seminar - Seismicity-Permeability Linkages in Fractured Reservoirs	<b>Derek ELSWORTH</b> Penn State University Park, USA
	January 8, 2025	<b>Atsushi SAINOKI</b> FAST
4-2-22 (3-1-14)	The 141st IROAST Seminar - Healthcare and Technology	<b>Abdul HAFEEZ-BAIG</b> University of Southern Queensland, Australia
	March 14, 2025	<b>Makiko KOBAYASHI</b> FAST

FAST: Faculty of Advanced Science and Technology

IINa: Institute of Industrial Nanomaterials

### IROAST Seminar Report

No. 4-2-1 (Seminar)	Name	Hamid HOSANO	Title	Professor
	Affiliation	Institute of Industrial Nanomaterials		
Seminar Title	The 119th IROAST Seminar “Population Balance Modelling-Fundamentals and Applications”			
Venue	Kurokami South C7, Academic Commons Kurokami Bldg.3, 5F Room 516			
Time & Date	11:30 – 13:00, May 7, 2024			
Speaker’s Name/ Title/Affiliation	Stelios RIGOPOULOS, Professor, Imperial College of London			
Number of Participants	Total: 4 (Int’l participants: 4) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	May 5 – 7, 2024			

-Seminar report -

#### 1. Seminar Overview

Title: Population Balance Modelling-Fundamentals and Applications

The presentation covered Population Balance modelling fundamentals and their applications. The population balance methodology provides a powerful framework for studying polydisperse entities such as aerosols, crystals and bubbles. The lecture explained applications of the population balance methodology in case studies including nanoparticle synthesis, soot formation and crystallization. Especial emphasize was given to nanoparticle formation.

#### 2. Seminar Outcomes and Future Plan

The lecture provided opportunities for students at Kumamoto University to learn about Population Balance modelling fundamentals and explore their potential applications for nanoparticles formation as well as utility of nanoparticles for potential collaborative projects.

Interdisciplinary research at the interface of engineering and medicine using nanoparticulate carriers was discussed.



Prof. RIGOPOULOS



At the venue1



Prof. HOSANO



At the venue2



## IINa Intl. Lecture & Seminar No. 1 - The 119<sup>th</sup> IROAST Seminar -

**Title: Population Balance Modelling – Fundamentals and Applications**

**Lecturer: Prof. Stelios Rigopoulos (Reader in Thermofluids, Imperial College London, UK)**

**Date & Time: May 7, 2024 (Tue.) 11:30~12:00**

**Venue: Academic Commons Kurokami Bldg. 3 (Kurokami South C7 <https://ewww.kumamoto-u.ac.jp/en/about/access/campus/>), 5<sup>th</sup> Floor, Room 516**

### IROAST Seminar Report

No. 4-2-2 (Seminar)	Name	Sadahiro TSUREKAWA	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 120th & the 121st IROAST Seminars “Migration of grain boundaries”			
Venue	Kurokami South C8, Faculty of Engineering Research Bldg.1, Room 308			
Time & Date	10:25 – 11:55, May 21 and (8:40 – 10:10, May 23), 2024			
Speaker’s Name/ Title/Affiliation	Dmitri A. MOLODOV, Distinguished Professor, RWTH Aachen Univ. Germany			
Number of Participants for 2 days	Total: 29 (120th) / 26 (121st) (Int’l participants: 2 (120th) / 2 (121st))			
	Invitees: 1 (120th) / 1 (121st) (Int’l participants: 1 (120th) / 1 (121st))			
Duration of Visit	May 21 (120th) and 23 (121st), 2024			

#### 1. Seminar Overview

Professor D. A. Molodov delivered a special lecture on the topic of "Migration of grain boundaries" on 21 and 23 May 2024 as part of the regular course on Material Interface Science taught by Professor S. Tsurekawa. A total of 55 attendees, comprising graduate students, researchers and faculty members from Kumamoto University, were present at the lecture (please see photos). Grain boundary migration is a significant phenomenon that influences the development of microstructures in materials. In the lectures, Prof. D. A. Molodov outlined the fundamental principles of grain boundary migration, drawing on both experimental and theoretical insights. Key dependencies and relationships were highlighted, including the relationship between boundary migration rate and driving force, the misorientation dependence of grain boundary mobility, the compensation effect, and the effect of inclinational anisotropy of boundary energy on capillary-driven boundary migration. Additionally, examples of stress-driven boundary migration and magnetically-driven boundary motion were presented.

#### 2. Seminar Outcomes and Future Plan

Following the seminar, students were given the chance to present and discuss their experimental research with Prof D.A. Molodov. Prof D. A. Molodov provided detailed feedback and guidance to each student (please see photos).

Prof D. A. Molodov and Prof S. Tsutsukawa have been collaborating on a project concerning the local mechanical properties at grain boundaries of orientation-controlled aluminum bicrystals, focusing in particular on the grain boundary plane inclination effect. During Prof Molodov's visit to Kumamoto University, we discussed our experimental results and future research plans, including graduate students from Prof Tsurekawa's group who are participating in the project.

**1st seminar on May 21st**



Distinguished Prof. MOLODOV



At the venue

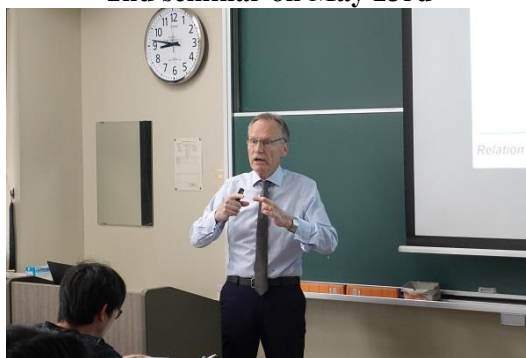


Prof. TSUREKAWA



Group photo

**2nd seminar on May 23rd**



Distinguished Prof. MOLODOV



At the venue1



Prof. TSUREKAWA



At the venue2



**120th & 121st IROAST SEMINAR**

**120th Topic**  
 Tue, May 21, 2024  
 10:25-11:55  
 Fundamentals:  
 Grain boundary mobility,  
 Driving forces for grain  
 boundary motion, Drag effects  
 during grain boundary motion,  
 Measurement of grain  
 boundary migration.

**121st Topic**  
 Thurs, May 23, 2024  
 8:40-10:10  
 Relation between driving force and  
 boundary migration rate,  
 Misorientation dependence of grain  
 boundary mobility, Mechanically  
 driven grain boundary migration  
 coupled to shear, Magnetically  
 induced grain boundary migration in  
 non-ferromagnetic metals.

# Migration of Grain Boundaries

IROAST Distinguished Professor  
**Dmitri Molodov**

@Room 308, Kurokami South C3  
 (Faculty of Engineering Research Bldg. 1)

**Organizer**  
**Prof. Sadahiro Tsurekawa**  
 FAST, Kumamoto university

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



At Prof. TSUREKAWA's laboratory



Prof. MOLODOV with members of Prof. TSUREKAWA's group

### IROAST Seminar Report

No. 4-2-3 (Seminar)	Name	Hamid HOSANO	Title	Professor
	Affiliation	Institute of Industrial Nanomaterials		
Seminar Title	The 122nd IROAST Seminar “Shock wave driven drug injector”			
Venue	Kurokami South C7, Academic Commons Kurokami Bldg.3, 5F Room 516			
Time & Date	13:30 – 14:30, May 28, 2024			
Speaker’s Name/ Title/Affiliation	Viren MENEZES, Professor of Aerospace Eng., Indian Institute of Tech. Bombay (IITB), INDIA			
Number of Participants	Total: 5 (Int’l participants: 4) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	May 22 – 29, 2024			

-Seminar report -

#### 1. Seminar Overview

Title: Shock wave driven drug injector

The talk presented a needle-free drug delivery device for liquid drug injection into skin and other soft living targets. The device was powered by a shock wave, which forced a micro drug jet out of a 125  $\mu\text{m}$  nozzle at a very high speed, such that the jet had enough momentum to penetrate a soft target. The depth of jet penetration was found sufficient for drug uptake by the target body. The device was tested, in-vivo, for drug delivery on Wistar rats. The results of the in-vivo tests have been encouraging.

#### 2. Seminar Outcomes and Future Plan

Future research collaborations will include, development of clinical prototypes and further in-vivo testing of a drug delivery device. In addition, a research program on velocity measurement techniques will be initiated.

The visit was productive, with several technical discussions and interactions. The doctor students attended the presentation were encouraged to perform applied research.



Prof. MENEZES



Prof. MENEZES



Prof. HOSANO



At the venue



## IINa Intl. Lecture & Seminar No. 2 - The 122<sup>nd</sup> IROAST Seminar -

**Title: Shock wave driven drug injector**

**Lecturer: Viren Menezes (Professor of Aerospace Eng., Indian Institute of Tech. Bombay (IITB), India)**

**Date & Time: May 28, 2024 (Tue.) 13:30~14:00**

**Venue: Academic Commons Kurokami Bldg. 3  
(Kurokami South C7 <https://ewww.kumamoto-u.ac.jp/en/about/access/campus/>), 5<sup>th</sup> Floor, Room 516**

**Abstract:** The talk presents a needle-free drug delivery device for liquid drug injection into skin and other soft living targets. The device is powered by a shock wave, which forces a micro drug jet out of a 125  $\mu\text{m}$  nozzle at a very high speed, such that the jet has enough momentum to penetrate a soft target. The depth of jet penetration has been found sufficient for drug uptake by the target body.

**Supported by Institute of Industrial Nanomaterials (IINa), Kumamoto University**



### IROAST Seminar Report by IROAST Visiting (Associate) Professor Invitation

No.3-1-1 (Invitation Program) No.4-2-4 (Seminar)	Name	Shintaro IDA	Title	Professor
	Affiliation	Institute of Industrial Nanomaterials		
Seminar Title	The 123rd IROAST Seminar “Electrocatalysis for resolving energy & environmental issues”			
Venue	International Seminar Room 2F, Kurokami South W4 (Faculty of Engineering Research Bldg.2)			
Time & Date	16:00 – 16:45, June 13, 2024			
Speaker’s Name/ Title/Affiliation	M. Abul HASNAT, Professor, Shahjalal University of Science & Technology, Bangladesh			
Number of Participants	<u>Total: 32</u> (Int’l participants: 10 ) Invitees: 1 (Int’l participants: 1 )			
Duration of Visit	June 12 – 14, 2024			

-Seminar report -

#### 1. Seminar Overview

Professor Hasnat from Shahjalal University of Science & Technology in Bangladesh was invited to give a lecture on the latest research findings related to electrochemistry.

#### 2. Seminar Outcomes and Future Plan

The seminar was attended by approximately 30 participants and led to extensive discussions following the lecture, making the event a great success. Additionally, it was decided to explore the possibility of conducting joint research with Professor Hasnat's research group in the future.



Dr. HASNAT



Prof. IDA



At the venue



Group photo



# THE 123RD IROAST SEMINAR

THURSDAY, JUNE 13, 16:00-16:45

@International Seminar Room, 2F, Kurokami South W4,  
(Faculty of Engineering Research Bldg.2)



## DR. M. ABUL HASNAT

Electrochemistry & Catalysis Research Lab  
Shahjalal University of Science & Technology, Bangladesh

***“Electrocatalysis for resolving  
energy & environmental issues”***

### ORGANIZER

Prof. Shintaro IDA  
IINa, Kumamoto University

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🌐 <https://iroast.kumamoto-u.ac.jp>

**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-2 (Invitation Program) No.4-2-5 (Seminar)	Name	Takuro NIIDOME	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 124th IROAST Seminar “Visualization of EGFR Internalization as a Theranostic Approach”			
Venue	Industrial Innovation Laboratory 1F, Oe Campus			
Time & Date	13:30 – 14:30, July 8, 2024			
Speaker’s Name/ Title/Affiliation	Ick Chan KWON, Principal Investigator, Biomedical Research Institute of Science and Technology (KIST), Korea			
Number of Participants	Total: 9 (Int’l participants: 2 )			
	Invitees: 1 (Int’l participants: 1 )			
Duration of Visit	July 8 – 12, 2024			

**1. Seminar Overview**

Prof. Kwon explained the new concept of the receptor-targeted delivery system. His discovery suggests a new paradigm in the field of targeting research. He presented the information in an easy-to-understand manner, making the explanation about clinical trials particularly engaging. Currently, his findings have received approval for Phase I clinical trials in Korea. It is a great opportunity to observe how nanomaterials transition to clinical trials for practical application.

**2. Seminar Outcomes and Future Plan**

Since 2019, Prof. Kwon has held monthly meetings with my lab students to check on research progress. Unfortunately, the material preparation failed, which led us to change the direction of the research project. Despite this setback, Prof. Kwon continued to provide valuable feedback to the students. Now, we have prepared lipid nanoparticles (LNP) using a similar system to the one that previously failed. We expect to publish collaborative papers in 2025.

**3. Research achievements during his/her stay in Kumamoto University.**

Prof. Kwon attended the 40th Japan DDS conference as a plenary speaker. During this time, we discussed the direction for three manuscripts. Based on his experience as a chief editor, he suggested searching for references related to our new findings. We discovered that there are no references to support our results. Therefore, we will collaborate with Prof. Kwon to finalize the manuscripts.

**4. Prospect for further research collaboration.**

In September 2024, Associate Prof. Lee plans to visit KIST for a research collaboration. Prof. Kwon’s lab at KIST specializes in techniques for synthesizing recombinant proteins. Therefore, we plan to visit and learn these techniques for new research applications.



Dr. KWON



Prof. NIDOME



Assoc. Prof. LEE



At the venue1



Group photo



At the venue2





# 124th IROAST Seminar

July 8 th Mon. 13:30 - 14:30

Industrial Innovation Laboratory 1 F, at Oe Campus

## “Visualization of EGFR Internalization as a Theranostic Approach”

**Dr. Ick Chan Kwon**

BIOMEDICAL RESEARCH DIVISION, KIST, KOREA



### Abstract

Targeting the epidermal growth factor receptor (EGFR) is a promising approach for colorectal cancer treatment, yet individual responses to EGFR-targeted therapies vary widely. Current diagnostic methods fall short in predicting therapeutic efficacy.

To address this, we developed two innovative probes: an EGF-conjugated fluorescence-activatable probe (EGF-probe) and a fluorogenic cetuximab-conjugated probe (Cetux-probe). The EGF-probe, paired with an EGF-conjugated doxorubicin prodrug (EGF-prodrug), uses lysosomal enzyme activity to activate fluorescence and cytotoxicity upon EGFR-mediated endocytosis. Similarly, the Cetux-probe evaluates EGFR internalization and degradation, predicting the response to cetuximab therapy.

Both probes demonstrated strong correlations between fluorescence activation and therapeutic efficacy in colorectal cancer cells, dependent on lysosomal activity rather than EGFR expression. These tools offer a significant advancement in personalized cancer therapy by enhancing the ability to predict and monitor treatment responses, paving the way for more effective and tailored patient care.

1. Y.Sung, et al, *Biomaterials*, 303, 122382 (2023)
2. H.Y. Kim, et al, *J. Controlled Release*, 328, 222-236 (2020)

**Organizer : Prof. Takuro NIIDOME, FAST, KU**



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Website: <https://iroast.kumamoto-u.ac.jp>

**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-3 (Invitation Program) No.4-2-6 (Seminar)	Name	Toshifumi MUKUNOKI	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 125th IROAST Seminar “AI & Computer vision for geo-materials”			
Venue	Kurokami South C2, 3F, Room 328 (Faculty of Engineering Bldg.1)			
Time & Date	10:30 am – 12:00 pm, July 12, 16 and 17, 2024			
Speaker’s Name/ Title/Affiliation	Patrice DELMAS, Visiting Professor, The University of Auckland, NZ			
Number of Participants	Total: 17 (7/12), 16 (7/16), 16 (7/17), [Int'l participants:7 (7/12), 5 (7/16), 6 (7/17) ] Invitees (all 3days): 1			
Duration of Visit	July 12 – 17, 2024			

-Seminar report -

**1. Seminar Overview**

Associate Professor Patrice Delmas has 30 years’ experience in Computer Vision and Artificial intelligence from its early foundations’ methods of the late 1990s up to today’s bleeding edge applications in a variety of research domains. Over 6 hours of mixed lectures and practical material, I will first briefly encompass the field evolution and today’s challenges of the AI field when dealing with Computer Vision. We will then look at the concepts behind a popular deep learning approach, how to initiate the process of training and testing such deep learning models and what the results really mean. The exemplar data will be based on CT-scan data acquired at Kumamoto University X-Earth Center as part of my IROAST role and our collaboration with Professor Toshifumi Mukunoki.

Day 1: Lecture of introduction of machine learning and environment set up for machine learning (ML)

Day 2: Feedback of ML and how to perform image processing using ML

Day 3: Feedback of ML and how to use Python code

**2. Seminar Outcomes and Future Plan**

Students learned the merit and demerit to use AI with machine learning. Most of students understand the concept of machine learning and so they will use AI for their research. In particular, the use of image processing was lectured and they learned the point of “Annotation” to prepare good input data.

As for future plan, if some students want to learn and perform more machine learning, Dr. Delmas will accept the students as far as they could get financial support from others.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

In this time, Dr. Delmas installed the Machine learning system into the PC with GPU possessed by Dr. Mukunoki’s lab. They discussed the potential issue for collaboration to use this system for CT image analysis. While he stayed here, he taught and supported students how to set up machine learning environment.

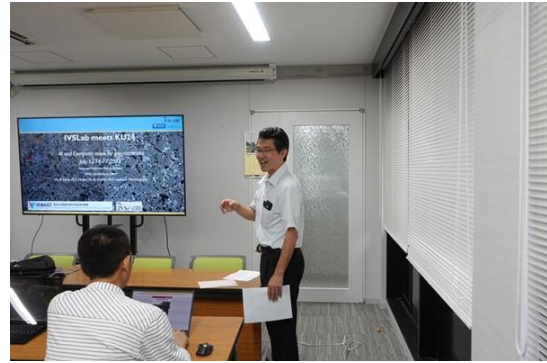
**4. Prospect for further research collaboration.**

As he mentioned in his lecture, the advantage of image processing using machine learning is to be able to treat so many data in short time. But, we have to validate the results always. In order to introduce machine learning into the CT image analysis, annotated data also should be prepared and it will take so long time; however, it may solve image segmentation problem caused by the cupping effect in the CT

image caused by beam hardening. This discussion may produce one good paper. We just started this discussion. We also have submitted JSPS program for Invitational Fellowships for Research in Japan based on current research project. If it worked, Prod. Delmas will be here from August to October here.



Assoc. Prof. DELMAS



Prof. MUKUNOKI



Assoc. Prof. DELMAS



At the venue1



Group photo



At the venue2



# 125th IROAST Seminar

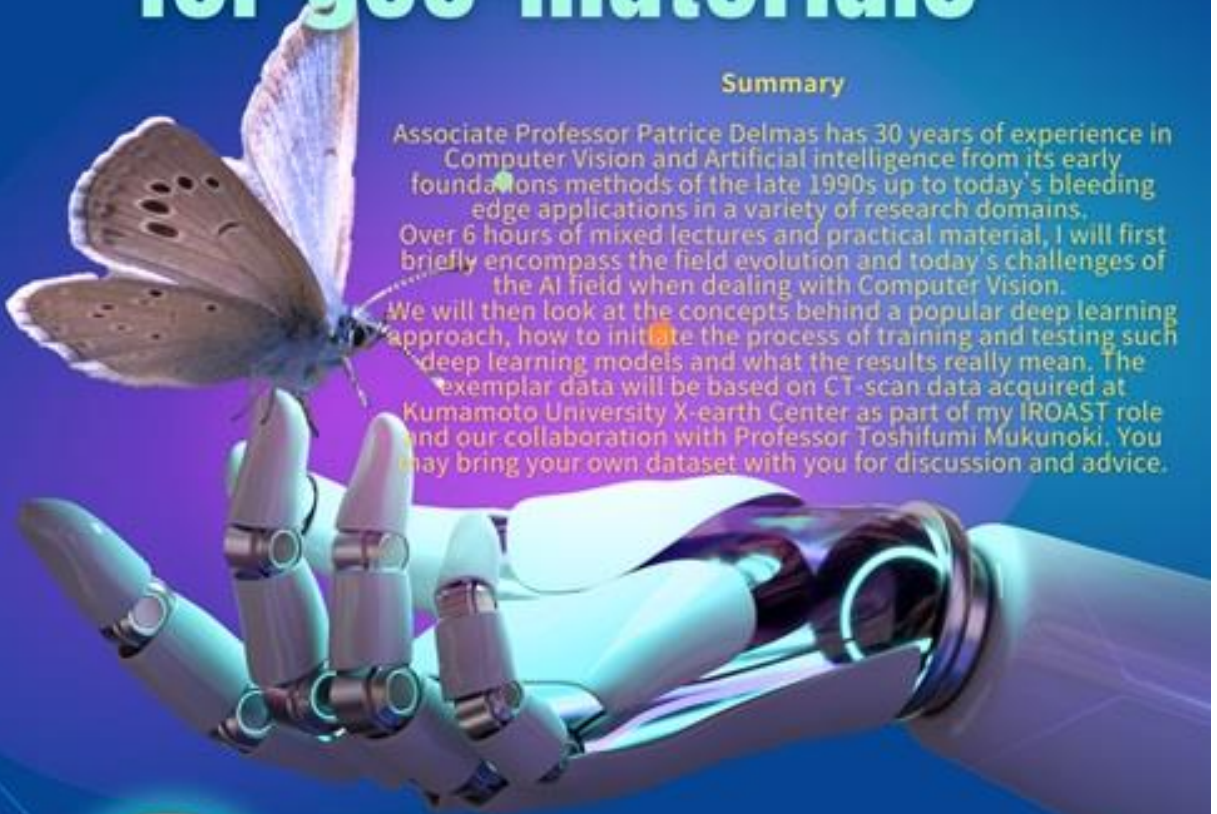
12, 16 & 17 July 10:30-12:00

Kurokami South C2, 3F Room 328  
(Faculty of Engineering Bldg.1)

## “AI & Computer vision for geo-materials”

### Summary

Associate Professor Patrice Delmas has 30 years of experience in Computer Vision and Artificial intelligence from its early foundations methods of the late 1990s up to today's bleeding edge applications in a variety of research domains. Over 6 hours of mixed lectures and practical material, I will first briefly encompass the field evolution and today's challenges of the AI field when dealing with Computer Vision. We will then look at the concepts behind a popular deep learning approach, how to initiate the process of training and testing such deep learning models and what the results really mean. The exemplar data will be based on CT-scan data acquired at Kumamoto University X-earth Center as part of my IROAST role and our collaboration with Professor Toshifumi Mukunoki. You may bring your own dataset with you for discussion and advice.



Speaker

**Dr. Patrice Delmas**

IROAST Visiting Professor,  
The University of Auckland, NZ



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

Organizer : Prof. Toshifumi MUKUNOKI, FAST, KU



**IROAST Seminar Report**

No. 4-2-7 (Seminar)	Name	Mitsuru SASAKI	Title	Associate Professor
	Affiliation	Institute of Industrial Nanomaterials (IINa)		
Seminar Title	The 126th IROAST Seminar “Beyond critical point: Creation of supercritical fluid technology”			
Venue	Kurokami South W4, 2F Room203, Faculty of Engineering Research Bldg.2			
Time & Date	11:00 am – 12:00 pm, July 26, 2024			
Speaker’s Name/ Title/Affiliation	Youn-Woo LEE, Professor, School of Chemical & Biological Engineering, Seoul National University, Korea			
Number of Participants	Total: 19 (Int’l participants: 6 )			
	Invitees: 1 (Int’l participants: 1)			
Duration of Visit	July 24 – 31, 2024			

-Seminar report -

**1. Seminar Overview**

On July 26, 2024, Associate Professor Mitsuru SASAKI (Institute of Industrial Nanomaterials (IINa)) who is an IROAST International Joint Research Faculty Member served as the organizer, and Professor Youn-Woo LEE (Seoul National University) was welcomed to present at the 126th IROAST Seminar.

IROAST Visiting Professor Youn-Woo LEE from Seoul National University (Korea) delivered a lecture on supercritical CO<sub>2</sub> technology—a research area that Seoul National University has been working on for many years. He provided examples such as the use of sesame oil extraction, coffee bean extraction, and methods to prevent the deterioration of Joseon Dynasty documents. Prof. Lee had been visiting Kumamoto University every year before the time of COVID-19, and at the opening, he spoke enthusiastically about Kumamoto as his second home, including an episode from a Japanese class he took at Kumamoto University during that time.

**2. Seminar Outcomes and Future Plan**

During his stay, Professor Lee visited our research group's laboratory and gave detailed advice on how to make the high-temperature and high-pressure reactor that our students are currently building easier to use, how to measure and control temperature and pressure, and how to select high-pressure joints. We will continue to collaborate on research on biomass conversion and the development of wastewater treatment processes using pulse discharge, and will discuss the matter using tools such as email and Zoom.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

During his stay, Professor Lee introduced the fundamental properties of supercritical fluids and the trends in technology that utilize them at the IROAST seminar mentioned above. In addition, he held a research discussion with Professor Tetsuya Kida, a research debate with Professor Kitain Armand, and a research discussion with Professor Ken Momose of the Semiconductor and Digital Research and Education Organization.

**4. Prospect for further research collaboration.**

We will continue to collaborate on research on biomass conversion and the development of wastewater treatment processes using pulse discharge, and will discuss the matter using tools such as email and Zoom. Also, Prof. Lee will join a new member of my research cluster.



Prof. LEE



Assoc. Prof. SASAKI



At the venue1



At the venue2



Q&A time



Group photo

# 126<sup>th</sup> IROAST Seminar

July 26 Fri. 11:00-12:00

Kurokami South W4, 2F Room 203  
(Faculty of Engineering Research Bldg.2)



**Prof. Youn-Woo LEE**

School of Chemical & Biological Engineering,  
Seoul National University, Korea

## “Beyond critical point: Creation of supercritical fluid technology”

### Summary

In this lecture, long term R&D activities at Seoul National University will be presented with emphasis on the commercialization efforts in the fields of supercritical technology.

Nano particles of various metal oxides prepared in supercritical water or alcohol including a continuous production of LiFePO<sub>4</sub> will be introduced. It will be presented that a commercial SCWO plant for treating wastewater from TPA manufacturing process which contains many organic acids and homogeneous catalyst such as cobalt and manganese acetate.

New applications using supercritical CO<sub>2</sub> technology which is able to preserve the micro-structure during drying stage will be proposed.

Supercritical CO<sub>2</sub> drying technology for post-treatment of ceramic nanoparticles synthesis will be presented. Several processes of washing followed by drying of same CeO<sub>2</sub> nanoparticles which were synthesized in one batch reactor will be compared and discussed. The restoration process of the Annals of the Joseon Dynasty, one of the Korea's national treasures, composed of a solvent extraction process and a scCO<sub>2</sub> drying process, were developed for extracting beeswax without damaging printing as well as paper.

Some other commercialization example of extraction process will be discussed.



**Organizer: Assoc. Prof. Mitsuru SASAKI, IINa, KU**

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### IROAST Seminar Report

No. 4-2-8 (Seminar)	Name	—	Title	—
	Affiliation	IROAST		
Seminar Title	The 127th IROAST Seminar “Presentation of Research Results by IROAST Postdoctoral Researchers 2024”			
Venue	Kurokami South C4 IROAST Meeting Room #204 (2F, Academic Commons Kurokami Bldg.2)			
Time & Date	2:30 pm – 6:00 pm, August 21, 2024			
Speaker’s Name/ Title/Affiliation	Dr. Reetu Rani, Postdoctoral Researcher, IROAST Dr. Prafulla Bahadur MALLA, Postdoctoral Researcher, IROAST Dr. Jonas Karl N. AGUTAYA, Postdoctoral Researcher, IROAST			
Number of Participants	<u>Total: 40</u> (Int’l participants: 20 )			

-Seminar report -

On August 21, 2024, the IROAST held the Presentation of Research Results by IROAST Postdoctoral Researchers 2024 (the 127th IROAST Seminar).

This presentation was held in connection with the completion of the activities of three postdoctoral researchers hired under the "Foreign Postdoctoral Researcher Invitational Program for Strategic International Growth" at the end of August this year, and was attended by about 40 faculty members and students.

After an opening address by Dr. Kazuki TAKASHIMA, Director of the Research Organization, the three researchers gave presentations on their achievements during their two years at IROAST. After each presentation, questions from the audience followed, making the event a very productive one, and Deputy Director Kei TODA concluded with his impressions of the meeting.

After the presentations, a farewell party was also held for the three postdoctoral fellows, where their activities over the past two years were praised. We look forward to their further progress in their next steps.

■Facilitator



Prof. Kei TODA  
IROAST Vice Director

■Opening Remarks



Prof. Kazuki TAKASHIMA  
IROAST Director



## ■ Presentations



Dr. Reetu Rani  
Postdoctoral Researcher, IROAST



Dr. Prafulla Bahadur MALLA  
Postdoctoral Researcher, IROAST



Dr. Jonas Karl N. AGUTAYA  
Postdoctoral Researcher, IROAST

## ■ Closing Remarks



Prof. Kei TODA  
IROAST Vice Director



At the venue

## \*Program

4:35-4:50 "Exploring methods for selective transfer of ionic solutes"  
-Dr. Reetu Rani (Advisor: Professor Shinichi OHIRA) \*FAST

4:55-5:10 "Seismic Performance of Shear Walls with Low Bond Ultra High-Performance Reinforcing steel bars under Multiple Reversed Cyclic Loading "  
-Dr. MALLA Prafulla Bahadur (Advisor: Associate Professor Gaochuang CAI) \*IROAST

5:15-5:30 "Elucidation of the gas sensing mechanism of semiconductor metal oxides by a combined DRIFTS and DFT approach"

-Dr. AGUTAYA Jonas (Advisor: Professor Tetsuya KIDA) \*FAST

\*Poster

# 127<sup>th</sup> IROAST Seminar Presentations of Research Results by IROAST Postdoctoral Researchers

## Speakers



Dr. Reetu Rani

Talk title:  
"Exploring methods for  
selective transfer of  
ionic solutes"



Dr. MALLA Prafulla Bahadur

Talk title:  
"Seismic Performance of  
Shear Walls with Low  
Bond Ultra High-  
Performance Reinforcing  
steel bars under Multiple  
Reversed Cyclic Loading"



Dr. AGUTAYA Jonas

Talk title:  
"Elucidation of the gas  
sensing mechanism of  
semiconductor metal  
oxides by a combined  
DRIFTS and DFT  
approach"

As the three Postdoctoral Researchers hired in September 2022 under the IROAST program, "**Foreign Postdoctoral Researcher Invitational Program for Strategic International Growth**" will finish their activities at IROAST at the end of August this year, to provide them with a place to present the results of their research and to promote the achievements of their research over the past two years within Kumamoto University, and to promote exchange and collaboration among researchers in the university.

## 21st August, 2024

No registration  
is required

Kurokami South C4 (Academic Commons Kurokami Bldg. 2),  
2F conference room 204

From 4:30 pm - 6:00 pm



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

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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-4 (Invitation Program) No.4-2-9 (Seminar)	Name	Tetsuya KIDA/ Armando T. QUITAIN	Title	Professor/ Professor
	Affiliation	Faculty of Advanced Science and Technology/ Headquarters for Admissions and Education		
Seminar Title	The 128th IROAST Seminar “Multifunctional Reactor: The Key to Sustainable Production”			
Venue	Online and On-site Kurokami North E1, General Education Bldg. Room B201			
Time & Date	12:55 – 14:25, October 8, 2024			
Speaker’s Name/ Title/Affiliation	Suttichai ASSABUMRUNGRAT, Professor, Chulalongkorn University, Thailand			
Number of Participants	<u>Total: 248 participants</u> Onsite: 56 (Int’l participants: 15) Online: 182 participants (Indonesia, Thailand, Malaysia, Philippines) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	October 4 – 13, 2024			

**1. Seminar Overview**

The seminar given by Prof. Suttichai Assabumrungrat focused on the concept of multifunctional reactor as applied to “biorefinery”. Multifunctional reactor is a chemical reactor that integrates one or more functions together with chemical reaction in one unit operation. It offers innovative solutions to enhance efficiency, reduce waste, and mitigate environmental impact. It has become an important approach towards achieving sustainable production and advancing the transition to carbon neutrality and net-zero emissions targets. This seminar provided the concept of multifunctional reactor, different types of multifunctional reactor, and examples of past successful implementations in many processes particularly in chemical and petrochemical industries. It also highlights ongoing efforts to utilize multifunctional reactor in advancing development of the Bio-Circular-Green Economy, a promising strategy towards achieving Sustainable Development Goals (SDGs). This seminar was participated by many researchers and students (both online and on-site).

**2. Seminar Outcomes and Future Plan**

This seminar has broadened the knowledge of participating researchers and students on many aspects of “multifunctional reactor as applied to biorefinery concept”. Research-related activities other than the seminar were as follows:

- Discussion on the contents of our two joint research publications (in-preparation):
  - “Glycerol Conversion to Biofuels”, (Fuels, submitted and under review)
  - “Deamination of Algal Bio-oil using Green Approach”, (in preparation)
- Discussion on our on-going JSPS-NRCT Bilateral Joint Research Project on conversion of glycerol to useful chemicals and fuels with the students working on this topic and future research proposals.
- Discussion to further strengthen our future collaboration on research and academic exchanges including the JSPS Bilateral JRP Workshop scheduled on November 28~30, 2024 in Chulalongkorn University, and to be participated by 11 students and 2 faculty members from Kumamoto University.

For IROAST and Kumamoto University, it is expected that this collaboration with Prof. Suttichai Assabumrungrat of Chulalongkorn University, the leading academic institution in Thailand, will continue to yield significant results, and will be able to make a significant contribution to further development of human resources, and for active promotion of international joint research between Japan and ASEAN countries.





Prof. ASSABUMRUNGRAT



Prof. QUITAIN



Prof. ASSABUMRUNGRAT



At the venue1



At the venue2



Group photo





# 128<sup>th</sup> IROAST SEMINAR



## “Multifunctional Reactor: The Key to Sustainable Production”

**Prof. Suttichai  
ASSABUMRUNGRAT**

Department of Chemical Engineering,  
Faculty of Engineering,  
Chulalongkorn University, Thailand



### Abstract

Multifunctional reactor is a chemical reactor that integrates one or more functions together with chemical reaction in one unit operation. It offers innovative solutions to enhance efficiency, reduce waste, and mitigate environmental impact. It has become an important approach towards achieving sustainable production and advancing the transition to carbon neutrality and net-zero emissions targets. This talk provides the concept of multifunctional reactor, different types of multifunctional reactor, and examples of past successful implementations in many processes particularly in chemical and petrochemical industries. It also highlights ongoing efforts to utilize multifunctional reactor in advancing development of the Bio-Circular-Green Economy, a promising strategy towards achieving Sustainable Development Goals (SDGs).

### Organizers

**Prof. Tetsuya KIDA**

Faculty of Advanced Science & Technology, KU

**Prof. Armando T. QUITAIN**

Center for International Education, KU

**OCTOBER 8 (TUE), 12:55~14:25**

**Kurokami North E1:  
General Education Building Room B201**

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



**IROAST**

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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-5 (Invitation Program) No.4-2-10 (Seminar)	Name	Tetsuya KIDA Armando T. QUITAIN	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology/ Headquarters for Admissions and Education		
Seminar Title	The 129th IROAST Seminar “Contributions to the Decarbonisation of Industry through the Transformation of Biomass into Chemical Products”			
Venue	Kurokami North E6: Center for International Education Room 1B (College of Cross-Cultural and Multidisciplinary Studies)			
Time & Date	12:55 – 14:25, October 24, 2024			
Speaker’s Name/ Title/Affiliation	Maria Jose COCERO, Professor, University of Valladolid, Spain			
Number of Participants	<u>Total: 98 participants</u> Onsite: 13 (Int’l participants: 8 ) Online: 85 participants (Indonesia, Thailand, Malaysia, Philippines) Invitees: 1 (Int’l participants: 1 )			
Duration of Visit	October 22 – 25, 2024			

**1. Seminar Overview**

The transition towards a carbon-neutral and circular economy is indeed a pressing need. The industry is evolving within a context of energy transition where there is a demand for progress in replacing fossil fuel products with renewable and environmentally friendly alternatives. The seminar given by Prof. Maria Jose Cocero focused on the concept of the development of sustainable biorefineries by using supercritical fluids. Some key important topics on biomass were also addressed including overviews of biorefinery, biomass and biobased products. The lecture also presented case studies of industrial-use products obtained from various type of biomass utilizing SCW as both solvent and reaction medium. This seminar was participated by many researchers and students (online and on-site).

**2. Seminar Outcomes and Future Plan**

This seminar has broadened the knowledge of participating researchers and students on many aspects of “sustainable biorefineries”. Research-related activities other than the seminar were as follows:

1. Discussion regarding our on-going projects - Bilateral Joint Research Project (Open Partnership) on the application and analysis of “CO<sub>2</sub>-H<sub>2</sub>O System for Biomass Valorization”.
2. Consultation of graduate students on the topics related to biomass conversion technologies.
3. Orientation of 2 graduate students visiting her laboratory for 2-month research internship.
4. Discussion on the contents of our 2 papers (in preparation):
  1. “Selective Cleavage of Glycosidic Bonds Using the CO<sub>2</sub>-H<sub>2</sub>O Synergy”, (in preparation)
  2. “Ultrafast Reactor for Selective Hydrolysis of Bioflavonoids” (in preparation)
5. Discussion to further strengthen our future collaboration on research and academic exchanges.

For this purpose, 2 Japanese graduate students were dispatched to Prof. Cocero’s laboratory for a 2-month research internship starting late October. Kumamoto University has also been included as an associate member institution in the recently submitted “*Erasmus Mundus Academic Exchange Program*” application by Valladolid University.

For IROAST and Kumamoto University, it is expected that this active joint research and academic collaboration with Prof. Maria Jose Cocero of Valladolid University, one of the leading academic institutions in Spain, will continue to yield significant results, and will be able to make a significant contribution to further development of human resources, and for active promotion of international joint research between Japan and European countries.



Prof. COCERO



Prof. QUITAIN



Prof. COCERO



At the venue1



At the venue2



Group photo



# 129th IROAST SEMINAR

**OCTOBER 24 (THURSDAY) 12:55 ~ 14:25**

**Kurokami North E6: Center for International Education Room 1B  
(College of Cross-Cultural and Multidisciplinary Studies)**

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

**Prof. Maria Jose COCERO**

*Press Tech Research Group Bioeconomy Institute (BioEcoUva)  
University of Valladolid, Spain*



**“Contributions to the Decarbonisation of Industry through the Transformation of Biomass into Chemical Products”**



**Vegetable oils**



**Tomato pomace**



**Black liquor**

## Abstract

The transition towards a carbon-neutral and circular economy is indeed a pressing need. The industry is evolving within a context of energy transition where there is a demand for progress in replacing fossil fuel products with renewable and environmentally friendly alternatives. Processes involving supercritical fluids facilitate the development of processes and products that utilize renewable raw materials and environmentally friendly solvents, intensify processes by reducing operating times, and achieve easily scalable continuous processes. The lecture will present case studies of industrial-use products obtained from three different biomasses: vegetable oils, and tomato pomace, and black liquor utilizing SCW as both solvent and reaction medium.

**Organizers : Prof. Tetsuya KIDA** *Faculty of Advanced Science & Technology, KU*

**: Prof. Armando T. QUITAIN** *Center for International Education, KU*



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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-6 (Invitation Program) No.4-2-11 (Seminar)	Name	Yutaka KUWAHARA	Title	Assistant Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 130th IROAST Seminar “Design Strategies for Developing Heavy-Atom-Free Photoredox Catalysts”			
Venue	Kurokami South W4 (Faculty of Engineering Research Bldg.2) 2F, International Seminar Room 201			
Time & Date	14:00 – 15:00, October 24, 2024			
Speaker’s Name/ Title/Affiliation	Tomoyasu MANI, Associate Professor, University of Connecticut, USA			
Number of Participants	Total: 26 (Int’l participants: 5) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	October 23 – 27, 2024			

-Seminar report -

**1. Seminar Overview**

We invited Dr. Tomoyasu Mani as a speaker of the 130th IROAST seminar held on October 24, 2024. He is an associate professor at the University of Connecticut, USA, and is also a visiting associate professor of IROAST. The seminar attracted an audience of approximately 20 students and faculty members. Dr. Mani delivered a thought-provoking lecture titled “Design Strategies for Developing Heavy-Atom-Free Photoredox Catalysts.” In his talk, he presented two approaches for developing pure organic photoredox catalysts for organic synthesis. He highlighted how the catalytic activity of organic chromophores could be harnessed by using both singlet and triplet excited states. The seminar provided an excellent opportunity for attendees to gain insights into cutting-edge strategies in photoredox catalysis.

**2. Seminar Outcomes and Future Plan**

Dr. Mani’s seminar introduced students and young researchers to an exciting and novel field that many were previously unfamiliar with. The talk not only sparked their interest in the topic but also emphasized the importance of international collaboration.

The discussion underscored the potential for strengthening research ties between our institutions, with the aim of fostering collaborative research that could lead to impactful scientific contributions. We believe that the seminar served as a valuable platform for inspiring the next generation of researchers and for recognizing the mutual benefits of collaboration.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

During his visit, Dr. Mani dedicated time to interact with members of Dr. Kuwahara’s research group of our university:

- He engaged in hour-long discussions with three of our students, providing valuable feedback, suggestions, and guidance on their ongoing research projects. He was particularly impressed by their progress and the quality of their presentations.
- Dr. Mani and Dr. Kuwahara held several in-depth discussions on our collaborative project. These meetings allowed us to make significant progress on a manuscript, which we aim to submit for publication in the near future.
- They visited the museum for the Amakusa porcelain stone by Kuwahara’s recommendation. The material is famous as a main raw one of Japanese porcelain such as Arita ware. They were impressed by its history and culture of their surroundings in Amakusa city.

#### 4. Prospect for further research collaboration.

Dr. Mani and Dr. Kuwahara explored several promising research directions that leverage the complementary expertise of our laboratories. We identified potential areas for collaboration and outlined preliminary plans to obtain results that could serve as the basis for future funding proposals. We aim to submit these proposals to funding agencies in Japan or the United States as opportunities arise. We are optimistic that this partnership will yield significant scientific advancements and look forward to deepening our collaboration through joint research endeavors and publications.



Associate Prof. MANI



Assist. Prof. KUWAHARA



At the venue



Group photo



At the museum for  
the “Amakusa” porcelain stone



# 130th IROAST SEMINAR

October 24 (THU), 14:00~

Kurokami South W4 (Faculty of Engineering Research Bldg.2)  
2F, International Seminar Room 201

## “Design Strategies for Developing Heavy-Atom-Free Photoredox Catalysts”

**Assoc. Prof. Tomoyasu MANI**

University of Connecticut/Brookhaven National Laboratory



### Abstract

Photoredox catalysis, where light is used to drive chemical reactions, offers a powerful tool for creating highly reactive species under mild conditions. Traditionally, this process involves absorbing light to create electronically excited states, which transfer electrons to or from stable molecules, generating radical cations and anions. These reactive intermediates drive complex transformations efficiently and selectively. Long-lived triplet excited states are preferred over singlets for most applications, as they allow ample time for these electron transfer reactions. To achieve this, many current photoredox catalysts rely on heavy metals like iridium and ruthenium, which enhance triplet formation through the heavy-atom effect. While these catalysts have found success in diverse fields like natural product synthesis and medicinal chemistry, the use of heavy metals raises sustainability concerns. Heavy-atom-free alternatives not only promote greener chemistry but also hold the potential to expand the scope of reactions. Unfortunately, generating triplet states in purely organic molecules has been challenging, as their formation efficiency is low, limiting their application in photoredox catalysis.

In this presentation, I'll introduce two innovative strategies that allow us to overcome this hurdle. First, we use a spin-orbit charge-transfer intersystem crossing (SOCT-ISC) mechanism, which enables  $\pi$ -conjugated organic molecules to access triplet states without relying on heavy atoms.<sup>1, 2</sup> We are also exploring an unexpected route—using short-lived singlet states. While singlets have historically been overlooked for photoredox catalysis due to their fleeting nature, we've discovered that they can serve as a direct pathway to high-energy radical intermediates. By harnessing the energy stored in these singlet excited states, we expect that we can perform a range of catalytic reactions, unlocking new reactivity patterns that were previously unattainable.

These strategies represent a shift in how we approach photoredox catalysis, moving away from reliance on precious metals and opening new avenues for innovation in green chemistry.

### References

1. Abuhadba S, Tsuji M, Mani T, Esipova TV. meso-Antracenyyl-BODIPY Dyad as a New Photocatalyst in Atom-Transfer Radical Addition Reactions. ACS Omega 2021, 6(48): 32809-32817.

2. Buck JT, Boudreau AM, DeCarmin A, Wilson RW, Hampsey J, Mani T. Spin-Allowed Transitions Control the Formation of Triplet Excited States in Orthogonal Donor-Acceptor Dyads. Chem 2019, 5(1): 138-155.

**Organizer: Assist Prof. Yutaka Kuwahara**

Faculty of Advanced Science & Technology, KU



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### IROAST Seminar Report

No. 4-2-12 (Seminar)	Name	Toshifumi MUKUNOKI	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	X-EARTH Center & The 131st IROAST Joint Seminar “Mechanics of rooted soil: recent advances”			
Venue	Kurokami South C8, 3F, Room 231 (Faculty of Engineering Bldg.2)			
Time & Date	14:40 – 16:10, October 28, 2024			
Speaker’s Name/ Title/Affiliation	Anthony LEUNG, Professor, The Hong Kong University of Science and Technology, China			
Number of Participants	Total: 48 (Int’l participants: 13) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	October 28, 2024			

-Seminar report -

#### 1. Seminar Overview

The 131st IROAST Seminar was held on October 28, organized by Prof. Toshifumi MUKUNOKI (Faculty of Advanced Science and Technology, Kumamoto University/Head of the X-EARTH Center), and featured a lecture by Prof. Anthony LEUNG from the Hong Kong University of Science and Technology (HKUST). His talk, titled "*Mechanics of Rooted Soils: Recent Advances*," presented the latest scientific findings on the hydrodynamic behavior of unsaturated rooted soils and their implications for the engineering design of bioengineered slopes. The seminar was co-organized with the X-EARTH Center and attracted a large audience of students and faculty members.

#### 2. Seminar Outcomes and Future Plan

Prof. Anthony LEUNG is one of the leading young researchers in geotechnical engineering worldwide. This was his first visit to Kumamoto University. I first met him at an international conference, where I was convinced that his presentation would have a significant impact on our graduate students. As a result, I invited him to visit Kumamoto University last year. Despite his young age, Prof. Leung currently serves as the President of the Hong Kong Geotechnical Society. During his visit to Japan, he also gave a special lecture at the Japanese Geotechnical Society headquarters in Tokyo. I planned this joint seminar to coincide with his visit.

Prof. Leung’s research activities are highly influential, and I am considering inviting him to become an adjunct professor at Kumamoto University in the near future. Additionally, his primary research tool is the X-ray CT scanner, which presents an excellent opportunity for collaborative research, particularly as our research interests align. His work focuses on natural disasters such as landslides, which is a highly relevant topic for the Kumamoto region.







X-Earth Center &



# Joint Seminar

October 28 (Mon), 14:40~16:10  
Kurokami South C8, 3F, Room 231  
(Faculty of Engineering Bldg. 2)



**Prof. Anthony LEUNG**

The Hong Kong University of Science & Technology

## “Mechanics of rooted soil : recent advances”



### Abstract

Characterising the hydromechanical properties of unsaturated rooted soils is crucially important to correctly determine the vegetation effects on seepage and stability of bioengineered soil slopes. Understanding the engineering behaviour of rooted soils requires knowledge from pore-level physical soil-root mechanical interaction, which is however lacking in the current state-of-the-art. This presentation will report the latest scientific discoveries of the hydromechanical behaviour of unsaturated rooted soils and their implication to engineering design of bioengineered slopes.

The first part of the presentation will focus on the mechanical anisotropy behaviour of rooted soils, in terms of both shear strength and shear modulus. New microstructure fabric anisotropic models will be introduced to explain several new experimental phenomena when subjected to different stress paths.

The second part of the presentation will report the advanced use of artificial intelligence (AI) to aid the discovery of the pore-level soil-root-water interaction, in order to explain the underlying mechanisms of root exploration on the water retention behaviour.

**Organizer: Prof. Toshifumi Mukunoki, Head of the X-EARTH Center**  
(FAST, Dept. of Civil & Environmental Engineering, & Architecture)

More Information :

Please apply from this site!



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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-7 (Invitation Program) No.4-2-13 (Seminar)	Name	Sadahiro TSUREKAWA	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 132nd IROAST Seminar “Microstructure of metallic materials produced by additive manufacturing”			
Venue	Kurokami South C3, 3F Room 308 (Faculty of Engineering Research Bldg.1)			
Time & Date	13:30 – 14:30, November 7, 2024			
Speaker’s Name/ Title/Affiliation	Pavel LEJČEK, Professor •Institute of Physics, Czech Academy of Sciences, Czech Republic			
Number of Participants for 2 days	Total: 22 (Int’l participants: 3) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	November 2 – 15, 2024			
<p>Prof. Pavel Lejček delivered a special lecture on “<i>Microstructure of metallic materials produced by additive manufacturing</i>” on November 7, 2024. More than 20 audiences including academic staffs, graduate students and undergraduate students in Kumamoto University attended his lecture (<i>see photo attached</i>). The abstract of his lecture is as follows:</p> <p>Additive manufacturing – or 3D printing – has been gaining an important role in production of various materials with complicated shapes and new microstructures. In the field of metallic materials, it has been already used to produce functional parts such as propellers and implants. Therefore, the study of the process of additive manufacturing as well as of the structure and properties of the materials produced in this way together with searching for their mutual relationships, has been very intensive in the last decades and results in improved processing of many products. In the present talk, the basic processes of the additive manufacturing will be introduced and documented by videos. The research topic of this talk is focused on the development of the microstructure of additively manufactured metallic materials. It will be shown that the microstructure of Al-based alloys differs substantially from that of pure iron, and the reasons for this difference will be explained using our own experimental results. For example of a maraging steel, it will be shown how the presence of trace elements affects the microstructure of the material and its mechanical properties. From the viewpoint of the macrostructure, metamaterials produced by additive manufacturing will be introduced which represent an important group of metallic products.</p> <p>"Additive manufacturing" is attracting attention as a new material process using 3D printing technology. Intensive research is being carried out both nationally and internationally. However, the microstructure formed by this technique, which determines material properties, is not yet fully understood, and Prof. P. Lejček's talk presented his latest research on this topic, which attracted particular attention from the audience, including many questions from students.</p> <p>During Prof. P. Lejček's stay at Kumamoto University, he discussed with students of his host Prof. Tsurekawa's research group on the experimental results of individual students and gave a lot of useful advice. In particular, a Ph.D. student working with Prof. P. Lejček reported on progress of her research and had a detailed discussion on future research plans. For the students, the discussions with a world-class researcher were an extremely valuable experience.</p>				





Prof. LEJČEK



Prof. TSUREKAWA



At the venue1



At the venue2



Q&A time



Group photo



Discussion with an undergraduate student



Discussion with a graduate student





Prof. LEJČEK and Ph.D. student



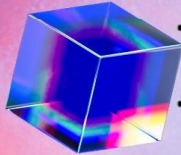
Group photo Prof. TSUREKAWA's group with Prof. LEJČEK

# 132nd IROAST SEMINAR

**November 7, Thurs. 13:30 ~ 14:30**

**Kurokami South C3, 3F Room 308**  
(Faculty of Engineering Research Bldg. 1)

**Prof. Pavel LEJČEK**



- Institute of Physics, Czech Academy of Sciences, Prague, Czechia
- University of Chemistry and Technology, Prague, Czechia



**“Microstructure of metallic materials produced by additive manufacturing”**

## **ABSTRACT**

In the present talk, the basic processes of the additive manufacturing will be introduced and documented by videos. The research topic of this talk is focused on the development of the microstructure of additively manufactured metallic materials. It will be shown that the microstructure of Al-based alloys differs substantially from that of pure iron, and the reasons for this difference will be explained using our own experimental results. For example of a maraging steel, it will be shown how the presence of trace elements affects the microstructure of the material and its mechanical properties. From the viewpoint of the macrostructure, metamaterials produced by additive manufacturing will be introduced which represent an important group of metallic products.

**Organizer: Prof. Sadahiro TSUREKAWA**  
Faculty of Advanced Science & Technology, KU



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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-8 (Invitation Program) No.4-2-14 (Seminar)	Name	Makoto TAKAFUJI	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 133rd IROAST Seminar “Historical Origins of The Vaccine. Achievements & Controversies”			
Venue	Kurokami South W3, 2F Room 203 (Academic Commons Kurokami Bldg.1)			
Time & Date	13:00 – 14:00, November 8, 2024			
Speaker’s Name/ Title/Affiliation	Josep Barona, Professor, University of Valencia, Spain			
Number of Participants	Total: 22 (Int’l participants: 1)			
	Invitees: 1 (Int’l participants: 1)			
Duration of Visit	November 6 – 16, 2024			

-Seminar report -

**1. Seminar Overview**

The discovery of the vaccine by the English physician William Jenner (1796) marked a milestone in the history of the prevention of epidemics and infectious diseases. Smallpox was the main cause of mortality in the 18th century worldwide and the vaccine allowed the first national preventive policies. The conference analyses the previous variolation tests and their acculturation to Europe from Asia, the impact of Jenner's discovery and the controversies raised in various countries about the vaccine along the 19th century. It also discusses the first Royal expedition to spread the vaccine throughout the world, the foundation of national institutes of hygiene and vaccination in many countries, including Japan highlighting the relevance of Kitasato. Finally, it raises a question about vaccine research, clinical trials and the pharmaceutical industry since the end of World War II.

**2. Seminar Outcomes and Future Plan**

The seminar provided an exceptional opportunity for young researchers to not only deepen their expertise in their respective fields but also to gain a broader understanding of the history of science. It allowed them to engage with interdisciplinary research, fostering a rich exchange of ideas across diverse domains. This experience significantly contributed to expanding their academic horizons and promoting a more holistic view of scientific progress. During Prof. Josep BARONA's visit, we again discussed student and academic exchanges and consulted concrete action plans for the future.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

The exchange agreement between the University of Valencia (UV) and Kumamoto University (KU) will be renewed in 2025. Currently, only academic exchange is concluded, but discussions were held with the officer for international affairs of the graduate school of science and technology, and Dr. Sims Lander to include a student exchange agreement. Dr. Sims Lander are planning to visit to the UV with several students in GLC course of KU.

**4. Prospect for further research collaboration.**

Building on our collaboration that began in 2024, in 2025, we will continue our exchange with the University of Valencia to further discuss the evaluation of photo-functional properties of supramolecular assemblies with complexation ability and to assess the progress of our joint research activities. We will also continue to move forward with finalizing a student exchange agreement, following the academic exchange agreement that has already been concluded.





Prof. BARONA



Prof. TAKAFUJI



Prof. BARONA



Prof. TAKAFUJI



At the venue



Group photo

# 133rd IROAST SEMINAR

November 8 (Friday), 13:00~  
Kurokami South W3, 2F Room 203  
(Academic Commons Kurokami Bldg.1)



**Prof. Josep Lluís BARONA-VILAR**

University of Valencia, Spain

## “Historical origins of the vaccine. Achievements & Controversies”



### Abstract

The discovery of the vaccine by the English physician William Jenner (1796) marked a milestone in the history of the prevention of epidemics and infectious diseases. Smallpox was the main cause of mortality in the 18th century worldwide and the vaccine allowed the first national preventive policies. The conference analyses the previous variolation tests and their acculturation to Europe from Asia, the impact of Jenner's discovery and the controversies raised in various countries about the vaccine along the 19th century. It also discusses the first Royal expedition to spread the vaccine throughout the world, the foundation of national institutes of hygiene and vaccination in many countries, including Japan highlighting the relevance of Kitasato. Finally, it raises a question about vaccine research, clinical trials and the pharmaceutical industry since the end of World War II.



**Organizer: Prof. Makoto TAKAFUJI**

Faculty of Advanced Science and Technology, KU



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Website: <https://iroast.kumamoto-u.ac.jp>



**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-9 (Invitation Program) No.4-2-15 (Seminar)	Name	Tetsuya KIDA	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 134th IROAST Seminar “Recent advances in MOX-based electro-optical chemical sensors and fuel cells”			
Venue	Kurokami South W4: 2F, Conference Room (Faculty of Engineering Research Bldg. II)			
Time & Date	10:00 – 11:00, November 22, 2024			
Speaker’s Name/ Title/Affiliation	Dario ZAPPA, Associate Professor, University of Brescia, Italy			
Number of Participants	<u>Total: 31</u> (Int’l participants: 12) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	November 16 - 23, 2024			
<p>-Seminar report -</p> <p><b>1. Seminar Overview</b></p> <p>Chemical/gas sensors play an important role in various fields such as environmental monitoring, food quality monitoring, and toxic gas leak detection. Nanowires (NWs) and NW-based heterostructures are important components of future sensing devices due to their unique properties such as high crystallinity, flexibility, and conductivity. Despite the rapid growth of smart, portable, and wearable chemical sensing devices, the development of reliable devices for chemical, gas, and vapor detection remains challenging.</p> <p>During the seminar, Prof. Dario Zappa talked on the synthesis of one-dimensional nanomaterials and their applications in the energy and environmental fields. He detailed how metal oxide nanostructures (nanowires, nanotubes, surface-functionalized nanowires, and heterostructures) are excellent gas sensor materials. Of particular importance are the results showing that a single nanowire can be used as an optical gas sensor capable of detecting NO<sub>2</sub>. In addition to chemical sensors, he exemplified the great potential of nanowires as electrode materials for solid oxide fuel cells.</p> <p><b>2. Seminar Outcomes and Future Plan</b></p> <p>The seminar broadened the perspectives of the participating researchers and students on the promising feasibility of oxide nanowires for electrochemical devices. Before and after the seminar, the possibility of future collaborations and international joint publications were discussed. 1 year ago, one Japanese graduate student (Fuko Shiga, M2) was staying in his laboratory in Italy for three months. This student was doing very well in her research and Prof. Zappa would like to continue to accept students from Kumamoto University. Therefore, we will continue the student exchange and send a graduate student from Kumamoto University to his laboratory in Brescia again.</p> <p>-Activities report with visiting (associate) professor-</p> <p><b>3. Research achievements during his/her stay in Kumamoto University.</b></p> <p>During his stay, we introduced Kumamoto University's facilities and explained our recent research results. We also provided opportunities for discussions between Prof. Zappa and graduate students and young researchers to improve their motivation for overseas research. Several students have expressed interest in doing research in Brescia and are considering applying for Tobitate's scholarship program.</p>				

#### 4. Prospect for further research collaboration.

Currently, the Italian and Japanese teams are preparing to apply for a NATO (North Atlantic Treaty Organization) research grant for a joint application. The research topic is hydrogen energy devices. So far, Prof. Zappa has been awarded two NATO project grants and there is a good chance that our proposal will be accepted.



Assoc. Prof. ZAPPA



Prof. KIDA



At the venue1



At the venue2



Q&A time



Group photo

# 134th IROAST SEMINAR



## Assoc. Prof. DARIO ZAPPA



### "Recent advances in MOX-based electro-optical chemical sensors & fuel cells"

University of Brescia,  
Italy

November 22 (Fri.)

10:00am~11:00am

Kurokami South W4,  
2F, Conference Room  
Faculty of Engineering  
Research Bldg. II

#### Abstract

Metal oxides represent a vast class of materials of interest for various scientific communities, ranging from physics to chemistry, from material science to engineering. Among these applications, chemical sensors and solid oxide fuel cells (SOFC) are among the most interesting one, as nanosizing the surface of metal oxide allows to dramatically outperform their bulk counterparts.

In this seminar material development recently achieved at SENSOR Lab in Brescia will be presented, including the integration of these materials into resistive and optical chemical sensors. The performance of these devices will be discussed, with a specific focus on understanding the working mechanisms, in particular for novel electro-optical devices.

Moreover, NiO-GDC nanostructured anode material for SOFC will be introduced, together with preliminary IV curves and benchmark with commercial devices.

Organizer: **Prof. TETSUYA KIDA**  
Faculty of Advanced Science &  
Technology, KU

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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-10 (Invitation Program) No.4-2-16 (Seminar)	Name	Tetsuya KIDA	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 135th IROAST Seminar “Development of chemical vapor sensors their potential applications”			
Venue	Kurokami South W4: 2F, Conference Room (Faculty of Engineering Research Bldg. II)			
Time & Date	11:00 – 12:00, November 22, 2024			
Speaker’s Name/ Title/Affiliation	Tung Thanh TRAN, Senior Researcher at AM2D Research Hub, School of Chemical Engineering, The University of Adelaide, South Australia			
Number of Participants	Total: 29 (Int’l participants: 13) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	November 14 – 23, 2024			
<p>-Seminar report -</p> <p><b>1. Seminar Overview</b></p> <p>Metal-organic frameworks (MOFs) are designable and tunable functional crystalline porous materials that have been investigated for applications in catalysis, chemical sensing, gas storage, and separation. Rational design and synthesis of MOFs based on reticular chemistry allows unprecedented control over their structural features and functionality. The utilization of metal organic frameworks (MOFs) for gas sensors has received increasing attention over the past decade. Much effort has been devoted to improving the performance of the gas sensors by optimizing the pore and crystal structures. In the seminar, Dr. Tran discussed the current status and future prospects of MOFs as gas sensor materials. He demonstrated that coupling MOFs and graphene or graphene oxides efficiently detects gaseous species at low concentrations in air and real atmosphere.</p> <p><b>2. Seminar Outcomes and Future Plan</b></p> <p>The seminar broadened the perspectives of the participating researchers and students on the entirely new gas sensor applications of MOFs and their wonderful potentials. Before and after the seminar, the possibility of future collaborations and international joint publications were discussed. One Japanese graduate student (Ami Takase, M1) is currently staying in his laboratory in Australia for three months. According to him, this student is doing very well in her research and Dr. Tran would like to continue to accept students from Kumamoto University. Therefore, we decided to continue the student exchange and send a graduate student from Kumamoto University to his laboratory in Adelaide for another year of joint research.</p> <p>-Activities report with visiting (associate) professor-</p> <p><b>3. Research achievements during his/her stay in Kumamoto University.</b></p> <p>During his stay, we introduced Kumamoto University's facilities and explained our recent research results. We also provided opportunities for discussions between Dr. Tran and graduate students and young researchers to improve their motivation for overseas research. Several of them have expressed interest in doing research in Adelaide and are considering applying for Tobitate's scholarship program.</p> <p><b>4. Prospect for further research collaboration.</b></p> <p>Two papers co-authored with the University of Adelaide are currently being submitted to prestigious journals, both in revision and expected to be accepted soon. We will further promote collaborative research and continue to produce high quality research results.</p>				





Dr. TRAN



Prof. KIDA



Dr. TRAN



At the venue



Group photo1



Group photo2

# 135th **IROAST** SEMINAR

## “Development of chemical vapor sensors their potential applications”



### **Dr. TUNG TRAN**

*Senior Researcher at AM2D Research Hub,  
School of Chemical Engineering,  
the University of Adelaide,  
South Australia*

#### **Abstract**

The disruptive chemical sensor technology, currently under development based on sensing, monitoring chemicals and diagnostics, that combining sensors, artificial intelligent (AI) and Internet of things (IoT), is expected to revolutionise for the development of next-generation sensors. These are gaining tremendous attention in both academia and industry because of their broad applications in manufacturing processes, food and environment control, medicine, disease diagnostics, security and defence, aerospace and so forth. Current challenges include the development of low cost, ultrahigh sensitive and user friendly sensors which have high selectivity, fast response and recovery times and small dimensions. The critical demands of these new sensors are typically associated with advanced nanoscale sensing materials. Among them, 2D materials and their composites have demonstrated the ideal properties to overcome these challenges and merged as one of the most popular sensing platforms for diverse potential applications.

In this lecture, I present and discuss recent advances in 2D and their composite for chemical sensors, their sensing performance, and the state-of-the-art applications.

**Prof. TETSUYA KIDA** *(Organizer)*  
**FAST, KU**

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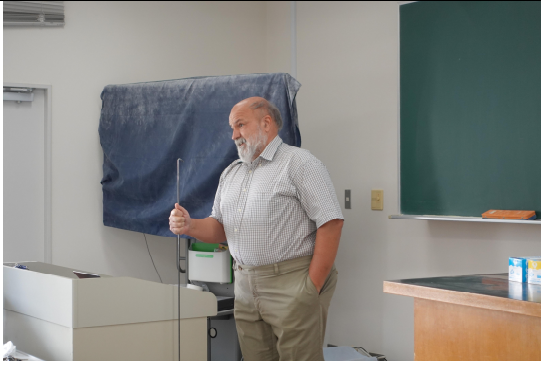
**November 22 (Fri.)  
11:00am~12:00pm**

**Kurokami South W4,  
2F, Conference Room  
(Faculty of Eng. Recr. Bldg. II)**

### IROAST Seminar

No. 4-2-17 (Seminar)	Name	Yoichi NAKAJIMA	Title	Associate Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 136th IROAST Seminar “Neutron scattering methods in condensed matter physics, chemistry and materials sciences”			
Venue	Kurokami South E3, 2F Room D201 (Faculty of Science Bldg.3)			
Time & Date	12:55 – 14:25 November 22, 2024			
Speaker’s Name/ Title/Affiliation	László PUSZTAI, Scientific Advisor, HUN-REN Wigner Research Centre for Physics, Hungary			
Number of Participants for 2 days	<u>Total: 15</u> (Int’l participants: 3) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	November 9 – 23, 2024			
<p>In the seminar, Prof. Pusztai introduced the fundamentals of neutron techniques used in condensed matter physics, chemistry, and material sciences. He started with an explanation of the nature of neutrons and the history of neutron scattering. He discussed the methods to generate neutrons for neutron scattering measurements and exhibited the instrumentations and principles utilized at neutron facilities. Additionally, he explained the interaction mechanisms between neutrons and materials, illustrating what information can be extracted from the neutron scattering measurements. Prof. Pusztai emphasized the importance of neutron scattering measurements and highlighted their unique advantage relative to other techniques. He introduced several neutron scattering techniques, such as neutron diffraction, small-angle neutron scattering, and inelastic neutron scattering, along with key instrumentations associated with each technique. He pointed out potential problems in the measurements and data analysis and also presented various solutions to these problems. He also exhibited some researches such as magnetic structures of oxide materials based on the modern neutron scattering methods.</p> <p>Finally, this seminar gave a very wonderful experiences to young students of our university. In addition to the faculty staffs, lots of graduate and undergraduate students attended this seminar. Prof. Pusztai prepared his presentation with these students in his mind and explained the above topics in a way that was easy to understand even for non-experts. So that the young students were able to easily follow the talk and recognize the importance of the novel neutron scattering techniques for probing the nature of materials. After the talk, some students asked Prof. Pusztai English questions. This seminar offered new knowledge about neutron scattering and encouraged the students to consider the applications of these techniques in their future researches.</p>				

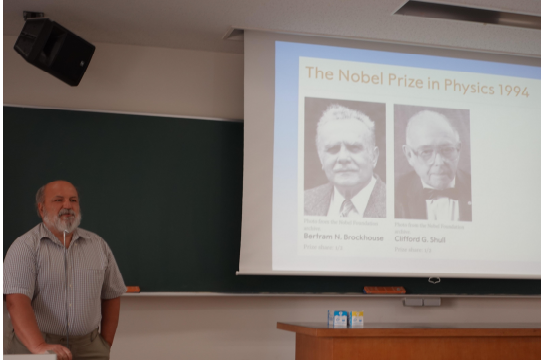




Prof. PUSZTAI



Assoc. Prof. NAKAJIMA



Prof. PUSZTAI



Prof. PUSZTAI



At the venue1

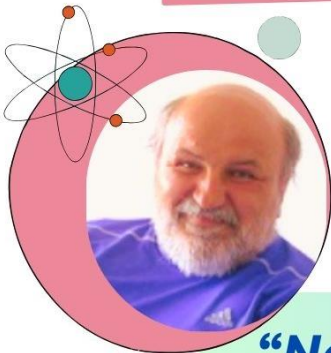


At the venue2



# 136th IROAST SEMINAR

**November 22 (Fri.) 12:55~14:25**  
**Kurokami South E3, 2F, Room D201**  
(Faculty of Science Bldg. 3)



**Prof. LÁSZLÓ PUSZTAI**  
HUN-REN Wigner Research Centre for Physics,  
Hungary

***“Neutron scattering methods in condensed matter physics, chemistry and materials sciences”***

## Abstract

30 years ago, two American researchers were awarded the 1994 Nobel Prize in Physics. An excerpt from the original press release: 'In simple terms, Clifford G. Shull has helped answer the question of where atoms "are" and Bertram N. Brockhouse the question of what atoms "do". ' Based on their work done in the 1950's and 60's, now large scale neutron scattering facilities are operational all over the world -- one of the most powerful ones is actually in Japan (the Materials and Life Science Facility in the J-PARC centre in Tokai-mura).

In this lecture, I plan to introduce the basics of neutron techniques in general, and those of neutron diffraction (ND), small angle neutron scattering (SANS) and inelastic neutron scattering (INS) in particular. I will touch upon problems with instrumentation, including the various ways of generating and guiding neutron beams, and detection of scattered neutrons. A comparison with complementary experimental techniques, notably those based on synchrotron radiation, will also be provided.

I will argue that neutron scattering techniques are still unique in a number of areas, like the structure and dynamics of hydrogenous materials (such as water and aqueous solutions), magnetic structures, as well as microscopic dynamics in general. As a demonstration, in the final section of the lecture, I will show some recent examples of the use of modern neutron scattering methods.

**ORGANIZER: Assoc. Prof. YOICHI NAKAJIMA, FAST, KU**



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### IROAST Seminar Report

No. 4-2-18 (Seminar)	Name	Yoji MINE	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 137th IROAST Seminar “Development of High Strength Biodegradable Metals for Regenerative Medicine”			
Venue	Kurokami South C3, F3, Room 308 (Faculty of Engineering Research Bldg. I)			
Time & Date	10:30 – 11:30, December 11, 2024			
Speaker’s Name/ Title/Affiliation	Yufeng ZHENG, Distinguished Professor School of Materials Science and Engineering, Peking University, China			
Number of Participants	<u>Total: 31</u> (Int’l participants: 7) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	December 9 – 13, 2024			

-Seminar report -

#### 1. Seminar Overview

After two decades of research and development of biodegradable metallic materials, Mg-based, Fe-based and Zn-based biodegradable metals had been widely studied by in vitro and in vivo biocompatibility testing. In this seminar, he outlined the design concepts of biodegradable metallic materials and introduced his recent research activities.

#### 2. Seminar Outcomes and Future Plan

We have started to discuss new collaborative studies on the fatigue crack growth behaviour in Zn-based biodegradable alloys.

-Activities report with visiting (associate) professor-

#### 3. Research achievements during his/her stay in Kumamoto University.

Dr. Kwak and his undergraduate student reported the microstructures of alloys used in the collaborative study and we discussed the research plan.

#### 4. Prospect for further research collaboration.

Prof. Zheng will provide us new alloys when he returns to Japan in February 2025.

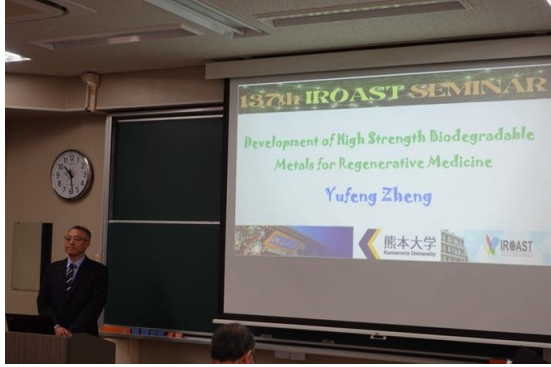


Prof. ZHENG



Prof. MINE





Prof. ZHENG



At the venue1

# 137th IROAST SEMINAR

DECEMBER 11<sup>th</sup> 10:30 AM

Kurokami South C3, 3F, Room 308  
(Faculty of Engineering Research Bldg. I)

## “Development of High Strength Biodegradable Metals for Regenerative Medicine”

Prof. Yufeng ZHENG

School of Material Science and Engineering,  
Peking University, China

ABSTRACT

After two decades of research and development of biodegradable metallic materials, Mg-based, Fe-based and Zn-based biodegradable metals (BMs) had been widely studied by in vitro and in vivo biocompatibility testing. There were WE43 Mg alloy and Mg-Ca-Zn alloy bone screws being clinically used in Europe and China, Nitride Fe bioresorbable vascular scaffold being CE marked and clinically trailed in China, Zn-Mg-Fe alloy Maxillofacial bone screw being clinically trailed in China. For the mechanical strength viewpoint, the current Mg-based biodegradable metals is in generally below 350MPa and it can only be suitable for low load-bearing application in regenerative medicine, whereas the Zn-based biodegradable metals had been explored, with the Zn-Li-Mg alloys exhibiting the tensile strength around 600MPa close to that of the pure Ti and stainless steel, and is applicable for the medium load-bearing application in regenerative medicine. The Fe-based biodegradable metals had shown higher mechanical strength, but the majority of biometal society believe that Fe-based BMS is unsuitable for orthopaedic applications since element iron does not exist in the bone. So there is the requirement to development of higher strength biodegradable metals with the mechanical property comparable to CoCr alloys, to meet the high load-bearing applications in regenerative medicine. In the present work, we tried to solve this problem from two aspects. One is to develop Zn-based BMs with higher strength by the addition of more alloying elements into Zn-Li alloys. And we found that rare earth elements are helpful to further enhance the mechanical strength of Zn-Li alloys to the level of around 800MPa. On the other hand, we screened the metal elements on the periodic table by our proposed "biodegradability & biocompatibility" dual criteria, and proposed the development of a high-performance molybdenum based biodegradable metals system with mechanical properties comparable to CoCr alloys. We had explored the impact of simulated inflammation on the corrosion behavior of pure Mo, a potential biodegradable metal for biomedical applications for the first time. Under simulated inflammatory conditions, Mo exhibits altered electrochemical properties, such as increased open circuit potential, higher corrosion rates, and reduced impedance as H<sub>2</sub>O<sub>2</sub> concentration rises. Immersion test confirm the higher corrosion rates with increases in H<sub>2</sub>O<sub>2</sub> concentration. Interestingly, pure Mo exhibit uniform corrosion behavior under aggressive simulated inflammation which is beneficial to maintain biomedical devices' mechanical integrity. Our recent further works indicate the Mo-based biodegradable alloys can be fabricated by the addition of some alloying elements into Mo, and exhibit the mechanical strength higher than 800MPa. We also demonstrated that the additive manufacture technology is feasible to produce 3D printing Mo-based BM scaffold.

Organizer: Prof. Yoji MINE (FAST, Kumamoto University)

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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-11 (Invitation Program) No.4-2-19 (Seminar)	Name	Makoto TAKAFUJI	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 138th IROAST Seminar “Transferring Chiral Information between Objects with different dimensions”			
Venue	Kurokami South W10, 100 <sup>th</sup> Anniversary Hall			
Time & Date	13:00 – 14:00, December 17, 2024			
Speaker’s Name/ Title/Affiliation	Reiko ODA, Research Director, CBMN (UMR5248), CRSN-Univ. of Bordeaux, France			
Number of Participants	<u>Total: 71</u> (Int’l participants: 5) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	December 16 – 18, 2024			

-Seminar report -

**1. Seminar Overview**

This IROAST seminar was held jointly with the Kyushu Branch Forum of the Society of Polymer Science, Japan. Dr. Reiko Oda gave a lecture titled “Transferring Chiral Information between Objects with different dimensions”, in which she presented her research on the use of nanohelix-like supramolecular assemblies formed from chiral surfactants as templates. She introduced her latest research results using nano helical silica synthesized by using nano helical supramolecular assemblies formed from chiral surfactants as templates. The interaction between nano helical silica and chiral molecules was evaluated using circular dichroism and circularly polarized luminescence spectra, and the enantioselective interaction between them was evaluated to discuss the hierarchical nature between chiral materials of different sizes.

In addition to Dr. Oda, four other lecturers were invited to speak on “Chirality in Inorganics and Hybrids,” discussing chirality in organic-inorganic hybrid materials and inorganic materials.

**2. Seminar Outcomes and Future Plan**

The seminar was held jointly with the Kyushu Branch Forum of the Society of Polymer Science, Japan, and four Japanese professors including two professors in Kumamoto University in the same field also gave lectures. Many graduate students and researchers participated from laboratories in related fields in the Faculty of Engineering and the Faculty of Science of our university. We believe that this forum provided a good opportunity for young researchers to deepen their expertise in their respective fields and broaden their research perspectives.

We have published four academic papers and one accepted paper in 2023-2024.

-Activities report with visiting (associate) professor-

**3. Research achievements during her stay in Kumamoto University.**

Two graduate students visited the University of Bordeaux as internship students for six months last year and two months this year to promote joint research. They reported on the progress of their current research and discussed future plans. In addition, new research topics were discussed with the researchers, graduate students and members in the research cluster “Nano-Organics and Nano-Hybrids”.

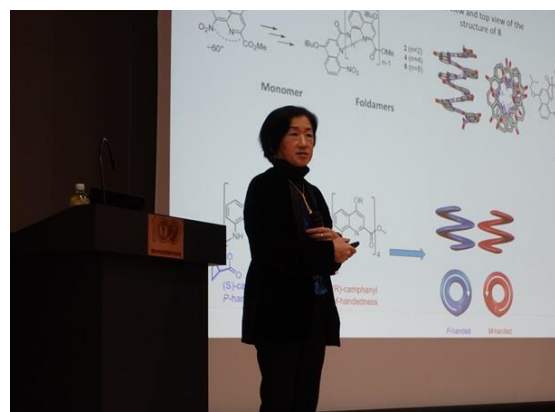
#### 4. Prospect for further research collaboration.

The progress of the international joint research with Reiko Oda's group was reported and future plans were discussed. Two graduate students visited the University of Bordeaux as internship students last year and this year, and we discussed the progress of their current research. Currently, we are in the process of renewing the Double Degree Program between the University of Bordeaux and our university, which is based on our joint research activities.

We have also submitted a joint application with Tohoku University and Kyoto University for the JSPS Core-to-Core Program.



Research Director ODA



Research Director ODA



Research Director ODA



At the venue1



At the venue2



At the venue3

# 138th IROAST SEMINAR

“Transferring Chiral Information between  
Objects with different dimensions”



**Dr. Reiko ODA**  
**Research Director**

CBMN(UMR5248), CNRS-Univ. of Bordeaux, France

DECEMBER 17 13:00 PM

Kurokami South W10, 100th Anniversary Hall

## Abstract

Chirality can be transmitted between various media and size scales, from spinning elementary particles or chiral molecules to mesoscopic and macroscopic structures through electromagnetic fields or emergent spin structures. These transmission processes. The transmission mechanism of chirality information, which can be expressed in the intra-inter-atomic/molecular interaction, is extremely complex and never ceases to fascinate scientists. When investigating systems spanning a large size range, hierarchical nanostructures based on molecular assemblies represent promising structures that allow us to fill in the gap that is difficult to assess from both top-down and bottom-up approaches.

For several decades, based on the molecular assembly, we have developed helical nanostructures with controlled sizes of the order of 10-100 nm and handedness, which have shown very promising properties not only as fundamentally interesting shaped objects with intriguing properties but also as helical platforms transferring the chiral information between very small to large objects and vice-versa, from electrons, atoms, molecules or large polymers and even nanoparticles. Through such interaction, we have shown exciting examples of their use in chiral induction, amplification, crystallisation, reaction, and chiral recognition.

**Organizer: Prof. Makoto TAKAFUJI**

Faculty of Advanced Science and Technology, KU



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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-12 (Invitation Program) No.4-2-20 (Seminar)	Name	Hiroshi CHO	Title	Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 139th IROAST Seminar “Meshfree Modelling of Ocean Waves, Landslides and Soil-Water Interactions”			
Venue	Kurokami South C2, 4F, Room 401 (Faculty of Engineering Bldg.1)			
Time & Date	10:25 – 11:55, December 20, 2024			
Speaker’s Name/ Title/Affiliation	Dongfang LIANG, Professor, University of Cambridge, UK			
Number of Participants	<u>Total: 14</u> (Int’l participants: 4) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	December 20 – 27, 2024			

-Seminar report -

**1. Seminar Overview**

In this seminar, Prof. Liang introduced to the audience on the history and recent developments of Cambridge University, and delivered a lecture on the fundamentals and applications of typical meshfree methods, such as Smoothed Particle Hydrodynamics (SPH) and the Material Point Method (MPM), which are increasingly utilized in scientific computing.

Traditionally, solving continuum mechanics problems numerically requires domain decomposition using computational meshes. When the domain boundary changes, the mesh must be updated to accommodate the new boundary. In the lecture, Prof. Liang presented several examples of applying modern meshfree computational methods to civil engineering problems involving significant boundary deformations, such as nonlinear ocean waves, sediment transport, and landslides. The meshfree methods are particularly well-suited for such problems, as they inherently avoid mesh distortion.

Additionally, in civil engineering, the strong interactions between soil and water are often critical in phenomena like seepage-induced slope instability and wave runup on porous beaches. The necessity of considering the dynamic coupling between the soil and water phases were also explained as well as the importance of satisfying both the mass and momentum conservation principles.

**2. Seminar Outcomes and Future Plan**

Young researchers and students expressed strong interest in Cambridge University and numerical simulation methods. They asked many questions regarding the details of the simulations, as well as about campus life in Cambridge. An active discussion followed the seminar.

In our research group, we are also addressing problems with complex boundaries using approaches based on unstructured mesh. In addition, we have accumulated a substantial amount of experimental data and are continuing our hydraulic experiments. There is significant potential for collaboration in enhancing numerical methods and utilizing the experimental data collected by Kumamoto University during the numerical simulations. It is anticipated that the results will lead to international collaborative papers in the near future.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

After the seminar, Prof. Liang visited the areas affected by the 2020 water disaster along the Kuma River in southern Kumamoto Prefecture to gain insight into the geographical characteristics of the river and the disaster management technologies employed in the region. He also paid a visit to the Midori River and Kikuchi River to examine traditional river training structures such as gabion spur dykes.

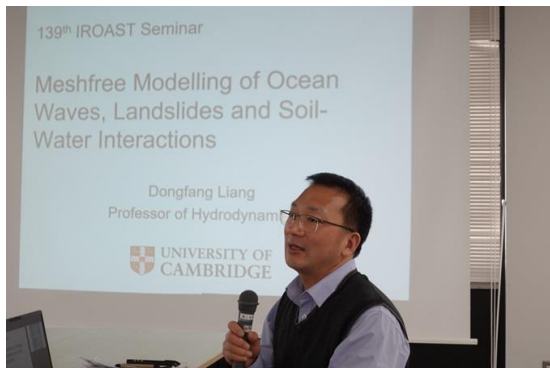
During his time in Kumamoto, he toured the experimental facilities in the Hydraulics Experiment

Building and joined in experiments conducted by students from the River Environment Laboratory. He had a talk with Prof. Cho and Dr. Inagaki on further exchange plan. Before departing for Cambridge, he participated in a joint field survey conducted by Kumamoto University and Setsunan University, focusing on the local riverbed topography along the Yodo River.

#### 4. Prospect for further research collaboration.

During this visit, Prof. Liang gained a comprehensive understanding of the research activities and plans at the River Environment Laboratory of Kumamoto University. Prof. Liang and Prof. Cho identified several research topics of mutual interest, which will help accelerate international collaboration.

We are preparing to present our joint research at an upcoming international conference and will work on co-authoring papers for international academic journals. We also agreed to seek research funding to facilitate exchanges of faculty members and students, as well as to advance our joint international research projects.



Prof. LIANG



Prof. CHO



At the venue1



At the venue2



Q&A time



Group photo





Report photo in Hitoyoshi



Flood marks in 2020

# 139th IROAST SEMINAR



**Prof. Dongfang LIANG**  
**University of Cambridge, UK**

“Meshfree Modelling of Ocean Waves,  
Landslides and Soil-Water Interactions”

### **Abstract**

Traditionally, the numerical solution of continuum mechanics problems requires the decomposition of the domain with computational mesh. Once the domain boundary changes, the mesh should be updated to adapt to the new boundary. This talk will show several examples of applying the modern meshfree computational methods to civil engineering problems involving large deformations at the boundary, such as nonlinear ocean waves, sediment transport and landslides. The meshfree methods are ideal for this type of problems, because they inherently avoid the mesh distortion. In civil engineering, the strong interactions between soil and water are often crucial in the phenomena like the seepage induced slope instability and wave runup on porous beaches. The necessity of considering the dynamic coupling between the soil and water phases will be explained as well as the importance of satisfying both the mass and momentum conservation principles. The meshfree methods included in this talk are the Smoothed Particle Hydrodynamics (SPH) and Material Point Method (MPM), which have been increasingly used in scientific computing.

**December 20th (Friday)**  
**10:25-11:55**

**Kurokami South C2, 4F, Room 401**  
**(Faculty of Engineering Bldg. 1)**

**Organizer: Prof. Hiroshi CHO (FAST, Kumamoto University)**



**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-13 (Invitation Program) No.4-2-21 (Seminar)	Name	Atsushi SAINOKI	Title	Associate Professor
	Affiliation	Faculty of Advanced Science and Technology		
Seminar Title	The 140th IROAST Seminar “Seismicity-Permeability Linkages in Fractured Reservoirs”			
Venue	Kurokami South C8, 2F, Room 221 (Faculty of Engineering Bldg. 2)			
Time & Date	14:40 – 16:10, January 8, 2025			
Speaker’s Name/ Title/Affiliation	Derek ELSWORTH, Professor, Energy and Mineral Engineering & Geosciences, G3 Center and EMS Energy Institute, Pennsylvania State University, University Park, USA			
Number of Participants	<u>Total: 12</u> (Int’l participants: 8) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	January 8 – 10, 2025			

-Seminar report -

**1. Seminar Overview**

The development and utilization of underground resources, such as natural gas and geothermal fluid, is imperative for sustainable development to be achieved. In this regard, a better understanding of permeability in reservoirs composed of fractured rock mass is crucial because it directly influences the productivity of fluid injection and/or extraction. Recent studies have shown that the permeability of reservoirs undergoes change when microseismic events occur in the reservoir due to fluid injection and/or extraction.

In this seminar, Prof. Elsworth gave a presentation on his studies on seismicity-permeability linkages in fractured reservoirs. The study was based on seismic monitoring and permeability tests in the field, which was related to hydraulic characteristics of rock discontinuity, i.e., shear deformation of fractures caused by fluid injection/extraction-induced pore pressure change has an influence on the hydraulic aperture of the discontinuity, thereby resulting in the change in its permeability. Finally, machine learning technology was introduced to predict the change in permeability based on only seismic data.

At the end of seminar, deep discussions were made between Prof. Elsworth and participants and lasted for 30 minutes, indicating the success of the presentation and great interest of the participants in the presentation topic.

**2. Seminar Outcomes and Future Plan**

Although the number of participants is less than expected, fruitful discussions were made during the question time. As the development of geothermal energy has attracting attention in Japan, the research field of Prof. Elsworth would become more important for us in the future. Hence, we should plan to hold a seminar periodically on relevant topics.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

During his stay in Kumamoto University, we held a laboratory seminar with Prof. Elsworth, in which PhD students and Postdoc working at Sainoki’s laboratory gave presentations on various topics, such as mitigation method of induced seismicity by increasing the stiffness of fault damage zone, microscopic strain distribution inside 3-D printed specimens with an internal fracture, and carbon dioxide mineralization technology. Prof. Elsworth gave feedback on the presentation.

#### 4. Prospect for further research collaboration.

We plan to conduct collaborative research on shear tests using 3D printed rock specimens with internal fractures. The presence of internal fractures in a specimen could affect the stress distribution on the discontinuity plane as well as the global stiffness of the specimen, thereby affecting the shear strength and shear behaviour. This is very important because a fault core undergoing slip is generally surrounded by a fault damage zone with a fracture network. Notwithstanding the fact, most of shear tests have been conducted with intact rock specimens without macroscopic internal fractures. Considering this gap between previous laboratory shear tests and natural fault, we plan to conduct the aforementioned shear test in the near future.



Prof. ELSWORTH



Assoc. Prof. SAINOKI



At the venue1



At the venue2

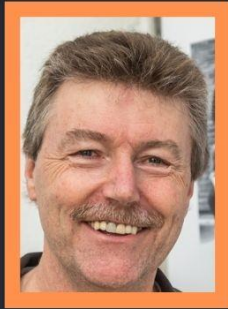


Q&A time



Group photo

# 140<sup>th</sup> IROAST SEMINAR



## “Seismicity–Permeability Linkages in Fractured Reservoirs”

**Prof. Derek ELSWORTH**

Energy and Mineral Engineering & Geosciences,  
G3 Center and EMS Energy Institute,  
Pennsylvania State University,  
University Park, USA



**Jan. 8<sup>th</sup> (Wednesday)**

**2:40pm~4:10pm**

**Kurokami South  
C8, 2F, Room 221**

**(Faculty of Engineering Bldg. 2)**

**Organizer**

**Assoc. Prof. Atsushi SAINOKI**

FAST, Kumamoto University

### **Abstract**

Triggered seismicity is a key hazard where fluids are injected or withdrawn from the subsurface and may also impact permeability. We constrain maximum event magnitudes in triggered earthquakes by relating pre-existing critical stresses to fluid injection volume – to explain why some recorded events are significantly larger than anticipated seismic moment thresholds. This formalism is shown consistent with a number of uncharacteristically large fluid-injection-triggered earthquakes. Such methods of reactivation of fractures and faults through hydraulic stimulation in shear or in tensile fracturing are used routinely as a method to create permeability in the subsurface. Microearthquakes (MEQs) generated in such stimulations may be used as diagnostic of permeability evolution. Although high fidelity datasets are meager, the EGS-Collab and Utah FORGE demonstration projects both provide high fidelity data sets that concurrently track permeability evolution and triggered seismicity. Machine learning deciphers the principal features of MEQs and the resulting permeability evolution that best track changes in permeability – with transfer learning methods allowing robust predictions across multiple geological settings. Changes in permeability on reactivated fractures in both Mode I and II suggest that permeability ( $k$ ) scales with the seismic moment ( $M$ ) of individual MEQs as  $k \propto M^{\alpha}$ . This scaling relation is exact at early time but degrades with successive MEQs but presents a method for characterizing crustal permeability evolution using MEQs.

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**IROAST Seminar & Research Activity Report by IROAST Visiting (Associate) Professor Invitation**

No.3-1-4 (Invitation Program) No.4-2-22 (Seminar)	Name	Makiko KOBAYASHI	Title	Professor
	Affiliation	FAST, Kumamoto University		
Seminar Title	141st IROAST Seminar “Healthcare and Technology”			
Venue	Kurokami South W2 Room 204 (Faculty of Engineering Core Laboratory Bldg.)			
Time & Date	16:00 – 17:00, March 14, 2025			
Speaker’s Name/ Title/Affiliation	Abdul HAFEEZ-BAIG, Assoc. Professor Information Systems Department, School of Business, University of Southern Queensland, Australia			
Number of Participants	<u>Total: 9 participants</u> Onsite: 5 (Int’l participants: 3) Online: 4 participants (Japan) Invitees: 1 (Int’l participants: 1)			
Duration of Visit	March 10 – 16, 2025			

-Seminar report -

**1. Seminar Overview**

The seminar provided a broad perspective rather than a deep technical discussion, making it well-suited for students. It focused on the evolving relationship between healthcare and technology, highlighting how advancements such as AI, machine learning, and wireless technology have reshaped healthcare in recent years. Instead of delving into complex technical details, the talk aimed to provide direction by posing a fundamental question: Does healthcare drive technology, or does technology drive healthcare? By examining trends and real-world applications, the seminar encouraged students to think about the interplay between these fields and their future implications.

**2. Seminar Outcomes and Future Plan**

As an outcome of the seminar, students gained a clearer understanding of the interdisciplinary nature of healthcare technology and its future directions. Additionally, one doctoral student expressed interest in a short-term research stay and engaged in discussions with the seminar speaker to explore potential opportunities.

-Activities report with visiting (associate) professor-

**3. Research achievements during his/her stay in Kumamoto University.**

During his stay, Professor Tanabe and the host professor, Professor Kobayashi, held discussions with the seminar speaker regarding potential collaborative research for the next academic year and the possibility of applying for international research grants.

**4. Prospect for further research collaboration.**

A joint study on abnormal detection through cough sounds using a wearable microphone is planned. An application for a travel grant has been submitted in the UK, and if accepted, the grant will be a collaborative project between Kumamoto University and Anglia Ruskin University (ARU) in the UK. In this case, procedures will be initiated to appoint a Visiting Associate Professor at Kumamoto University to facilitate the collaboration.



Assoc. Prof. HAFEEZ-BAIG



Prof. KOBAYASHI



At the venue1



At the venue2



Q&A time



Group photo



# 141<sup>st</sup> IROAST Seminar

March 14 (Friday) 4:00 pm ~ 5:00 pm

Kurokami South W2, 2F, Room 204

(Faculty of Engineering Core Laboratory Bldg.)



**"Healthcare  
and  
Technology"**

**Assoc. Prof. Abdul HAFEEZ-BAIG**

University of Southern Queensland,  
School of Business, Information Systems Dept.  
Australia

## Abstract

Healthcare and technology have shared a dynamic, interdependent relationship for many years, significantly impacting health services worldwide. Over the past decade, advancements in artificial intelligence (AI), machine learning, deep learning, handheld wireless technology, and various diagnostic innovations have transformed the way we perceive and integrate technology into healthcare.

This talk will explore a fundamental question: Does healthcare drive technology, or does technology drive healthcare? Through an analysis of emerging trends and real-world applications, we will examine how these two domains influence and shape each other in the modern era.



**Organizer:**

**Prof. Makiko KOBAYASHI**

FAST, Kumamoto University

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