

May 9-11, 2017

# KYOTO JAPAN



## Conference Proceedings

### **ICEAI**

International Congress on Engineering and Information

### **ICCBES**

International Congress on, Chemical, Biological and Environmental Sciences

### **ICCIS**

International Conference on Computer and Information Sciences

# Conference Proceedings

May 9-11 2017

Kyoto, Japan

ICEAI

International Congress on Engineering and  
Information

ICCBES

International Congress on Chemical, Biological and  
Environmental Sciences

ICCIS

International Conference on Computer and  
Information Sciences

**ICEAI**

**International Congress on Engineering and Information**

---

ISBN 978-986-88450-4-6

**ICCBES**

**International Congress on Chemical, Biological and Environmental Sciences**

---

ISBN 978-986-87417-8-2

**ICCIS**

**International Conference on Computer and Information Sciences**

---

ISBN 978-986-5654-25-2

## Content

---

<b>Content.....</b>	<b>3</b>
<b>Welcome Message .....</b>	<b>7</b>
<b>General Information for Participants .....</b>	<b>8</b>
<b>International Committees.....</b>	<b>10</b>
<b>International Committee of Nature Sciences .....</b>	<b>10</b>
<b>Conference Venue Information .....</b>	<b>13</b>
<b>Conference Schedule.....</b>	<b>15</b>
<b>Natural Sciences Keynote Speech.....</b>	<b>18</b>
<b>Oral Sessions.....</b>	<b>19</b>
<b>Environmental Sciences (1) .....</b>	<b>19</b>
ICCBES-0026.....	21
ICCBES-0011.....	34
ICCBES-0046.....	35
ICCBES-0101.....	38
ICCBES-0108.....	42
<b>Civil Engineering / Electrical Engineering.....</b>	<b>47</b>
ICEAI-0013.....	49
ICEAI-0019.....	63
ICEAI-0021.....	71
ICEAI-0032.....	82
ICEAI-0020.....	91
ICEAI-0044.....	102
<b>Environmental Sciences (2) .....</b>	<b>108</b>
ICCBES-0021.....	110
ICCBES-0049.....	120
ICCBES-0054.....	122
ICCBES-0058.....	124
ICCBES-0076.....	133
ICCBES-0070.....	138
<b>Computer Science / Information Engineering / Information Management / Information Technology.....</b>	<b>141</b>
ICEAI-0040.....	143
ICEAI-0041.....	144
ICCIS-0006 .....	146
ICEAI-0006.....	154
ICEAI-0015.....	157

ICCIS-0005 .....	159
ICCIS-0003 .....	172
ICCIS-0004 .....	185
<b>Biological Engineering / Biological Sciences / Chemical Engineering.....</b>	<b>188</b>
ICEAI-0018.....	190
ICCBES-0066.....	201
ICEAI-0029 .....	209
ICEAI-0056.....	211
ICCBES-0115.....	220
<b>Industrial Engineering .....</b>	<b>225</b>
ICEAI-0010 .....	227
ICEAI-0012 .....	237
ICEAI-0025 .....	250
ICEAI-0031 .....	260
ICEAI-0033 .....	270
ICEAI-0038.....	279
ICEAI-0043 .....	291
<b>Chemical Sciences .....</b>	<b>302</b>
ICCBES-0019.....	304
ICCBES-0020.....	307
ICCBES-0025.....	310
ICCBES-0032.....	318
ICCBES-0080.....	320
<b>Energy Engineering.....</b>	<b>321</b>
ICEAI-0030 .....	323
ICEAI-0034.....	332
ICEAI-0042 .....	344
ICEAI-0045.....	354
ICEAI-0052 .....	362
ICEAI-0060 .....	370
<b>Environmental Sciences (3) .....</b>	<b>372</b>
ICCBES-0073.....	374
ICCBES-0111.....	377
ICCBES-0112.....	379
ICCBES-0113.....	381
ICCBES-0043.....	383
<b>Poster Sessions (2) .....</b>	<b>388</b>
<b>Electrical Engineering / Biological Sciences(1) / Chemical Sciences / Computer Science / Civil Engineering .....</b>	<b>388</b>

ICEAI-0008.....	393
ICEAI-0011.....	402
ICEAI-0022.....	413
ICEAI-0024.....	415
ICEAI-0026.....	422
ICEAI-0035.....	425
ICCBES-0059.....	434
ICCBES-0068.....	436
ICCBES-0071.....	438
ICCBES-0084.....	440
ICCBES-0090.....	441
ICCBES-0091.....	443
ICCBES-0094.....	445
ICCBES-0095.....	447
ICCBES-0022.....	449
ICCBES-0031.....	451
ICCBES-0042.....	454
ICCBES-0047.....	456
ICCBES-0065.....	465
ICCBES-0069.....	468
ICCBES-0077.....	471
ICCBES-0081.....	474
ICCBES-0105.....	476
ICEAI-0027.....	478
ICEAI-0036.....	480
ICEAI-0055.....	483
<b>Poster Sessions (3) .....</b>	<b>494</b>
<b>Biological Sciences (2) / Information Engineering / Environmental Sciences / Environmental Engineering / Energy Engineering / Industrial Engineering ...</b>	<b>494</b>
ICCBES-0009.....	500
ICCBES-0010.....	502
ICCBES-0013.....	503
ICCBES-0014.....	505
ICCBES-0023.....	507
ICCBES-0028.....	509
ICCBES-0034.....	525
ICCBES-0055.....	527
ICCBES-0064.....	529
ICCBES-0078.....	531

<b>ICEAI-0014</b> .....	<b>534</b>
<b>ICEAI-0037</b> .....	<b>537</b>
<b>ICEAI-0054</b> .....	<b>542</b>
<b>ICCIS-0002</b> .....	<b>553</b>
<b>ICCBES-0027</b> .....	<b>564</b>
<b>ICCBES-0051</b> .....	<b>567</b>
<b>ICCBES-0056</b> .....	<b>569</b>
<b>ICCBES-0057</b> .....	<b>570</b>
<b>ICCBES-0079</b> .....	<b>571</b>
<b>ICCBES-0088</b> .....	<b>572</b>
<b>ICCBES-0098</b> .....	<b>580</b>
<b>ICEAI-0062</b> .....	<b>582</b>
<b>ICEAI-0003</b> .....	<b>594</b>
<b>ICEAI-0049</b> .....	<b>596</b>
<b>ICEAI-0039</b> .....	<b>598</b>

## ***Welcome Message***

---



### **Local Host**

**Michelle Kawamura Ph.D**

Associate Professor

Ritsumeikan University

Dear scholars and friends,

On behalf of Higher Education Forum I would like to welcome you all to Kyoto, Japan. Kyoto is a city representing a mixture of traditional Japanese cultures and modernization. From the well preserved constructions over centuries old, thousands of Buddhist temples and Shinto shrines to the untouched nature, this one of a kind place is unique in today's world. It is also these elements which attract people who appreciate and value historical surroundings. Beyond the various fascinating historical and traditional sites in Kyoto, the city also offers convenient transportation, comfortable accommodation, delicacies from all parts of the world and most of all, the hospitality of Kyoto. People in Kyoto welcome tourists to explore their culture, experience their customs and traditions. All these reasons led to an increasing number of foreign visitors to Kyoto every year. Some people visit for the first time and many others visit more than once.

Each year, many scholastic conferences of various disciplines take place in Kyoto. Kyoto has over 33 national, public and private universities. It also has over 57 vocational and technical schools. Including graduate schools and public and private research institutions, Kyoto takes pride in its education system, scholastic and research development. This is one of the reasons that many domestic and international conferences select Kyoto to host their conferences.

This is my third time, in three years to proudly act as the local host of Kyoto for the Higher Education Forum to welcome all the guests from all over the world. I have presented in 2014 and gave a welcome and keynote speech last year. I have met many professionals from different fields and exchanged knowledge from our researches to cultural experiences. The opportunity here is beyond scholastic exchange, but to also connect us to various cultures to become more aware of cultural differences, empathy and tolerance for others. I have gained new friends and learned profoundly here in the past 2 years participating in the conferences held by the Higher Education Forum. I sincerely hope you will enjoy your stay in Kyoto and bring home lots of experiences and knowledge from this conference.

See you soon~

Michelle Kawamura



## *General Information for Participants*

---

### ■ Registration

The registration desk will be situated on the **4<sup>th</sup> Floor** at the **Kyoto Research Park** during the following time:

**08:10-16:00 Wednesday, May 10, 2017**

**08:30-16:30 Thursday, May 11, 2017**

### ■ Organizer



Higher Education Forum (HEF)

Tel: + 886 2 2740 1498 | [www.prohef.org](http://www.prohef.org)



### ■ A Polite Request to All Participants

Participants are requested to arrive in a timely fashion for all addresses. Presenters are reminded that the time slots should be divided fairly and equally by the number of presentations, and that they should not overrun. The session chair is asked to assume this timekeeping role and to summarize key issues in each topic.



Sandals or Slippers



Tank Top



Shorts

### ■ Certificate

#### **Certificate of Presentation or Certificate of Attendance**

A certificate of attendance includes participant's name and affiliation, certifying the participation in the conference. A certificate of presentation indicates a presenter's name, affiliation and the paper title that is presented in the scheduled session.

#### **Certificate Distribution**

Oral presenters will receive a certificate of presentation from the session chair after their presentations or at the end of the session. Poster presenters will receive a certificate of presentation from the conference staff at the end of their poster session.

The certificate of presentation will not be issued, either at or after the conference, to authors whose papers are registered but not presented. Instead, the certificate of attendance will be provided after the conference.

### ■ Preparation for Oral Presentations

All presentation rooms are equipped with a screen, an LCD projector, and a laptop computer installed with Microsoft PowerPoint. You will be able to insert your USB flash drive into the computer and double check your file in PowerPoint. We recommend you to bring two copies of the file in case that one fails. You may also connect your own laptop to the provided projector; however please ensure you have the requisite connector.

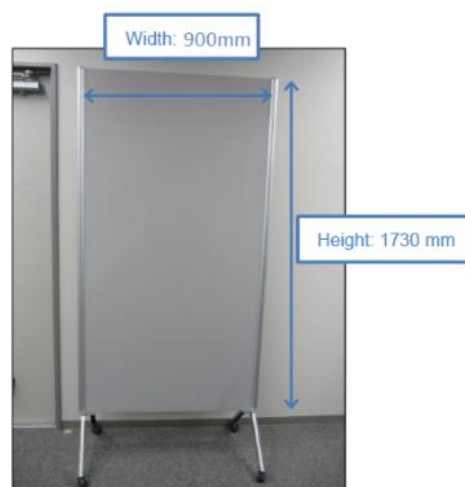
### Preparation for Poster Presentation

#### Materials Provided by the Conference Organizer:

1. Poster Panel (90cm×173cm)
2. Push pins

#### Materials Prepared by the Presenters:

1. Home-made poster(s)
2. Material: not limited, can be posted on the poster panel
3. Maximum poster size is A0



(Example)



## International Committees

---

### International Committee of Nature Sciences

Abdelmalik Serbout	University of physical and sports activities Djelfa	Algeria
Abdelwahab Elghareeb	Cairo University	Egypt
Abhishek Shukla	R.D. Engineering College Technical Campus, Ghaziabad	India
Ahmad Zahedi	James Cook University	Australia
Alexander M. Korsunsky	Trinity College, Oxford	UK
Almacen	Philippine Association of Maritime Training Centers	Philippines
Amel L. Magallanes	Capiz State University	Philippines
Amran Bin Ahmed	University Malaysia Perlis	Malaysia
Anthony D. Johnson	Seoul National University of Science & Technology	UK
Ashley Love	A.T. Still University	USA
Asif Mahmood	King Saud University, Riyadh	Saudi Arabia
Asmida Ismail	University Technology Mara	Malaysia
Baolin Wang	University of Western Sydney	
Byoung-Jun Yoon	Korea National Open University	South Korea
Chang Ping-Chuan	Kun Shan University	Taiwan
Chee Fah Wong	Universiti Pendidikan Sultan Idris	Malaysia
Chee-Ming Chan	Universiti Tun Hussein Onn Malaysia	Malaysia
Cheng, Chun Hung	The Chinese University of Hong Kong	Hong Kong
Cheng-Min Feng	National Chiao Tung University	Taiwan
Cheuk-Ming Mak	The Hong Kong Polytechnic University	Hong Kong
Chia-Ray Lin	Academia Sinica	Taiwan
Chih-Wei Chiu	National Taiwan University of Science and Technology	Taiwan
Chikako Asada	Tokushima University	
Chi-Ming Lai	National Cheng-Kung University	Taiwan
Ching-An Peng	University of Idaho	USA
Chin-Tung Cheng	National Kaohsiung (First) University of Science and Technology	Taiwan
Christoph Lindenberger	Friedrich-Alexander University	Germany
Daniel W. M. Chan	The Hong Kong Polytechnic University	Hong Kong
Deok-Joo Lee	Kyung Hee University	South Korea
Din Yuen Chan	National Chiayi University	Taiwan
Don Liu	Louisiana University	USA
Edward J. Smaglik	Northen Arizona University	USA
Ehsan Noroozinejad Farsangi	Kerman Graduate University of Advanced Technology (KGUT)	Iran

Farhad Memarzadeh	National Institutes of Health	USA
Fariborz Rahimi	University of Bonab	Iran
Fatchiyah M.Kes.	Universitas Brawijaya	Indonesia
Gi-Hyun Hwang	Dongseo University	South Korea
Gwo-Jiun Horng	Southern Taiwan University of Science and Technology	Taiwan
Hae-Duck Joshua Jeong	Korean Bible University	South Korea
Hairul Azman Roslan	Universiti Malaysia Sarawak	
Hamed M El-Shora	Mansoura University	Egypt
Hanmin Jung	Convergence Technology Research Planning	South Korea
Hasmawi Bin Khalid	University Teknologi Mara	Malaysia
Hikyoo Koh	Lamar University	USA
Hiroshi Uechi	Osaka Gakuin University	Japan
Ho, Wing Kei Keith	The Hong Kong Institute of Education	Hong Kong
Hsiao-Rong Tyan	Chung Yuan Christian University	Taiwan
Hsien Hua Lee	National Sun Yat-Sen University	Taiwan
Hung-Yuan Chung	National Central University	Taiwan
Hyomin Jeong	Gyeongsang National University	South Korea
Hyoungseop Kim	Kyushu Insititute of Techonogy	Japan
Jacky Yuh-Chung Hu	National Ilan University	Taiwan
Jeril Kuriakose	Manipal University	India
Jieh-Shian Young	National Changhua University of Education	Taiwan
Jivika Govil	Zion Bancorporation	India
Jongsuk Ruth Lee	Korea Institute of Science and Technology Information	South Korea
Jui-Hui Chen	CPC Corporation, Taiwan	Taiwan
Jung Tae Kim	Mokwon University	South Korea
Kamal Seyed Razavi	Federation University Australia	Australia
Kazuaki Maeda	Chubu Univeristy	Japan
Kim, Taesoo	Hanbat National University	South Korea
Kuang-Hui Peng	National Taipei University of Technology	Taiwan
Kun-Li Wen	Chienkuo Technology University	Taiwan
Lai Mun Kou	SEGi University	Malaysia
Lars Weinehall	Umea University	Sweden
Lee, Jae Bin	Mokpo National University	South Korea
M. Chandra Sekhar	National Institute of Technology	India
M. Krishnamurthy	KCG college of technology	India
Mane Aasheim Knudsen	University of Agder	Norway
Michiko Miyamoto	Akita Prefectural University	Japan
Minagawa, Masaru	Tokyo City University	Japan

Mu-Yen Chen	National Taichung University of Science and Tchonology	Taiwan
Norizzah Abd Rashid	Universiti Teknologi MARA	Malaysia
Onder Turan	Anadolu University	Turkey
Osman Adiguzel	Firat University	Turkey
P. Sivaprakash	A.S.L. Pauls College of Engineering & Technology	India
P.Sanjeevikumar	University of Bologna	India
Panayotis S. Tremante M.	Universidad Central de Venezuela	Venezuela
Patrick S.K. Chua	Singapore Institute of Technology	Singapore
Pei-Jeng Kuo	National Chengchi University	Taiwan
Phongsak Phakamach	North Eastern University	Thailand
Rainer Buchholz	Friedrich-Alexander University	Germany
Rajeev Kaula	Missouri State University	USA
Ransinchung R.N.(Ranjan)	Indian Institute of Technology	India
Ren-Zuo Wang	National Center for Research on Earthquake Engineering	Taiwan
Rong-Horng Chen	National Chiayi University	Taiwan
Roslan Zainal Abidin	Infrastructure University Kuala Lumpur	Malaysia
S. Ahmed John	Jamal Mohamed College	India
Saji Baby	Kuwait University	KUWAIT
Samuel Sheng-Wen Tseng	National Taiwan Ocean University	Taiwan
Sergei Gorlatch	University of Muenster	Germany
Shen-Long Tsai	National Taiwan University of Science and Technology	Taiwan
Sittisak Uparivong	Khon Kaen University	Thailand
Song Yu	Fukuoka Institute of Technology	Japan
Sudhir C.V.	Caledonian College of Engineering	Oman
Suresh. B. Gholve.	Rtm Nagpur University	India
Thippayarat Chahomchuen	Kasetsart University	Thailand
Victor A. Skormin	Binghamton University	USA
Vivian Louis Forbes	Wuhan University	China
William L. Baker	Indiana State University	USA
Wong Hai Ming	The University of Hong Kong	Hong Kong
Wong Tsun Tat	The Hong Kong Polytechnic University	Hong Kong
Wooyoung Shim	Yonsei University	South Korea
Ya-Fen Chang	National Taichung University of Science and Tchonology	Taiwan
Yasuhiko Koike	Tokyo University of Agriculture	Japan
Yee-Wen Yen	National Taiwan University of Science and Technology	Taiwan
Yoshida Masafumi	Tokyo City University	Japan
Youngjune Park	Gwangju Institute of Science and Technology	South Korea
Yuan-Lung Lo	Tamkang University	Taiwan

## Conference Venue Information

### Kyoto Research Park

Tel: +81-75-322-7800

Address: 134, Chudoji Minami-machi, Shimogyo-ku, Kyoto 600-8813, Japan

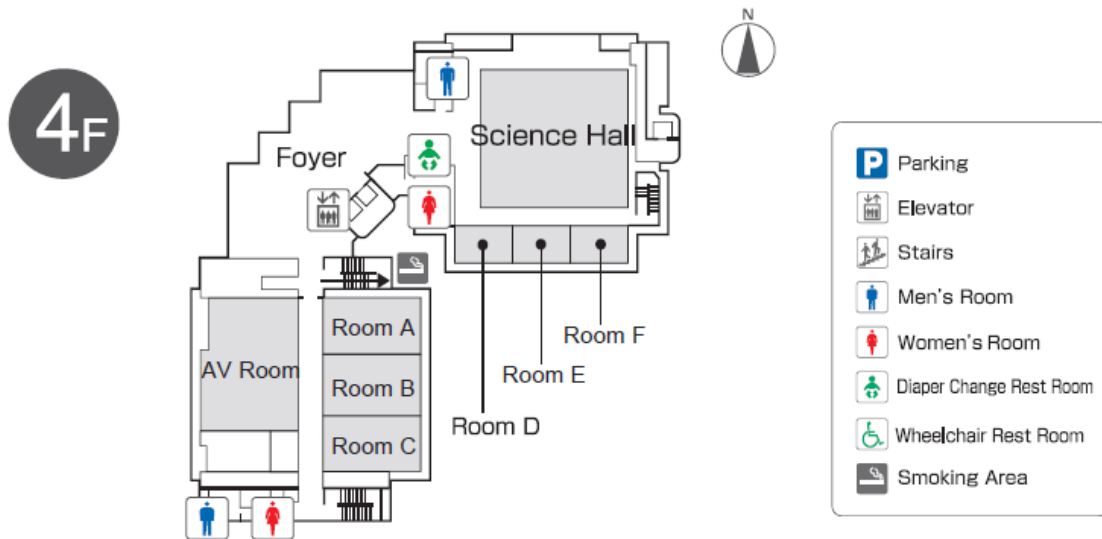
Located at the ancient capital of Japan, Kyoto Research Park (KRP) is set at a convenient spot. KRP has a wide variety of networks involving universities, industries, administrative institutes, public research institutes, and economic bodies. KRP offers various of conference rooms, offices, and labs.

The conference will be held at Hall 1 inside the research park. Hall 1 is near to JR Tanbaguchi-Eki.



## Floor Map (4<sup>th</sup> Floor)

# Floor Map of Bldg. #1



## *Conference Schedule*

**Tuesday, May 09, 2017**

**Internal Training**

**Wednesday, May 10, 2017**

**Oral Session (4<sup>th</sup> Floor)**

Time	Schedule	Venue
<b>08:10-16:00</b>	<b>Registration</b>	Foyer Area
<b>08:30-10:00</b>	Environmental Sciences (1)	Room B
	Civil Engineering / Electrical Engineering	Room C
<b>10:00-10:20</b>	<b>Tea Break &amp; Networking</b>	Foyer Area
<b>10:20-12:30</b>	Environmental Sciences (2)	Room C
	<p><b><u>Welcome Speech &amp; Networking(10:20-10:30)</u></b>  <b>Prof. Michelle Kawamura</b>                      Ritsumeikan University</p> <p>-----</p> <p><b><u>Nature Science Keynote Speech (10:30-11:30)</u></b>  <b>Prof. Simona Vasilache</b>                      University of Tsukuba  <i>Topic: <u>Multicultural Perspectives on Software Engineering</u></i></p>	AV Room
<b>12:30-13:30</b>	<b>Lunch</b>	Atrium
<b>15:00-15:20</b>	<b>Tea Break &amp; Networking</b>	Foyer Area
<b>15:20-16:50</b>	Computer Science / Information Engineering / Information Management / Information Technology	Room B



## Wednesday, May 10, 2017

### Poster Session (Foyer Area, 4<sup>th</sup> floor)

Time	Schedule
14:00-15:00	Poster Session (2)
	Electrical Engineering / Biological Sciences (1) / Chemical Sciences / Computer Science / Civil Engineering

## Thursday, May 11, 2017

### Oral Session (4<sup>th</sup> Floor)

Time	Schedule	Venue
08:30-16:30	<b>Registration</b>	Foyer Area
08:40-10:10	Biological Engineering / Biological Sciences / Chemical Engineering	Room B
	Industrial Engineering	Room C
10:10-10:30	<b>Tea Break &amp; Networking</b>	Foyer Area
10:30-12:00	Chemical Sciences	Room B
	Energy Engineering	Room C
12:00-13:00	<b>Lunch</b>	Atrium
13:00-14:30	Environmental Sciences (3)	Room C
14:30-14:50	<b>Tea Break &amp; Networking</b>	Foyer Area
16:20-16:30	<b>Tea Break &amp; Networking</b>	Foyer Area

**Thursday, May 11, 2017**

**Poster Session (Foyer Area, 4<sup>th</sup> floor)**

<b>Time</b>	<b>Schedule</b>
<b>11:00-12:00</b>	Poster Session (3)
	Biological Sciences (2) / Information Engineering / Environmental Sciences / Environmental Engineering / Energy Engineering / Industrial Engineering

# Natural Sciences Keynote Speech

## AV Room

10:30-11:30 Wednesday, May 10, 2017

---

### Topic:

*Multicultural Perspectives on Software Engineering*

### Prof. Simona Vasilache

Dept. of Computer Science  
Graduate School of Systems and Information  
University of Tsukuba  
Japan



---

### Abstract

Globalization plays a major role in all aspects of our 21st century life, influencing software engineering practice, as well as software engineering education.

Software engineering is a relatively young engineering discipline and it is under constant development and evolution; software development teams often include members from various cultural backgrounds. At the same time, the multicultural nature of education proves to be a challenge in all educational aspects, including those related to software engineering .

This talk will highlight some of the challenges posed by multiculturalism in the field of software engineering, both in industry and in academia.

### Introduction of Prof. Simona Vasilache

Simona Vasilache is an assistant professor in the Graduate School of Systems and Information Engineering at the University of Tsukuba in Japan. She completed her undergraduate studies at the Politechnica University of Bucharest, Romania, and she obtained her PhD from the University of Tsukuba in Japan. Her research interests include human computer interaction, software engineering, formal methods, cultural aspects of e-learning, as well as intercultural communication.

For the past 5 years she has been teaching a culturally diverse group of international students in Japan.

### Environmental Sciences (1)

Wednesday, May 10, 2017

08:30-10:00

Room B

Session Chair: *Prof. Ayca Erdem*

---

#### ICCBES-0026

##### **Investigation and Assessment of Energy and Resource Integration into Sewage Treatment and Waste Heat Recovery**

Kuang-Chih Chang | *Ministry of Economic Affairs*

Ya-Feng Wang | *Chung Yuan Christian University*

Tien-Chin Chang | *National Taipei University of Technology*

Lin-Han Chiang Hsieh | *Chung Yuan Christian University*

Ciao-En Hu | *National Taipei University of Technology*

#### ICCBES-0011

##### **Seasonal Evaluation of the Sanitary Quality of the Alexandrian Mediterranean Coast Using Microbial Indicators**

Amira M. Hamdan | *Alexandria University*

#### ICCBES-0046

##### **Current Research Trends in Environmental Engineering: Content Analysis of Publications on Micropollutants**

Merve Ozkaleli | *Akdeniz University*

Ayşe Gunay | *Akdeniz University*

Meltem Asilturk | *Akdeniz University*

Cigdem Moral | *Akdeniz University*

Ayca Erdem | *Akdeniz University*

#### ICCBES-0101

##### **Effect of Dopants on Pt/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> Catalyst in Propane Dehydrogenation**

Nattanon Chartsakulsaka | *Chulalongkorn University*

Adisak Guntidaa | *Chulalongkorn University*

Joongjai Panpranota | *Chulalongkorn University*

Kongkiat Suriyeb | *SCG Chemicals*

Piyasan Prasertdama | *Chulalongkorn University*

**ICCBES-0108**

**The Effect of Loading Sequence of the La-Promoted  $\text{WO}_3/\text{SiO}_2$  Catalysts in the Cross-Metathesis of Ethylene and 2-Butene and Self-Metathesis of Propylene**

Thotsapan Kornpitak | *Chulalongkorn University*

Joongjai Panpranot | *Chulalongkorn University*

Piyasan Prasertdam | *Chulalongkorn University*

# Biological Engineering / Biological Sciences / Chemical Engineering

Thursday, May 11, 2017

08:40-10:10

Room B

Session Chair: *Prof. Lanny Sapei*

---

## ICEAI-0018

### Optimized Hot Air Flow Distribution System for Increasing the Dialyzer Drying Process Performance

Mohammad Fard | *Novatisteb Company*

Ali Rezaee | *Novatisteb Company*

## ICCBES-0066

### A Method for the Quantification of 18F-FDOPA in PET Imaging for Parkinson's Disease Correlation to Brain Structures

Printaporn Sanguansuttigul | *King Mongkut's University of Technology Thonburi*

Teerapol Saleewong | *King Mongkut's University of Technology Thonburi*

Sayaphat Suksai | *Srinakharinwirot University*

Kitiwat Khamwan | *Chulalongkorn University*

Saknan Bongsebandhu-Phubhakdi | *Chulalongkorn University*

## ICEAI-0029

### Simulations of Geometrical Effects on Transport Properties Through Micro- and Nanopores

Attaphon Chaimanatsakun | *Kasetsart University*

Deanpen Japrunng | *Thailand Science Park*

Prapasiri Pongprayoon | *Kasetsart University*

## ICEAI-0056

### High-Grade Biosilica Isolated from Diluted Acids Leached Rice Husk

Lanny Sapei | *University of Surabaya*

Natalia Suseno | *University of Surabaya*

Karsono Samuel Padmajaya | *University of Surabaya*

Jessica Natalia Wibowo | *University of Surabaya*

Chandra Widjaja | *University of Surabaya*

**ICCBES-0115**

**Effects of Natural Steroid Sand Fish (*Holothuria Scabra*) for Uterus Development of Post Menopausal Women**

Etty Riani | *Bogor Agricultural University*

Chairunissa | *Bogor Agricultural University*

Hera Maheswari | *Bogor Agricultural University*

Farah Bilqistiputri | *Lampung University*

Nastiti Kusumorini | *Bogor Agricultural University*

**High-Grade Biosilica Isolated from Diluted Acids Leached Rice Husk**

**Lanny Sapei<sup>\*</sup>, Natalia Suseno, Karsono Samuel Padmawijaya,**

**Jessica Natalia Wibowo, Chandra Widjaja**

Department of Chemical Engineering, University of Surabaya, Indonesia

<sup>\*</sup> E-mail: lanny.sapei@staff.ubaya.ac.id

**Abstract**

Rice husk which consists of ~20% silica seems to be quite promising to be the biosilica resources. As one of the most abundant agricultural wastes derived from paddy milling sites, rice husks have been generally directly burn on sites causing air pollution and environmental problems. Rice husk silica is amorphous in nature which is quite reactive and has a great potential to be used as a raw material for various silica based products. The aim of this experiment was to study the efficacy of diluted acids such as HCl and citric acid in order to obtain high-grade silica. The characterisation of silica ashes included the analysis of composition and structure using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), X-ray Fluorescence (XRF). The specific surface area of silica was determined using Brunauer, Emmet, Teller-Surface Area Analyzer (BET-SAA). Silica produced from these experiments had an amorphous form. The highest silica purity with Si content of 96.2% was obtained from rice husk treated using diluted HCl. However, the highest specific surface area of ~253 m<sup>2</sup>/g was derived from diluted citric acid treated rice husks. Diluted acids seemed to be quite effective in removing metallic impurities enabling to produce high grade biosilica.

Keywords: Amorphous silica, rice husk, dilute acids, leaching.

**1. Introduction**

The rice paddy production in the world reached 748 million tons in 2016 of which ~ 90% was produced in Asia (FAO, 2016). In Indonesia, about 75 million tons was produced in 2015 (BPS, 2016). Around 20% of rice paddy is rice husk (Blissett, 2017), thus around 15 million tons of rice husks are produced annually in Indonesia. Rice husk is produced during the paddy milling and regarded as the second largest wastes after rice straws. Rice husk is generally accumulated and burnt on sites thus increasing air pollution. Rice husks have been considered to be the amorphous silica resources which have been widely used in many industrial applications such as cements (Sinyoung, 2017; Aprianti, 2017), fillers (Hsieh, 2017; Noushad, 2016), polymer composites (Yaakob, 2017), adsorbent (Deokar, 2016), catalyst support (Kumar, 2016), and drug delivery (Rajanna, 2017). Besides that, there have been several attempts to harness rice husk as biomass derived fuels (Blissett, 2017) and as precursors for silica-based materials