# **Preface**

The 4<sup>th</sup> International Conference on Materials Sciences and Nanomaterials (ICMSN 2020), the 5<sup>th</sup> International Conference on Advanced Functional Materials (ICAFM 2020) and the 3<sup>rd</sup> International Conference on Advanced Composite Materials (ICACM 2020) were held virtually in web streaming because of the COVID-19 pandemic, with a success.

The proceedings of ICMSN 2020, ICAFM 2020 and ICACM 2020 includes a selection of papers submitted to the conference from universities, research institutes and industries. All of the papers were subjected to peer-review by conference committee members and international reviewers. They were selected for their quality and relevancy to the subjects of the conference.

ICMSN 2020, ICAFM 2020 and ICACM 2020 are aimed at providing an excellent avenue for academicians, students, researchers, professionals, engineers, and scientists from academia and industry to share their research findings and to build networks for further collaborative research in their respective areas.

I would like to express my gratitude and appreciation to the Conference Technical Committee for their great contribution in organizing these conferences. I would also like to thank the conference keynote speakers and participants to share their knowledge with the rest of the participants. Special thanks to TTP Trans Tech Publications Inc. for providing the platform to publish the conference papers. And many thanks to the reviewers for their time and effort in maintaining the academic quality and standard.

I hope this volume will prove useful for researchers and practitioners in developing and applying new technologies and processes in the field of materials sciences, nanomaterials, advanced functional materials and advanced composite materials.

Prof. Yuyuan Zhao University of Liverpool, UK

# **Conference Committees**

### **Advisory Chairs**

- Prof. David Ginley, Materials and Chemistry Science and Technology NREL, USA
- Prof. Zheng-Hong Lu, University of Toronto, Canada

#### **Conference Chairs**

- Prof. Yuyuan Zhao, University of Liverpool, UK
- Prof. Alexander M. Korsunsky, Vice President, Trinity College, University of Oxford, UK
- Prof. Hao Gong, National University of Singapore, Singapore
- Prof. Hongfa (Henry) Hu, University of Windsor, Canada
- Prof. Hideaki Tsukamoto, Hosei University, Japan
- Prof. Alan Lau, Swinburne University of Technology, Australia

### **Program Chairs**

- Prof. Yasuhiko HAYASHI, Okayama University, Japan
- Prof. Angelo Maligno, University of Derby, UK
- Prof. Qingsong Yu, University of Missouri, USA
- Prof. Ju Chou, Florida Gulf Coast University, USA
- Prof. Lihui Lang, Beihang University, China
- Prof. Young Hoon Rim, Semyung University, Korea

#### **Conference Poster Chair**

Prof. Tingkai Zhao, Northwestern Polytechnical University, China

## **Publicity Chairs**

Assoc. Prof. Steven Frederick Durrant, Instituto de Ciência e Tecnologia de Sorocaba, UNESP,

Brazil

Assoc. Prof. Ludmila Kucerova, University of West Bohemia, Czech Republic

#### **International Technical Committee**

Daolun Chen, Ryerson University, Canada

Xiaolong Jia, Beijing University of Chemical Technology, China

Ricardo Nuno Madeira Soares Branco, University of Coimbra, Portugal

Qumrul Ahsan, Universiti Teknikal Malaysia, Malaysia

Dong Won Jung, Jeju National University, South Korea

Elia Guzmán, Universidad Michoacana de San Nicolás de Hidalgo, Mexico

Wilfrido Molina, Universidad Michoacana de San Nicolás de Hidalgo, Mexico

Mohsen A. Hassan, Egypt-Japan University of Science and Technology, Egypt

Bonamali Pal, Thapar University, India

Yuzo Nakamura, Kagoshima University, Japan

Dawei Li, China University of Petroleum (East China), China

P. A. Kakavas-Papaniaros, Technological Educational Institute of Western Greece, Greece

Claudia Valentina Cimpoiu, Babes-Bolyai University, Romania

Alysson Martins A. Silva, Universidade de Brasilia, Brazil

Mohd Zul Helmi Rozaini, Universiti Malaysia Terengganu, Malaysia

Walid Daoud, City University of Hong Kong, China

Chun-Cheng Lin, R.O.C. Air Force Academy, Taiwan

Camilla Mileto, Universitat Politècnica de València, Spain

Siti Norasmah Surip, Universiti Teknologi MARA, Malaysia

Andoni Lasheras Aransay, Universidad del país vasco (UPV/EHU), Spain

Radka Pernicova, Czech Technical University in Prague, Czechia

Kornkamol Srithammaraj, Chulalongkorn University, Thailand

Elena Fertman, National Academy of Sciences of Ukraine, Ukraine

Thi Hinh Dinh, Phenikaa University, Vietnam

Yang Xi, Sr. Quality Scientist, Newomics Inc. USA

Koorosh Gharehbaghi, RMIT University, Australia

Mohamad Zaki Hassan, Universiti Teknologi Malaysia, Malaysia

Zuruzi Abu Samah, Alfaisal University, Kingdom of Saudi Arabia

Rahul M. Mane, Shivaji University, India

Darunee Wattanasiriwech, Mae Fah Luang University, Thailand

Christèle Jaillet, CRPP-CNRS University of Bordeaux, France

Brischetto Salvatore, Politecnico di Torino, Italy

Sumit Kumar Gupta, Parishkar College of Global Excellence Jaipur, India

Cheung-poon, Ryerson University, Canada

Jian Sun, China University of Geosciences, China

Jianlin Liu, Univeristy of Califonia, Riverside, USA

Na Yan, Northwestern Polytechnical University, China

Yu-Lun Chueh, National Tsing Hua Universitiy, Taiwan

Wang Hai, Yunnan University, China

Pung Swee Yong, Universiti Sains Malaysia, Malaysia

Nadras Othman, Universiti Sains Malaysia, Malaysia

Astuty bt. Amrin, UTM Razak School of Engineering and Advanced Technology, Malaysia

Yuan Li, Soochow University, China

Jaime Llanos, Universidad Católica del Norte, Chile

O.L. Shanmugasundaram, K.S.Rangasamy College of Technology, India

Weiming Tian, Harbin Institute of Technology, China

Jose Angel Roldan Lopez, Universidad Nacional de Trujillo, Peru

Vimolvan Pimpan, Chulalongkorn University, Thailand

Caterine Donoso, Universidad de las Fuerzas Armadas ESPE, Ecuador

Yu-Cheng Chen, Biotech Company, Taiwan

N. Shanmuga priya, Siddaganga Institute of Technology, India

Mário S. Ming Kong University Lisbon, Portugal

Jian Yang, Shanghai Jiao Tong University, China

Shen-Yung Lin, National Formosa University, Taiwan

Kung-Chung Hsu, National Taiwan Normal University, Taiwan

Arnold C. Alguno, MSU-Iligan Institute of Technology, Philippines

Xiang Li, University of Shanghai for Science and Technology, China

Rey Y. Capangpangan, Caraga State University, Philippines
Radhika Pathak, Priyadarshini Institute of Architecture and Design studies, India
Ana I. Almerich Chulia, Universitat Politècnica De València, Valencia (Spain)
Ibetombi Soibam, NIT Manipur, India
R. Yuvakkumar, Alagappa University, India
Hao Wang, Northeastern University, China
Hendra Suherman, Universitas Bung Hatta, Indonesia
Chye Lih Tan, Universiti Malaysia Perlis, Malaysia