# CONFERENCE PROGRAM

**March 28-31, 2020**

## ICMMME 2020

**The 5th International Conference on Manufacturing, Material and Metallurgical Engineering**

## AMSE 2020

**The 2nd International Conference on Advanced Materials Science and Engineering**

**Organized by** **Co-sponsored by** **Technical Supported by**

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# CONTENTS

# CONFERENCE AGENDA

## ■ March 28, 2020—Test Presentation

| | |
|---|---|
| 9:00-9:10 | Keynote Speaker I<br>**Prof. Ramesh K. Agarwal \| Washington University in St. Louis, USA** |
| 9:10-9:20 | Keynote Speaker II<br>**Prof. Changduk Kong \| Chosun University, South Korea** |
| 9:20-9:30 | Keynote Speaker III<br>**Prof. Seok-Soon Lee \| Gyeongsang National University, South Korea** |
| 9:30-10:00 | Break |
| 10:00-10:30 | Session I — Design and Preparation of Engineering Materials |
| | Session II — Nanotechnology and Composite Materials |
| | Session III — Digital Manufacturing System and Industrial Production |
| 10:30-11:30 | Break |
| 11:30-12:00 | Session IV — Materials Science and Engineering Applications |
| | Session V — Material Structure and Performance Analysis |
| | Session VI — Mechanical Engineering |
| 9:00-14:00 | Q&A Time |

## ■ March 29, 2020—Formal Presentation

| | |
|---|---|
| **Morning** | |
| 9:00-9:05 | Opening Remarks |
| 9:05-9:45 | Keynote Speaker I<br>**Prof. Ramesh K. Agarwal \| Washington University in St. Louis, USA** |
| 9:55-10:35 | Keynote Speaker II<br>**Prof. Changduk Kong \| Chosun University, South Korea** |
| 10:45-11:25 | Keynote Speaker III<br>**Prof. Seok-Soon Lee \| Gyeongsang National University, South Korea** |
| **Afternoon** | |
| 13:30-15:00 | Session I — Design and Preparation of Engineering Materials |
| | Session II — Nanotechnology and Composite Materials |
| 15:00-16:00 | Break |
| 16:00-17:30 | Session III — Digital Manufacturing System and Industrial Production |
| | Session IV — Materials Science and Engineering Applications |

## ■ March 30, 2020—Formal Presentation

| | |
|---|---|
| 10:00-11:30 | Session V — Material Structure and Performance Analysis |
| | Session VI — Mechanical Engineering |

## ■ March 31, 2020—Replay Presentation | 11:00-17:00

# WELCOME ADDRESS

We are pleased to welcome you to join the 5th International Conference on Manufacturing, Material and Metallurgical Engineering (ICMMME 2020) and the workshop The International Conference on Advanced Materials Science and Engineering (AMSE 2020), which take place during March 28-31, 2020. The conference is focuses on issues related to information, computer technologies and data analysis. The conference also brings researchers, academics, practicing engineers, as well as advanced research students together from a number of countries and various sectors to share and discuss their research results and experiences.

We wish to express our sincere appreciation to all of the individuals who have contributed to ICMMME 2020 and AMSE 2020. Special thanks are extended to our colleagues in program committee for their thorough review of all the submissions, which is vital to the success of the conferences, and also to the members in the organizing committee and the volunteers who had dedicated their time and efforts in planning, promoting, organizing and helping the conference. Last but not least, our special thanks go to invited keynote speakers as well as all the authors for contributing their latest researches to the conference.

This conference program is highlighted by three keynote speakers: Prof. Ramesh K. Agarwal, Washington University in St. Louis, USA; Prof. Changduk Kong, Chosun University, South Korea; Prof. Seok-Soon Lee, Gyeongsang National University, South Korea; and 6 parallel sessions with material science, manufacturing and mechanical engineering.

Wish you enjoy the conference.

ICMMME 2020
AMSE 2020
Organizing Committee

# CONFERENCE COMMITTEE

### Conference Chairs

Ramesh K. Agarwal, Washington University in St. Louis, USA

Changduk Kong, Chosun University, South Korea

### Program Chairs

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S. Lee, Gyeongsang National University, South Korea

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Rosli Ahmad, Universiti Tun Hussein Onn Malaysia, Malaysia
Manyi Chen, Wuhan University of Technology, China
Thanakom Soontornchainacksaeng, King Mongkut’s University of Technology North Bangkok, Thailand
Chou Chau Yuan Fong, Universiti Brunei Darussalam, Brunei
Elammaran Jayamani, Swinburne University of Technology Sarawak Campus, Malaysia
Datin Napsiah Ismail, Universiti Putra Malaysia, Malaysia
Ali Arslan Kaya, Mugla Sitki Kocman University, Turkey

# KEYNOTE SPEAKER I

**Prof. Ramesh K. Agarwal**
Washington University in St. Louis, USA

**Prof. Ramesh K. Agarwal** is the William Palm Professor of Engineering in the department of Mechanical Engineering and Materials Science at Washington University in St. Louis. From 1994 to 2001, he was the Sam Bloomfield Distinguished Professor and Executive Director of the National Institute for Aviation Research at Wichita State University in Kansas. From 1978 to 1994, he was the Program Director and McDonnell Douglas Fellow at McDonnell Douglas Research Laboratories in St. Louis. Dr. Agarwal received Ph.D in Aeronautical Sciences from Stanford University in 1975, M.S. in Aeronautical Engineering from the University of Minnesota in 1969 and B.S. in Mechanical Engineering from Indian Institute of Technology, Kharagpur, India in 1968. Over a period of forty years, Professor Agarwal has worked in various areas of Computational Science and Engineering - Computational Fluid Dynamics (CFD), Computational Materials Science and Manufacturing, Computational Electromagnetics (CEM), Neuro-Computing, Control Theory and Systems, and Multidisciplinary Design and Optimization. He is the author and coauthor of over 500 journal and refereed conference publications. He has given many plenary, keynote and invited lectures at various national and international conferences worldwide in over fifty countries. Professor Agarwal continues to serve on many academic, government, and industrial advisory committees. Dr. Agarwal is a Fellow eighteen societies including the Institute of Electrical and Electronics Engineers (IEEE), American Association for Advancement of Science (AAAS), American Institute of Aeronautics and Astronautics (AIAA), American Physical Society (APS), American Society of Mechanical Engineers (ASME), Royal Aeronautical Society, Chinese Society of Aeronautics and Astronautics (CSAA), Society of Manufacturing Engineers (SME) and American Society for Engineering Education (ASEE). He has received many prestigious honors and national/international awards from various professional societies and organizations for his research contributions.

### Recent Developments in Composite Structures for Green Aircraft Applications

***Abstract*** — In recent years, there has been emphasis on 'Green Aviation' with the dual aims of reducing the energy consumption as well as emissions. Several new concepts for the aircraft have been proposed to reduce drag, improve engine efficiency, and reduce mass. Majority of the wing-tube transport aircraft in service today are very efficient high speed air vehicles equipped with high bypass jet engines. Since early 1960s most improvements in aircraft efficiency have come from advanced turbofan propulsion technology (40 %) and improved aerodynamics to increase the Lift/Drag (15%); however, the structural efficiency of the aluminum aircraft did not change much because of limited emphasis on considerations of novel materials, structures, and manufacturing processes. In recent years, reduction of aircraft mass has become one of the major drivers in developing new aircraft design concepts, novel materials and manufacturing processes without affecting the intrinsic qualities, namely the safety, reliability, durability and comfort. As a result, the metal composites based on textile-reinforced polymers that are locally blended with metal elements are being investigated for aircraft structures. Additionally, in the near future a tremendous leap in material morphologies is expected from intermediate components such as solid plates and slender beams that are assembled and joined mechanically to flexible bundles of fibers, which are then transformed into integral

three-dimensional structures via both the traditional textile manufacturing and modern fiber placement machinery. These textile structures are impregnated ('pre', 'in situ' or 'post'- before, during or after molding) and finally solidified into ultra-modern integral multipart and multifunctional solid lightweight composite structures. This review will describe these developments that will transform the 'state of the art' aircraft concepts into more efficient (more pay-load per unit weight and per dollar) transport, both by increasing the structural simplicity and efficiency, and by a more straightforward use of modern materials and processes.

In addition, to address many challenges of 'Green Aviation,' nearly a decade ago NASA launched an initiative called the 'Environmentally Responsible Aviation (ERA).' In this initiative, Blended-Wing-Body (BWB) aircraft is being seriously considered as a long-haul transport aircraft. BWB provides many aerodynamic advantages; however it presents structural challenges due to the noncircular cross section of the center part of its fuselage. Although significantly lighter than the conventional aluminum structures, even the most efficient composite primary structures used in today's state-of-the-art aircraft are not adequate to overcome the weight and cost penalties introduced by the highly contoured airframe of the BWB. In the pressurized cabin regions where the design is primarily driven by the out-of-plane loading considerations and where secondary bending stresses are developed, a traditional layered material system would require thousands of mechanical attachments to suppress delaminations and to join structural elements, ultimately leading to fastener pull-through problems in the thin gauge skins. Furthermore, a conventional composite solution for BWB would entail high manufacturing costs due to its highly contoured airframe. Also, an effective BWB structure must operate in out-of-plane loading scenarios while simultaneously meeting the arduous producibility requirements inherent in building the highly contoured airframe. In addition to the secondary bending stresses experienced during pressurization, another key difference in the BWB shell is the unique biaxial loading pattern that occurs during maneuver loading conditions. It is important to capture such attributes to overcome the inherent weight penalties of the BWB noncircular pressure cabin. To address these issues, scientists at NASA and the Boeing Company are working together to develop a new structural concept called the pultruded rod stitched efficient unitized structure (PRSEUS). This concept is being analytically and experimentally evaluated using a building block approach that assesses the fundamental structural responses in representative loading environments. This presentation will also review the current status of PRSEUS.

# KEYNOTE SPEAKER II

**Prof. Changduk Kong**
Chosun University,
South Korea

**Prof. Changduk Kong** graduated with a BSc in Aerospace Engineering from the Korea Aerospace University-National (Hons.) and a PhD in Aerospace Engineering from the Osaka Prefecture University, Japan.

He worked as Head of the Aero-Propulsion Division of ADD (Agency for Defence Development in1978-1994. He served as Professor at Department of Aerospace Engineering of Chosun University during 1994-2016, and was appointed as Dean of the School of Aerospace and Naval Architecture Engineering in 1999 and 2005-2006, and Dean of the Facility Management Office at Chosun University in 2011-2012. He has served as International Visiting Professor at Department of Aerospace Engineering of IIT(Indian Institute of Technology) Kharagpur, India in 2017-2021, Invited Professor at School of Aerospace and Mechanical Engineering of Korea Aerospace University, in 2016-2019, Invited Professor at Summer School of BUAA(Beijing University of Aeronautics and Astronautics), China in 2017-2019, and Emeritus Professor at Department of Aerospace Engineering of Chosun University since 2016. He was invited as Visiting Professor at Department of Aeronautics of Imperial College, UK in 2001-2002.

Prof. Kong has contributed greatly to the development of Aerospace Engineering in Korea, primarily through his roles as a non-standing Director of KIAST(Korea Institute of Aviation Safety Technology) in 2015-2018, a non-standing Director of AMRC(UK)-Korea in 2016-2020, CTO of EGT Company, President of KNST(Korea Society for Naval Science and Technology) in 2017-2018, President of SASE(The Society for Aerospace System Engineering) in 2013-2016, President of ICRC (International Collaboration Research Centre in Natural Composites, Chosun University in 2012-2014, President of KSAS(The Korean Society for Aeronautical and Space Sciences in 2010, President of KSPE(The Korean Society of Propulsion Engineers in 2007-2008, Chair of Cycle Innovation-IGTI-ASME in 2009-2011, President of RIME(Research Institute of Mechanical Engineering-Chosun University) in 2006-2008, and First Lieutenant of ROKAF(Republic of Korea Air Forces) in 1974-1978.

He has served as Editorial Board Members of IJTJ(International Journal of Turbo & Jet Engines), IJCM(International Journal of Composite Materials), CJS(Chinese Journal of Aeronautics) and AEAT(Aircraft Engineering and Aerospace Technology) since 1998, and Editor-in-Chief of JKSAS(Journal of Korean Society for Aeronautical and Space Science) and JKSPE(Journal of Korean Society of Propulsion Engineers) in 2006-2010. He received the Korean National Decoration in Science, Academic Achievement Awards from KSAS, SASE and KSPE, Defence Science Medals and the 2015 KAI-KSAS Prize for his scientific achievement and contribution to Korean aerospace development.

Prof. Kong has authored and co-authored more than 616 papers including 67 SCI journal papers, and has received numerous lecture invitations from companies, research institutes and universities and delivered eleven keynotes and invited lectures at international conferences. He has organized 26 national conferences, forums and workshops and was co-organiser on four international conferences.

### Development Status of Aerospace Composite Materials Technology in Korea

***Abstract*** — Composite materials are ideal for structural applications where high strength-to-weight and stiffness-to-weight ratios are required. Aircraft and spacecraft are typically weight sensitive structure, in

which composite materials can be cost-effective, for instance, about 800 USD/lb for commercial aircrafts and about 30,000USD/lb for spacecraft. Composite materials are often not only to improve the stiffness-to-weight ratio or strength-to-weight ratio or to improve toughness in mechanical design but also to reduce thermal expansion, or to maximize heat transfer, or to minimize thermal distortion in thermo-mechanical design. Due to these advantages most present aircrafts and spacecraft have been designed by composite materials. For example, new commercial aircrafts A350 and B787 use 53% and 50% composites among total airframe weight, respectively, and Eurofighter Typhoon uses 82 % composites in surface area ratio. Among composite materials the carbon composite materials are mostly used due to relatively better mechanical properties of high specific strength and specific stiffness, almost zero thermal expansion ratio, longer fatigue life, etc.

Recently, Korea has been developed several military and civil aircrafts such as KT-1 basic trainer, T-50 advanced supersonic trainer, FA-50 light attack fighter, KUH helicopter, KC-100 light airplane, LAH (Light Armed Helicopter)/LCH(Light Civil Helicopter) and KFX Next Generation Fighter, airframe structural components of Airbus and Boeing aircrafts as a risk-share-partner, UAVs, missiles, launcher vehicle, satellites, etc. using composite materials.

This presentation introduces present development status of aerospace composite materials technology including design, analysis and manufacturing, inspection and test in developed by global as well as Korean aerospace industries.

# KEYNOTE SPEAKER III

**Prof. Seok-Soon Lee**
Gyeongsang National University, South Korea

**Prof. Seok-Soon Lee** is the professor of Mechanical and Aerospace Engineering at Gyeongsang National University and the president of the Society of Aerospace System Engineering. He graduated from BSc (1982) in Aerospace Engineering from the Korea Aerospace University and MS (1984) and PhD (1989) in Mechanical Engineering from Korea Advanced Institute of Science and Technology(KAIST). Dr, Lee's research interests are structural analysis and testing, optimum design, CAD/CAE and eletromagnetic application in mechanics. Current researches are the high frequency induction hardening and electromagnetic forming simulations with FEA. Dr. Lee has published over 60 journal articles, 11 books and over 250 conference articles. Dr. Lee is an inventor on 11patents and over 10 patents pending. Dr. Lee is a fellow of The Korean Society of Mechanical Engineering(KSME), The Korean Society of Precision Engineering(KSPE), The Korean Society of Automotive Engineering(KSAE) and The Society for Aerospace System Engineering(SASE). He was the Head of Mechanical Engineering Training and Education Center(METEC) (2001-2006) and Brain Korea 21 Regional University Promotion Program (2002-2006). He was the Editor–in-Chief of Journal of Aerospace System Engineering and International Journal of Aerospace System Engineering. He was serving the chair of Asia Joint Symposium on Aerospace Engineering 2018(AJSAE2018) on October 31- November 3, 2018, Gyeongju, Korea and International Conference on Advances in Aerospace and Mechanical Engineering 2019(AAME 2019) on July 9-12, 2019 Songdo Convencia, Incheon, Korea.

## High-Frequency Heat Treatment Simulation of Parking Gear: Calculate of Alternating Current

***Abstract*** — Based on the electromagnetic-heat transfer co-simulation model, parking gear was simulated by high-frequency heat treatment. Prediction of the hardening zone was confirmed through cooling simulation after electromagnetic-heat transfer co-simulation. The cooling process was simulated by applying the cooling coefficient of the cooling water sprayed in the same way as the actual heat-treatment process. In order to obtain the current flowing through the coil during high-frequency induction heating, we should analysis the induction RLC (Reactance-Inductance-Capacitance) circuit. The high current value on induction coil cannot be measured directly, therefore we used the voltage measurement on the RCL circuit and get the current value on the coil.

The parking gear with 0.5-0.55% carbon content was compared with the simulation results of high-frequency induction heating temperature and hardening depth, and the temperature and hardening depth measurement data confirmed the high accuracy. Through the simulation results, we could establish the method of obtaining the current value flowing through the coil and the prediction of the hardened zone. The parking gear plays the role of a lock that prevents power transmission in the park pawl and car transmission. The surface of this gear needs to have a high fatigue life and wear resistance, so it strengthens a hardened surface by high-frequency induction hardening.

In order to simulate the high-frequency induction hardening process of the park gear, the current value on the coil during heating must be known. Since the high current of high frequency cannot be measured directly, it is calculated by applying a voltage to RLC circuit. The voltage of DC power supply

is DC 204V, current is DC 409A therefore the total power is 83.4kW. The frequency and voltage on DC-AC converter are measured as 19.77kHz and AC840V. The voltage and frequency on the coil are 19.82kHz and AC 90V. In order to calculate the current flowing through the induction heating coil, the CT-BOX of the high-frequency induction heating system was changed to the RLC circuit and we can get the current on the coil is 10,228A, which is applyed to the electromagnetic and heat transfer co-simulation. The temperature of the induction heating temperature measurement experiment of the parking gear was 977.4 ℃ and the simulation temperature was 1,036 ℃ with an error rate of 5.7%. In order to verify the curing depth of the parking gear obtained by the simulation, the experiment results were compared with the water spray cooling simulation results after high-frequency induction heating. As a result, a minimum error rate of 6.3% and a maximum error rate of 7.4% were obtained.

Parking gears were simulated for electromagnetic and heat transfer models for high-frequency heat treatment. For the electromagnetic analysis, the current on the coil was calculated by RCL circuit.analysis. Temperature distribution and hardening zone of experiment results were almost the same as simulations.

# PRESENTATION GUIDELINE

### Time Zone

Greenwich Mean Time (GMT) +9 — Japan Local Time

◆ Please set up your laptop time in advance

### Equipment needed:

◆ A computer with an internet connection (wired connection recommended)

◆ USB plug-in headset with a microphone (recommended for optimal audio quality)

◆ Webcam (optional): built-in or USB plug-in

### Environment requirement

◆ Quiet Location

◆ Stable Internet Connection

◆ Proper lighting

### Learn the zoom skills

Please visit:
https://support.zoom.us/hc/en-us/articles/201362033-Getting-Started-on-Windows-and-Mac

GIF guideline:
http://icmmme.com/zoom/

### Join the test session before the formal session.

To effectively control the time and avoid some unexpected situations, we advise you record your presentation ahead of time, play the video while it's your turn for presentation. The Video/presentation should be within 12 minutes, 3 minutes for Q&A, in total, one presentation is 15 minutes.

### Attention please:

The conference will be recorded, we will appreciate your proper behavior.

### Voice control rules during the presentation

◆ The host will mute all participants while entering the meeting

◆ The host will unmute the speakers' microphone when it is turn for his or her presentation.

◆ Q&A goes after each speaker, the participant can **raise hand** for questions, the host will unmute the questioner.

◆ After Q&A, the host will mute all participants and welcome next speaker.

# JOIN IN

## ■ March 28, 2020

| Time | Session | Meeting ID |
|---|---|---|
| 9:00-9:30 | Test Keynote Speech | 620953412 |
| 10:00-10:30 | Test Session I | 454449535 |
| 10:00-10:30 | Test Session II | 950479099 |
| 10:00-10:30 | Test Session III | 801901520 |
| 11:30-12:00 | Test Session IV | 968183971 |
| 11:30-12:00 | Test Session V | 683071069 |
| 11:30-12:00 | Test Session VI | 157821246 |
| 9:00-14:00 | Q&A Time | 145395523 |

## ■ March 29, 2020

| Time | Session | Meeting ID |
|---|---|---|
| 9:00-11:25 | Keynote Speech | 428013969 |
| 13:30-15:00 | Session I | 163551353 |
| 13:30-15:00 | Session II | 190138880 |
| 16:00-17:30 | Session III | 313192574 |
| 16:00-17:30 | Session IV | 982835124 |
| 9:00-17:30 | Q&A Time | 20957937539 |

## ■ March 30, 2020

| Time | Session | Meeting ID |
|---|---|---|
| 10:00-11:30 | Session V | 157898109 |
| 10:00-11:30 | Session VI | 508445711 |
| 10:00-11:30 | Q&A Time | 20954476434 |

## ■ March 31, 2020

| Time | Session | Meeting ID |
|---|---|---|
| 11:00-17:00 | Replay Presentation | 783276315 |

* Please join in the room 10-15 minutes earlier

* Rename as "**Paper ID + Name**" after joining meeting room

# QUICK GLANCE OF PRESENTATIONS

■ **March 28, 2020 | Test Parallel Sessions**

| | |
|---|---|
| **Session I—Design and Preparation of Engineering Materials \| 10:00-10:25** | |
| 10:00-10:05 | (M0014) Tuning Polymerization Rate Program Block Copolymer Assemblies in PISA: A Simulation Study |
| 10:05-10:10 | (M0062-A) Voltammetric Determination of Amaranth Based on Reduced Graphene Oxide and Poly(L-Methionine) Film Modified Screen Printed Carbon Electrode |
| 10:10-10:15 | (M0073-A) Novel Materials for Thermal Energy Storage |
| 10:15-10:20 | (M0010-A) Polyfluorenes with Pendant Azomethine Groups: Synthesis and Application as Hole-Buffering Layer in Polymer Light-Emitting Diodes |
| 10:20-10:25 | (M0006-A) Incorporation of Lipid-Based Nanocarriers in Alginate Hydrogel Beads to Improve the Stability and Adjust the Behavior in Gastrointestinal Tract |
| **Session II—Nanotechnology and Composite Materials \| 10:00-10:30** | |
| 10:00-10:05 | (M0013-A) Using MOF-derived Carbons as Robust Bifunctional Catalysts in Tandem Catalysis to Support Platinum Nanoparticles |
| 10:05-10:10 | (M0022-A) Modified Chitosan/Poly(Vinyl Alcohol) (PVA) Composite Membranes with High Thermal Stability and Proton Exchange Sites |
| 10:10-10:15 | (M045) Effect of Thermal property of Micro-eggshells/ATH fillers on Tracking Resistance of Silicone Rubber Composites |
| 10:15-10:20 | (M0020-A) Poly(vinyl alcohol)/N-Methylene Phosphonic Chitosan/2-Hydroxyethylammonium Formate Composite Membrane for PEMFC Application |
| 10:20-10:25 | (M0016-A) From Graphite to Graphene Oxide: the Influence of Oxidation Degree on the Mechanical Properties of Epoxy Nanocomposites |
| 10:25-10:30 | (M023) The Potential of Oil Palm Ash and Eggshell Powder As Hybrid Biofillers in Natural Rubber Biocomposites |
| **Session III—Digital Manufacturing System and Industrial Production \| 10:00-10:30** | |
| 10:00-10:05 | (M002) Automatic Digital Fringe Projection for Advanced Micro-Scale Connector Manufacturing System |
| 10:05-10:10 | (M019&M022) Highly Efficient Use Technology of the By-Product Gas in Iron and Steel Making Process<br>Effect of Abandoned BOF Gas on High Temperature Performance of High Cr-Containing Vanadia-Titania Magnetite Smelting in Blast Furnace |
| 10:10-10:15 | (M040) Performance Measurement and Improvement of Lean Manufacturing Operations: A Leanness Assessment Literature Review for the Product Development Industry |
| 10:15-10:20 | (M0057-A) Excellent Reusability of FeBC Amorphous Ribbons Induced by Progressive Formation of Through-Pore Structure During Acid Orange 7 Degradation |
| 10:20-10:25 | (M0037) Dispersion of the Light in the 1D Photonic Crystal |
| 10:25-10:30 | (M042) Application Phases for Productivity Improvement through Lean Methods Assessments in an Aeronautical Company – Case Study |

| Session IV—Materials Science and Engineering Applications \| 11:30-12:00 | |
|---|---|
| 11:30-11:35 | (M0096-A) Melting Point in Tungsten Under Complex Stress: Molecular Dynamics Calculations With Modified Finnis-Sinclair Potential. |
| 11:35-11:40 | (M027) Application of Natural Dolomite for Soil Upgrading |
| 11:40-11:45 | (M0077) Effect of Heating Process on Flexural Strength and Toughness of CFRTP Molded by Multi-layer Press -Investigation on Effect of Residual Stress |
| 11:45-11:50 | (M009) Discharge Energy Efficiency Improvement of P(VDF-HFP) Copolymers Thin Films by Stretching And Electron Beam Irradiation |
| 11:50-11:55 | (M0036) Iodine Plasmonic Crystal as the Visible-Range Spectral Filter |
| 11:55-12:00 | (M043) Glycerin Separation from Biodiesel Transesterification Process by Pulsed Electric Field with Specific Pulse Forming Network |
| **Session V—Material Structure and Performance Analysis \| 11:30-12:00** | |
| 11:30-11:35 | (M0011-A) Terminal Group Design and Electrochromic Properties of Aniline Oligomers |
| 11:35-11:40 | (M010) Preparation and Storage Energy Density Base on Dielectric Properties of P(VDF-HFP)/PU/ BNKT Thin Films |
| 11:40-11:45 | (M0092-A) Amine Functionalized Mesoporous Hybrid Materials: Influence of the Reaction Conditions on the Textural Characteristics and $CO_2$ Sorption |
| 11:45-11:50 | (M028) Measurement of Mass Transfer Coefficient of CO2–Amine System from Absorption Process |
| 11:50-11:55 | (M0056-A) Hybrid Ag-Ag2S Nano Heterostructures Based on Site-Sulfidation of Hexagonal Ag Nanoplates |
| 11:55-12:00 | (M0072) Effect of Wedge Tip Thickness of Nail Clipper on Cutting Characteristics of Polystyrene Ribbon |
| **Session VI—Mechanical Engineering \| 11:30-11:50** | |
| 11:30-11:35 | (M034) Investigation on Solubility of Carbon Dioxide in the Mixed Aqueous Solution of MEA and 2-MAE |
| 11:35-11:40 | (M021) Developing a Trajectory Planning for Curved-Contoured Surfaces for Use by 8-DoF Workcell in Robotic Fibre Placement |
| 11:40-11:45 | (M044) Multi-electrode Designed Shape for Small Scale Plasma Incinerator |
| 11:45-11:50 | (M048) Relations between Microstructure and Hardness of Plain Carbon Steels Using Eddy Current Technique |

## ■ March 29, 2020 | Formal Parallel Sessions

| | |
|---|---|
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| 13:30-13:45 | (M0013-A) Using MOF-derived Carbons as Robust Bifunctional Catalysts in Tandem Catalysis to Support Platinum Nanoparticles |
| 13:45-14:00 | (M0022-A) Modified Chitosan/Poly(Vinyl Alcohol) (PVA) Composite Membranes with High Thermal Stability and Proton Exchange Sites |
| 14:00-14:15 | (M045) Effect of Thermal property of Micro-eggshells/ATH fillers on Tracking Resistance of Silicone Rubber Composites |
| 14:15-14:30 | (M0020-A) Poly(vinyl alcohol)/N-Methylene Phosphonic Chitosan/2-Hydroxyethylammonium Formate Composite Membrane for PEMFC Application |
| 14:30-14:45 | (M0016-A) From Graphite to Graphene Oxide: the Influence of Oxidation Degree on the Mechanical Properties of Epoxy Nanocomposites |
| 14:45-15:00 | (M023) The Potential of Oil Palm Ash and Eggshell Powder As Hybrid Biofillers in Natural Rubber Biocomposites |
| **Session III—Digital Manufacturing System and Industrial Production \| 16:00-17:30** | |
| 16:00-16:15 | (M002) Automatic Digital Fringe Projection for Advanced Micro-Scale Connector Manufacturing System |
| 16:15-16:30 | (M019&M022) Highly Efficient Use Technology of the By-Product Gas in Iron and Steel Making Process<br>Effect of Abandoned BOF Gas on High Temperature Performance of High Cr-Containing Vanadia-Titania Magnetite Smelting in Blast Furnace |
| 16:30-16:45 | (M040) Performance Measurement and Improvement of Lean Manufacturing Operations: A Leanness Assessment Literature Review for the Product Development Industry |
| 16:45-17:00 | (M0057-A) Excellent Reusability of FeBC Amorphous Ribbons Induced by Progressive Formation of Through-Pore Structure During Acid Orange 7 Degradation |
| 17:00-17:15 | (M0037) Dispersion of the Light in the 1D Photonic Crystal |
| 17:15-17:30 | (M042) Application Phases for Productivity Improvement through Lean Methods Assessments in an Aeronautical Company – Case Study |

| Session IV—Materials Science and Engineering Applications \| 16:00-17:30 | |
|---|---|
| 16:00-16:15 | (M0096-A) Melting Point in Tungsten Under Complex Stress: Molecular Dynamics Calculations With Modified Finnis-Sinclair Potential. |
| 16:15-16:30 | (M027) Application of Natural Dolomite for Soil Upgrading |
| 16:30-16:45 | (M0077) Effect of Heating Process on Flexural Strength and Toughness of CFRTP Molded by Multi-layer Press -Investigation on Effect of Residual Stress |
| 16:45-17:00 | (M009) Discharge Energy Efficiency Improvement of P(VDF-HFP) Copolymers Thin Films by Stretching And Electron Beam Irradiation |
| 17:00-17:15 | (M0036) Iodine Plasmonic Crystal as the Visible-Range Spectral Filter |
| 17:15-17:30 | (M043) Glycerin Separation from Biodiesel Transesterification Process by Pulsed Electric Field with Specific Pulse Forming Network |

## ■ March 30, 2020 | Formal Parallel Sessions

| Session V—Material Structure and Performance Analysis \| 10:00-11:30 | |
|---|---|
| 10:00-10:15 | (M0011-A) Terminal Group Design and Electrochromic Properties of Aniline Oligomers |
| 10:15-10:30 | (M010) Preparation and Storage Energy Density Base on Dielectric Properties of P(VDF-HFP)/PU/ BNKT Thin Films |
| 10:30-10:45 | (M0092-A) Amine functionalized Mesoporous Hybrid Materials: Influence of the Reaction Conditions on the Textural Characteristics and $CO_2$ Sorption |
| 10:45-11:00 | (M028) Measurement of Mass Transfer Coefficient of CO2–Amine System from Absorption Process |
| 11:00-11:15 | (M0056-A) Hybrid Ag-Ag2S Nano Heterostructures Based on Site-Sulfidation of Hexagonal Ag Nanoplates |
| 11:15-11:30 | (M0072) Effect of Wedge Tip Thickness of Nail Clipper on Cutting Characteristics of Polystyrene Ribbon |
| **Session VI—Mechanical Engineering \| 10:00-11:00** | |
| 10:00-10:15 | (M034) Investigation on Solubility of Carbon Dioxide in the Mixed Aqueous Solution of MEA and 2-MAE |
| 10:15-10:30 | (M021) Developing a Trajectory Planning for Curved-Contoured Surfaces for Use by 8-DoF Workcell in Robotic Fibre Placement |
| 10:30-10:45 | (M044) Multi-electrode Designed Shape for Small Scale Plasma Incinerator |
| 10:45-11:00 | (M048) Relations between Microstructure and Hardness of Plain Carbon Steels Using Eddy Current Technique |

# M0014

Tuning Polymerization Rate Program Block Copolymer Assemblies in PISA: A Simulation Study

**Mr. Junfeng Wang**
China University of Petroleum (East China), China.

As a powerful tool of controlled preparation of polymeric nanomaterials, polymerization-induced self-assembly (PISA), has been developed and extensively studied in the past decade. In this work, the RAFT polymerization system of P4VP as chain transfer agent and St as monomer in methanol was modelled and their PISA process was simulated by dissipative particle dynamics. Different morphologies of P4VP-b-PS was obtained at tuning polymerization rate. The morphology evolution at high conversation was investigated in detail and it was found that the appearance of worm-like micelles was a key point to determine the self-assemblies was vesicles or tubes. In addition, the PISA behavior at low conversion was also studied. The final morphologies was different with that at 100% conversion, but these results were well agreed with experiments. This simulation studies identified polymerization rate as the key factors on tuning morphology in PISA and broadens its research method.

# M0062-A

Voltammetric Determination of Amaranth Based on Reduced Graphene Oxide and Poly(L-Methionine) Film Modified Screen Printed Carbon Electrode

**Assoc. Prof. Rungtiva Poo-arporn**, Chutimon Akkapinyo
King Mongkut's University of Technology Thonburi, Thailand

In recent years, several food additives have been permitted in the food industry. Amaranth is one of them. Amaranth is a synthetic food colouring substance that provides red colorant. It has been widely used to make more fascinating food. However, excessive consumption of amaranth has become a concern because it has the potential to cause many adverse health effects such as nausea, vomiting, dizziness. Further, it is hazardous to internal organs such as the liver and kidneys. Moreover, amaranth has been reported to be hazardous to fetuses. Therefore, it appears extremely urgent to identify and quantify with accuracy the dyes amaranth present in food products. In this work, a facile preparation of voltammetric biosensor was purposed for amaranth determination. Reduced graphene oxide (rGO) was synthesized by glucose reduction and modified on screen printed carbon electrode (SPCE) by drop casting. Poly(L-methionine) film was deposited on SPCE by electropolymerization. Due to the high specific surface area of rGO and sufficient active sites providing by poly(L-methionine) film, the oxidation of amaranth was dramatically enhanced on the modified electrode. Electrochemical behavior and pH optimization of amaranth was studied based on cyclic voltammetry. Differential pulse voltammetry was used to determine the accumulation time and detection range of amaranth. With optimized condition, the modified sensor exhibited a wide linear detection range from 10 to 100 μM. The modified electrode revealed a great sensitivity with the detection limit at 0.37 μM. With the properties of facile synthesis, disposability and low cost, the fabricated sensor provided the easier alternative for amaranth detection.

# M0073-A

Novel Materials for Thermal Energy Storage

**Mr. Ali Amir AlNajjar**, **Asst. Prof. Maryam Tariq Khaleel**, Lourdes Vega
Khalifa University of Science and Technology, United Arab Emirates

Metal-Organic Frameworks (MOFs) are relatively new porous materials that have recently attracted great attention due to their unique characteristics including high surface area and pore volume. In addition, they can be tuned and functionalized without affecting their porosity hence, can be engineered to target a specific application. 1 In this study, several MOFs are synthesized, characterized and tested for the adsorption of fourth-generation refrigerants specifically, hydrofluoroolefins (HFOs). HFO-based refrigerants will be used to soon replace the high global warming potential refrigerants such as hydrofluorocarbons, according to the Kigali's amendment to the Montreal Protocol, ratified 2016. 2 Hence, the optimal working pair is studied to be used for energy storage unit by adsorption as a part of a refrigeration cycle with the purpose of utilizing waste heat energy released from the condenser. Energy storage can act as a modulator between the supply and demand of energy and can help in shifting the cooling load from daytime to nighttime.

# M0010-A

Polyfluorenes with Pendant Azomethine Groups: Synthesis and Application as Hole-Buffering Layer in Polymer Light-Emitting Diodes

**Prof. Yun Chen**, Yu-Lin Jheng and Yo-Chao Hsieh
National Cheng Kung University, Taiwan

Efficient polymer light-emitting diodes (PLEDs) require balanced carriers' injection and transport, which can be realized by inserting a hole-buffering layer (HBL) between anode and aluminum cathode. We have synthesized two new hole-buffering polyfluorenes (PFT, PFI) with low-lying HOMO levels by the Suzuki-coupling reaction; they are composed of polyfluorene main chain and pendant azomethine groups. The HOMO and LUMO levels of PFT are -5.59 eV and -2.71 eV, whereas those of PFI are -5.63 eV and -2.41 eV, respectively, estimated from the onset oxidation and reduction potentials obtained in cyclic voltammetric measurements. Multilayer PLED devices have been successfully fabricated [ITO/PEDOT: PSS/HBL/SY-PPV/LiF/Al] using PFT or PFI as hole-buffer layer spin coated on top of hole-injecting PEDOT: PSS layer. The maximum luminance and maximum current efficiency of PFT-based device were 17,692 cd/m2 and 6.99 cd/A, whereas those of PFI-based one were 11,831 cd/m2 and 5.08 cd/A respectively. Both devices surpass the one without HBL in terms of emission performance. Current results indicate that both PFT and PFI are potential hole-buffering materials applicable to optoelectronic devices.

# M0006-A

Incorporation of Lipid-Based Nanocarriers in Alginate Hydrogel Beads to Improve the Stability and Adjust the Behavior in Gastrointestinal Tract

**Dr. Rui Sun**, Qiang Xia
Southeast University, China

Lipid-based nanocarriers, including nanoemulsions, solid lipid nanoparticles and liposomes, are widely

studied and used in food and pharmaceutical fields, due to high biocompatibility, low toxicity, easy production, and low cost. However, the application of lipid-based nanocarriers is restricted by the poor stability and the burst release behavior in the gastrointestinal tract. Alginate hydrogel beads are three-dimensional hydrophilic polymer networks, which might be used to immobilize lipid-based nanocarriers, confine Brownian motion, and decrease the rate of lipolysis and the probability of aggregation in gastrointestinal tract. In the present study, lipid-based nanocarriers were incorporated in alginate hydrogel beads using the extrusion dripping approach and followed by the ionic gelation method. The combination of the appearance, rigidity, and encapsulation efficiency of hydrogel beads was used to screen the optimum technological parameter. We have researched the effect of this incorporation on different lipid-based nanocarriers, including liposomes, nanoemulsions, and solid lipid nanoparticles. The results indicated that this incorporation method could improve the performance of different lipid-based nanocarriers, such as controlled release, improved stability and modified behavior in gastrointestinal tract.

# M0013-A

Using MOF-derived Carbons as Robust Bifunctional Catalysts in Tandem Catalysis to Support Platinum Nanoparticles

**Ms. Ao Huang**, Ming Ke, Wenyu Huang
China University of Pretroleum-Beijing, China

Sustainable chemistry encourages the development of environmentally friendly technology to minimize waste chemicals produced in individual procedures. Tandem catalysis, combining multiple catalytic processes into one step, could decrease waste production by circumventing intermediate separation and purification steps. Knoevenagel condensation is a powerful reaction for the production of α,β-unsaturated carbonyl compounds, which are key reactants or intermediates in therapeutic, cosmetic, and agrochemical industries. However, to produce alkylated nitriles, the Knoevenagel condensation products must be hydrogenated. Traditionally, Knoevenagel condensation and hydrogenation were always carried in two separated steps. Therefore, the rational design of a robust bifunctional catalyst that can combine condensation and hydrogenation into one step is highly desirable from the viewpoint of the atomic economy and environmental sustainability. Herein, we develop a bifunctional catalyst by supporting platinum nanoparticles on nitrogen-doped carbon derived from metal-organic frameworks. The nitrogen sites with basicity catalyze the Knoevenagel condensation reaction effectively. The platinum nanoparticles could efficiently catalyze the hydrogenation of the unsaturated nitriles without hydrogenate aldehyde reactants. The resultant shows the catalyst exhibits high activity, selectivity in a one-step tandem Knoevenagel condensation-hydrogenation reaction.

# M0022-A

Modified Chitosan/Poly (Vinyl Alcohol) (PVA) Composite Membranes with High Thermal Stability and Proton Exchange Sites

**Dr. Wai Yin Wong**, Chun Yik Wong, Kee Shyuan Loh, Wan Ramli Wan Daud, Kean Long Lim, Rashmi Walvekar, Mohammad Khalid
Universiti Kebangsaan Malaysia, Malaysia

Poly (vinyl alcohol) (PVA) has been investigated as a potential proton exchange membrane for low temperature fuel cell applications upon structural modifications. Sulfonation of PVA membrane is crucial to obtain the desired amount of proton exchange sites. Nonetheless, excessive crosslinking upon sulfonation could lead to a rigid structure that will reduce the film flexibility. Hence, polymer blending emerges as an alternative to further tailor the film properties such as improving the proton exchange sites and thermal stability. In this work, hydrophilic chitosan (CS) is selected to blend with sulfonated PVA to produce the composite proton exchange membranes. It was aimed in this work to study the effect of addition CS on the abovementioned properties along with the proton conductivity of the composite membranes. The CS was mixed with SPVA with 10, 15, 20 and 25 vol.% CS to produce the composite membranes. The thermogravimetric analysis indicated that all CS/PVA films are thermally stable with the first stage weight loss observed after 150 °C, without significant change as

compared to SPVA membrane. Meanwhile, it was observed with an increase in the proton exchange sites with increase in CS content from 1.46 meq/g H+ (0 vol.% CS) to 3.18 meq/g H+ (20 vol.% CS) before the decrease occur in 25 vol.% CS sample based on proton exchange capacity analysis, owing to the presence of amine functional groups in CS. Further electrochemical impedance spectroscopy analysis on the composite membranes correlates with these results, whereby the CS/SPVA with 15 vol.% CS exhibited a stable increase in ionic conductivity value from 6.8 mS/cm to 7.4 mS/cm with operating temperature increased from 25 °C to 80 °C. These results have indicated that CS/SPVA composite membranes can be potentially applied in the proton exchange membrane fuel cells at the mean operating temperature of 80 °C.

# M045

Effect of Thermal property of Micro-eggshells/ATH fillers on Tracking Resistance of Silicone Rubber Composites

**Mr. Pattarabordee Khaigunha**, Tanakorn Wongwuttanasatian and Amnart Suksri
Khon Kaen University, Thailand

Break down due to surface tracking is one of the critical insulation failures, especially in the polymeric insulation. It has made worse the reliability of the power transmission system. This present work attempts to solve the problem by observing the effect on tracking resistance of adding micro-eggshells and aluminum hydroxide into the silicone rubber. In order to fabricate the composite specimen, red eggshells (63 to 74 μm), aluminum hydroxide, and RTV silicone rubber were procured. The constant voltage test method, according to the IEC-60587 standard, was used to evaluate the tracking resistance; each specimen was applied by 4.5 kV for 1 hour, and the tracking length was declared as the inverse of tracking resistance. Besides, the rule of mixtures was employed to estimate the thermal conductivity. The results show that the tracking resistance of the composite specimens was overall higher as compare to the pure rubber. Moreover, It was found that tracking resistance and thermal conductivity decreased when the eggshells increased. It was described that the rise of thermal accumulation on the insulator surface in the hybrid composite caused by lower thermal conductivity. Therefore, it could be concluded that the mixing of micro-eggshells and aluminum hydroxide should not be used as fillers for suppressing the tracking failures.

# M0020-A

Poly (vinyl alcohol)/N-Methylene Phosphonic Chitosan/2-Hydroxyethylammonium Formate Composite Membrane for PEMFC Application

**Kee Shyuan Loh**, Yook Peng Siow, Tian Khoon Lee, Wai Yin Wong, Mohd Sukor Su'ait, Azizan Ahmad
Universiti Kebangsaan Malaysia, Malaysia

In this study, poly(vinyl alcohol)/ N-methylene phosphonic chitosan/ 2-hydroxyethylammonium formate (PVA/NMPC/2-HEAF) based membrane was prepared using the solution casting technique. The effects of 2-HEAF concentrations (0 – 20 wt. %) and crosslinking times (30 minutes and 120 minutes) on PVA/NMPC/2-HEAF membranes were studied. The characterization of PVA/NMPC/2-HEAF membranes were done by ATR-FTIR) XRD, water uptake test, IEC analysis, TGA and EIS. The formaldehyde crosslinks (-O-CH2-O-) formed were confirmed in FTIR through the formation of new peak by –CH2- stretching at around 2863 cm-1 and the increased intensity of C-O stretching absorption. The 2-HEAF was identified as a plasticizer as it increased the amorphous content in the

membrane from XRD analysis. The crystallinity of the membrane increased with longer crosslinking time (120 minutes) as shown by the increase in XRD peak intensity. PVA/NMPC/5 wt. % 2-HEAF membrane with 30 minutes of crosslinking showed the highest percentage of water uptake and IEC value. The addition of 5 wt. % of 2-HEAF did not give significant effect on the thermal properties of PVA/NMPC/2-HEAF membrane with 30 minutes of crosslinking. However, with 120 minutes of crosslinking, the weight loss percentage and Tmax of PVA/NMPC/5 wt. % 2-HEAF membrane increased compared to PVA/NMPC membrane without 2-HEAF. Tmax increased because of the complexation between 2-HEAF and polymer chains. The EIS result agreed with the water uptake and IEC analysis where PVA/NMPC/5 wt. % 2-HEAF membrane with 30 minutes crosslinking showed the highest ionic conductivity of 5.44 × 10-5 S cm-1. This was due to the plasticization effect of 2-HEAF that softened the polymer chains and which it also provided more charge carriers to increase the ion mobility in the membrane.

# M0016-A

From Graphite to Graphene Oxide: the Influence of Oxidation Degree on the Mechanical Properties of Epoxy Nanocomposites

**Dr. Jie Fan**, Jiping Yang, Hong Li, Meng Wang
Beihang University, China

Graphene oxides (GOs) with varied oxidation degree were prepared with modified Hummers' method, and characterized by TG, XRD, Raman and XPS spectroscopy. Through a three-roll milling technique, nanocomposites of epoxy resin reinforced with GOs and graphite were prepared, and their mechanical properties at room temperature and liquid nitrogen temperature were investigated. It was found that GOs with different oxidation degree could be dispersed well into the matrix according to the optical macroscopic and XRD results. The oxidation degree of GO has important influence on the mechanical properties of nanocomposites. The tensile strength of nanocomposites increased as the GO oxidation degree increased until GO was over oxidized. Nanocomposites reinforced with GO at certain oxidation degree had the highest tensile strength of 78 MPa at room temperature, which was 30% higher than that of the matrix. The deteriorated mechanical performance of nanocomposites with further oxidized GO is mainly caused by the weakened interface between epoxy and GO with too high polarity. The toughening mechanism of GO in epoxy resin was elucidated based on the SEM characterization of the fractured surface of nanocomposites. Nanocomposites modified with GO didn't present considerable advantage over the epoxy matrix at liquid temperature, signifying a different active mechanism.

# M023

The Potential of Oil Palm Ash and Eggshell Powder as Hybrid Biofillers in Natural Rubber Biocomposites

Philip Tan Shien Ming, **Assist. Prof. Aibao Chai**, Shamsul Kamaruddin and Ch'ng Shiau Ying
University of Nottingham Malaysia, Selangor, Malaysia

Astronomical amounts of solid biomass wastes are generated globally each day. It is imperative that the potential of conversion and utilisation of these wastes be identified and implemented, thus reducing landfill load and recovering value from this immense source of material. Natural rubber biocomposites were produced by compounding natural rubber matrix with oil palm ash and eggshell

powder as hybrid fillers. The mechanical properties of the biocomposites were determined. It is observed that the biocomposites exhibit higher stiffness than the unfilled natural rubber compound. Acid treatment is found to further increase the stiffness of the biocomposites.

# M002

Automatic Digital Fringe Projection for Advanced Micro-Scale Connector Manufacturing System

Ching-Hua Lu, **Assoc. Prof. Cheng-Yang Liu**
National Yang-Ming University, Taiwan

The digital fringe projection microscope has been investigated and used to estimate three-dimensional shape of micro-scale connector for advanced manufacturing system. This measurement system consists of digital projector, optical lenses, stereo microscope, and digital camera. In the software, the imaging program based on including black and white structure light, seven-step phase-shifting calculation, and path-independent phase unwrapping is well developed. The imaging results indicate that the three-dimensional shape of micro-scale connector is acquired by using this measurement system. The optical resolution of this measurement system is 3 μm and the measurement speed is 0.6 s. This measurement system has excellent performance including easy operation, fast measurement speed and high resolution. This measurement system can be applied to real-time three-dimensional shape detection in product processing of micro-scale connector.

# M019&M022

Highly Efficient Use Technology of the By-Product Gas in Iron and Steel Making Process

Effect of Abandoned BOF Gas on High Temperature Performance of High Cr-Containing Vanadia-Titania Magnetite Smelting in Blast Furnace

**Dr. Hanlin Song**, Jinpeng Zhang, **Prof. Xiangxin Xue**
Northeastern University, China

BOF gas, with an annual output of more than 100 billion standard cubic meters, is one of the primary by-product energy resources in the steelmaking process. However, the up to 34.7% abandoned rate of BOF gas in China has caused a lot of carbon emissions and energy resources waste. The abandoned BOF gas, with a high temperature of 1773~1873K and 20~40%(vol.%) CO and 20~30%(vol.%) $CO_2$ has a vast physical sensible heat and chemical latent heat. There are predictable recyclable values and comprehensive utilization prospects to achieve the ultra-low carbon emissions and energy conversion in ironmaking and steelmaking. The paper has carried out a detailed calculation of the energy value of abandoned BOF gas, and the feasibility analysis and program design of the overall resource recycling and energy utilization in ironmaking and steelmaking, including blast furnace smelting of vanadia-titania magnetite, combined blowing in BOF and vanadium-extracting converter, co-production of steel-chemicals industry.
Since the chromium-containing vanadia-titania magnetite (HCVTM) contains an excessive amount of $TiO_2$ (20~40%), it is quickly reduced to a high melting point of titanium carbonitride, which causes problems such as slag thickening, slag foaming, and iron loss increasing. Besides, abandoned BOF gas (ABOFG) is a kind of neglected by-product gas resource produced in the steelmaking process, which would be expected to utilize to help realize the combined ironmaking and steelmaking resources. Therefore, the effect of softening-smelting-dropping performance and mineral element

migration of full HCVTM with ABOFG blowing were investigated. With the $CO_2$ in ABOFG increased from 0 to 30%, the softening zone and melting zone decreased, and the location of the cohesive zone shifted downward slightly and became thicker, and the permeability of the cohesive zone has also been improved. In addition, increasing $CO_2$ content in ABOFG improved the content and recovery of V and Cr in the dripped iron.

# M040

Performance Measurement and Improvement of Lean Manufacturing Operations: A Leanness Assessment Literature Review for the Product Development Industry

**Mr. Leandro Silvério**, Luís Gonzaga Trabasso, Marcus Vinicius Pereira Pessôa
Aeronautics Institute of Technology (ITA), Brazil

Today manufacturing sectors are more competitive than before. Thus, to execute an enterprise's transformation in a company emerging as a lean organization it is crucial to have assessments and performance measurements that observe multiple variables during the lean implementation patch. The objective of this paper is to demonstrate a research method focused on lean performance measurement assessments from previous works, summarizing and organizing the existing evaluation standards in a way to allow different industrial segments to replicate the screening steps for a literature review construction. As a result, the existing lean performance measurements and methods from the last 23 years were refined in order to highlight opportunities and insights for future researches to be developed on the lean field.

# M0057-A

Excellent Reusability of Febc Amorphous Ribbons Induced by Progressive Formation of Through-Pore Structure during Acid Orange 7 Degradation

**Fang Miao**
Southeast University, China

Fe-based amorphous alloys have been proved to have good performance in dye degradation due to their short-range ordered and long-range disordered atomic structure. Most Fe-based amorphous alloys used for decolorization are Fe-Si-B alloys systems, or Fe-Si-B alloys with addition of other elements. Recently, The Fe80P13C7 amorphous ribbons have higher degradation efficiency than the widely investigated Fe78Si9B13 amorphous ribbons. However, the field applications of FePC amorphous ribbons are limited by drawbacks of the phosphorus (P) element, which is harmful to the environment. In addition, the volatile P makes the production process of amorphous alloys more complicated. Compared with FePC amorphous alloys, FeBC amorphous alloys contain no volatile elements, and have high saturation induction over 1.75 T, which have widely applied as soft-magnetic materials. Nevertheless, the degradation performance of FeBC amorphous alloys has never been studied.
This work compares dye degradation efficiency in the redox reaction using FeBC and FePC amorphous ribbons. The time required for degrading 50 % of acid orange 7 using FeBC amorphous ribbons is only 1/3 of that using FePC amorphous ribbons. Reusability tests reveal the extremely longer service life of FeBC amorphous ribbons (22 cycles) than FePC amorphous ribbons (5 cycles). In order to understand the mechanism of the high degrading ability and excellent reusability of FeBC

amorphous ribbons, synchrotron XRD, XPS, SEM and TEM analyses were performed. The long service life of FeBC amorphous ribbons is attributed to the gradual formation of 3D nanosheet array structures with through-pores. This work reveals the mechanism of highly efficient degradation using FeBC amorphous ribbons and proposes this alloy as a novel potential material used in wastewater treatment.

# M0037

Dispersion of the Light in the 1D Photonic Crystal

**Svetlana Pichkurenko**

Bauman Moscow State Technical University, Russia

We propose a novel, Kurosawa-like model to evaluate the 1D (Bragg stack-like) mesoporous aluminium oxide photonic crystal. We calculate its optical characteristics, such as the law of light dispersion in structure, the secondary emission spectrum of the composite, the speed of light in the crystal and the effective mass of the speed quanta. The results are important to the solid-state detection of paraphotons.

# M042

Application Phases for Productivity Improvement through Lean Methods Assessments in an Aeronautical Company – Case Study

**Mr. Leandro Silvério**, Luís Gonzaga Trabasso, Marcus Vinicius Pereira Pessôa

Aeronautics Institute of Technology (ITA), Brazil

A well defined manufacturing company focuses on lean practices along the whole product development process, not exclusively during the manufacturing and production phases. This study focuses on the application steps to be adopted for productivity improvement trough lean methods assessments in a product development company for the aeronautical industry. It also aims to provide insights for decision makers along the whole lean transformation patch, and to reduce the waste generation by eliminating the non–value–added activities resulted by a bad execution of the lean transformation tools and methods. By deploying the proposed study, the assessed enterprise increased its overall lean engagement level and production outputs.

# M0096-A

Melting Point in Tungsten Under Complex Stress: Molecular Dynamics Calculations with Modified Finnis-Sinclair Potential

**Mr. Dulat Akzhigitov**, Tamerlan Srymbetov, Boris Golman, Christos Spitas, Zhandos N. Utegulov
Nazarbayev University, Kazakhstan

Understanding melting processes in refractory materials under external stresses has been very critical to meet stringent requirements of harsh environment applications ranging from nuclear and fusion energy to aerospace. In these severe applications materials have to simultaneously withstand the effect of high temperatures and complex stress states. However, most of the prior research was focused on melting phenomena in the presence of primarily hydrostatic stresses. In our work we investigate melting phenomena in pure tungsten metal under complex stress states involving bending, i.e. the stress tensor composed of both hydrostatic and deviatoric stress types. We explore the relationship between high temperature melting point and applied complex stress numerically by molecular dynamics simulations using modified Finnis-Sinclair potential and double-phase method, and compare our results with theory and experiments reported in the literature. Our results on hydrostatic stress-dependent melting point have been found to be closest to experimentally determined melting point temperatures under shock compression. Proposed numerical method was also tested to predict the effect of complex stress state (i.e. tension and shear stresses) on melting temperature variation. New high temperature thermo-mechanical results are correlated with intricate structural changes taking place on the atomic scale.

# M027

Application of Natural Dolomite for Soil Upgrading

**Jakapan Pimolrat**, Kreangkrai Maneeintr, Pinyo Meechumna
Chulalongkorn University, Thailand

Soil degradation is the conditions with low-soil quality. It can result in low fertility, in soil. To overcome this problem, soil-quality upgrading should be applied. For this study, the acidic soil from Nan, Thailand is used to upgrade the soil conditions to fit well with the agricultural activities by using natural dolomite as a waste from the industries. It is blended with the acidic soil in various ratios from 5-30 % by weight. The optimal conditions for various soil properties such as pH, electrical conductivity (EC), bulk density and soil texture are investigated. From the results, the higher amount of dolomite can improve the soil properties. Acidity is lowered from 4.832 to 6.047. Bulk density is decreased at 1.1114 g/cm$^3$. Particle size distribution is sharply increased with the amount of dolomite. EC values are raised up to 4.25 dS/m. The natural dolomite can increase the soil quality from Nan province.

# M0077

Effect of Heating Process on Flexural Strength and Toughness of CFRTP Molded by Multi-layer Press -Investigation on Effect of Residual Stress

**Akihito ITAMI**, Kiyotaka OBUNAI, Kazuya OKUBO, Hiroyuki TAKEI
Graduate School of Doshisha University, Japan

This study investigated the effect of differences in heating process due to the molding with multi-layer press on changing in mechanical properties of CFRTP. CFRTP specimens molded with 10 pages multi-layer were prepared for 3 point bending tests and DCB tests, ENF tests in order to investigate the different of mechanical properties. The change in the mechanical properties of CFRTP molded by multi-layer press were investigated considering residual stress occurred by differences in heating process. Average of flexural strength, mode-I interlaminar fracture toughness and mode-II interlaminar fracture toughness of the specimen molded at 5th page were decreased compared with that of 1st page. Assuming the fiber as a rigid and considering the thermal shrinkage of resin, compressive residual stress should be occurred in the fiber since free shrinkage of the resin was constrained. It was considered that the reduction of flexural strength with the failure close to the compression surface was caused due to this additional compressive residual stress. The tensile residual stress also should be occurred in the resin due to constraint of free shrinkage of the resin. The observed reduction of toughness in the resin was also occurred for the procedure of crack propagation. The reduction rate of mode-I interlaminar fracture toughness was much remarkable than that of mode-II interlaminar fracture toughness. Tensile residual stress in the resin was dominant since the mode-I fracture is a crack opening mode.

# M009

Discharge Energy Efficiency Improvement of P(VDF-HFP) Copolymers Thin Films by Stretching and Electron Beam Irradiation

**Mr. Ardian Agus Permana**, C Putson
Prince of Songkla University, Thailand

Toward improving the applications for energy-based technology, dielectric polymers is getting attention due to its relatively high dielectric constant, dielectric breakdown and flexibility, with easily preparation, lightweight and low cost. Dielectric contribution and polarization responses lead to different shape and size of hysteresis loop. This work presents the techniques on reducing domain size for slimmer loop, indicating lower energy loss. As-casted P(VDF-HFP), stretched P(VDF-HFP) and electron irradiated-stretched P(VDF-HFP) thin films were prepared by solution casting method. The irradiation was prepared by emitting electron beam. The dielectric and AC conductivity properties were investigated by LCR meter, while polarization-electric field loops were observed by P-E loop instrument. The results show that stretching and electron beam irradiation significantly increase the dielectric constant of P(VDF-HFP). Their ability on modifying the domain size leads to reduce P-E loop of P(VDF-HFP), followed by reducing energy loss but improving storage energy density and discharge energy efficiency.

# M0036

Iodine Plasmonic Crystal as the Visible-Range Spectral Filter

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We analyse the optical properties of the 1D iodine-sapphire photonic crystal. Due to metal, besides the standard photonic crystal bandgaps, there is the additional wide (zero to plasma frequency) gap defined by the metal concentration. We propose to use the iodine plasmonic crystals with different metal concentration in the two crystal pass-and-reflect scheme to spectral crop the optical radiation.

# M043

Glycerin Separation from Biodiesel Transesterification Process by Pulsed Electric Field with Specific Pulse Forming Network

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Biodiesel production process can be rapidly done if the glycerin separation can be removed faster. With the palm oil crisis, biodiesel is needed for faster production to add more value and to solve the oversupply problem. Pulse forming network circuit can generate pulsed electric field (PEF) to speedily separate glycerin from biodiesel production. While the substance is reacting, the electrical impedance value of glycerin is changed, the pulse forming network will keep waveform to be a square wave. Transesterification process using palm oil mixed with methanol with a molar ratio of 1:6 by using 1 wt.% of KOH as a catalyst. The reaction chamber electrode was coaxial cylindrical electrodes with diameter 6 cm and 1 cm. The maximum voltage across the reaction chamber is 500 V with 1 ,5 and 10 kHz frequency. Glycerin separation was best achieved when using 5 kHz frequency. The glycerin was obtained at 155 ml in 20 minutes.

# M0011-A

Terminal Group Design and Electrochromic Properties of Aniline Oligomers

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Aniline oligomers are a kind of electrochromic material with low degree of polymerization, which not only have similar electrochromic properties to polyaniline, but also have good solubility. Due to their definite molecular architecture, it is easy to change their electrochromic properties by the design of terminal groups. It was found that more terminal groups with hydrogen bonding ability, like -NH2 and -COOH, led to denser molecular arrangements and smoother surface morphology, which caused slower ion conduction and longer switching time. The doping effects of carboxyl terminal group accelerated the bleaching process, while its hydrophilicity reduced the cycle stability of electrochromic films in aqueous solution. The color of aniline oligomers with schiff-base structure was changed obviously by introducing diverse groups at different position. The introduction of secondary amino and hydroxyl groups simultaneously changed the color change of tetraaniline from colorless-blue to orange-green. In a word, terminal group design is a simple and feasible method to change the color, switching time, cyclic stability and other properties of aniline oligomers.

# M010

Preparation and Storage Energy Density Base on Dielectric Properties of P(VDF-HFP)/PU/ BNKT Thin Films

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Novel electrical devices based on energy storage capacitor and energy conversion, have developed to advanced dielectric properties including electrical performance.In this work, three phases composite of poly(vinylidene fluoride hexafluoropropylene) (P(VDF-HFP)) blended with polyurethane (PU) and filled with $Bi_{0.5}(Na_{0.8}$ -$K_{0.2})_{0.5}TiO_3$ (BNKT) ceramic was studied on the on the dielectric, electrical properties and a storage energy density. All composite thin films are fabricated by the tape casting method in solution. Polarization-Electrical (P-E) loop of all composite thin films were also investigated relaxor-ferroelectric characteristic with the various electric fields. The recoverable energy density and energy efficiency from the loop were then analysed. As a result, the three phases composite of P(VDF-HFP)/PU/BNKT composites produce the highest dielectric constant as well as conductivity; however, they produce the lowest energy efficiency in this work. It seems that the interfacial polarization is easy switchable dipole moment in three phases more than one phase, resulting in high dielectric constant as well as conductivity. However, the larger conductivity seemly generates larger dielectric loss, resulting in lower energy efficiency. Therefore, the comparison based on three and two phases can be used to predict in capability of electric capacitor devices in the future.

# M0092-A

Amine Functionalized Mesoporous Hybrid Materials: Influence of the Reaction Conditions on the Textural Characteristics and CO2 Sorption

**Dr. Nina Encheva Velikova**, Ivanka Spasssova
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The objective of this work is synthesis of amine functionalized hybrid materials and investigation of the influence of the reaction condition on the materials structure, morphology and CO2 sorption properties. Amine– functionalized mesoporous silica materials were prepared by sol-gel method in acidic media by co-condensation reaction between Tetraethylortosilicate and bridging amine functionalized silsesquioxane precursor. The materials porosity was generated by applying soft template method as non-ionic triblock copolymer Pluronic P123 (PEO20-PPO70-PEO20) was used. For improving of the materials porosity micelles swelling agent and inorganic salt were used. The materials structure and morphology were investigated by solid ‑ state NMR (13C and 29Si CP/MAS NMR) spectroscopy, FT-IR, SAXS, SEM, pore size distribution and Nitrogen adsorption-desorption analysis. The determined heats of CO2 adsorption are above 50 kJ mol-1, which is an evidence for occurring of chemisorption process between CO2 and the amine groups of the hybrid materials. The material synthesized with the simultaneous presence of micelles swelling agent and inorganic salt shows higher values of CO2 sorption (31.3 mg.g-1 at 273 K) in comparison with the materials synthesized in absence of one of the additives.

# M028

Measurement of Mass Transfer Coefficient of CO2–Amine System From Absorption Process

**Thanakornkan Limlertchareonwanit**, Kreangkrai Maneeintr, Tawatchai Charinpanitkul
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Carbon dioxide ($CO_2$) is one of the main factors for climate change issues. Absorption is the technology to remove $CO_2$ from various industries. The equipment used is the packed column to promote high mass transfer rate and to study the overall mass transfer coefficient ($K_Ga_v$). The $K_Ga_v$ is an important parameter for designing and scaling up of packed column. Therefore, the objective of this work is to measure $K_Ga_v$ for $CO_2$ absorption into the aqueous solution of monoethanolamine (MEA) in a random-packed column and to investigate effect of parameters on $K_Ga_v$. The parameters are the solution flow rate from 5.3-15.9 $m^3/m^2h$, $CO_2$ initial loading from 0.0-0.2 mole/mole and $CO_2$ concentration in gas phase from 5-15 %v/v. The results show that $K_Ga_v$ increases as the solution flow rate and solution concentration increase. The $CO_2$ concentration in gas phase provides relatively high impact on $K_Ga_v$ with an increase in the $CO_2$ concentration.

# M0056-A

Hybrid Ag-Ag2S Nano Heterostructures Based on Site-Sulfidation of Hexagonal Ag Nanoplates

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Ag-Ag2S nanostructures have attracted significant attention due to their synergistic properties that arise from the interaction between the two components. In this study, a new approach of site-selective

sulfidation at the corner sites of hexagonal Ag nanoplates has been suggested. The synthesize of Ag-Ag2S hybrid nanostructures was conducted by adding sodium sulfide (Na2S) to hexagonal Ag nanoplates with poly(vinyl pyrrolidone) (PVP) as a stabilizer. As a precursor for elemental S, Na2S can directly contact to elemental Ag and generate Ag2S. Absorption spectra shows red shifting and decreasing in intensity from Ag nanoplates peak after the sulfidation occurred. By adjusting the concentration of Na2S, ratio of S to Ag and morphology of the hybrid structures can be controlled. Reaction was initiated at the corner sites of hexagonal Ag nanoplates and grew to the center. These nanoparticles further used as photocatalyst for degradation of Methylene Blue resulting in high photocatalytic activity.

# M0072

Effect of Wedge Tip Thickness of Nail Clipper on Cutting Characteristics of Polystyrene Ribbon

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Nagaoka University of Technology, Japan

This research was aiming to investigate cutting characteristics of Polystyrene ribbon that were cut by nail clippers. A pair of rotational-linked fixture of recent designed JIG was developed for measuring the cutting load and displacement of nail clipper arm. Nail clippers had the upper apex angle of αU = 13°, αU' = 45° and lower apex angle of L=20° and the lower biting edge thickness wL was chosen 0.06 and 0.25 mm. A 2-mm-width and 1-mm-thickness polystyrene ribbon was cut using the nail-clipper and the load response and the cut trace of sheared zone were investigated under the indentation velocity at V = 0.01 mm·s−1. A large force dropped and unstable crack was detected when using wL = 0.06 mm, while the force drop was disappeared without any large crack when wL= 0.25 mm due to the frictional restriction for fastening the work piece. While the peak line force was direct variation with tip thickness. When considered to vibration during cutting process by using AE sensor, nail clipper that have lower anvil thickness at 0.25 mm have lowest amplitude. Moreover, the cut traces were detected by microscope CCD camera.

# M034

Investigation on Solubility Of Carbon Dioxide In The Mixed Aqueous Solution of MEA and 2-MAE

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Absorption with amine solution is a method to reduce $CO_2$ causing climate change. The commercial amine solution is MEA. The disadvantage of MEA is low $CO_2$-loading capacity. Also, 2-(methylamino)-ethanol or 2-MAE is a new solvent developed to improve absorption performance. The aim of this work is to measure the $CO_2$ solubility in the mixture of MEA and 2-MAE at 15:15 %wt, from 30 °C to 80 °C and $CO_2$ partial pressures ranging from 5 to 100 kPa. From the results, at the same conditions, 30 %wt of MEA has the higher absorption capacity than that of 15:15 %wt of MEA:2-MAE and 2-MAE for 4.51 % and 7.04 %, respectively. For cyclic capacity, 15:15 %wt of MEA:2-MAE has capacity greater than 30 %wt of MEA for 34.10 % but lower than 30 %wt of 2-MAE for 22.78 %. A mixed-amine solution can be applied to reduce the disadvantage of MEA solution.

# M021

Developing a Trajectory Planning for Curved-Contoured Surfaces for Use by 8-DoF Workcell in Robotic Fibre Placement

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The replacement rate of conventional material by composites is increasing. Possessing high specific strength and stiffness makes composites attractive to many applications. Different techniques are being utilized for composite placement processes. Robotic Fibre Placement (RFP) is introduced as a competing approach for composite fabrication. This approach can provide many advantages; e.g. low labor cost, high performance, quick and effective process. The current work proposes an 8-DoF system established for laying the composite material. This system composed of three main units includes a 6-DoF industrial robot and two mandrel tools with different configurations. A sensory-based feedback control system is developed to manage the placement process. The placement process can be performed on two different surfaces. The end-cap surface has been fabricated then the cylindrical surface. Different geometries of pressure vessels have been generated; e.g. Oxidizer tanks that can be used in many applications such as (Hybrid rockets).

# M044

Multi-electrode Designed Shape for Small Scale Plasma Incinerator

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Currently electronic waste has increased due to the growth of an industrial economy. Conventional method of waste destruction was to use burner that heats up and finally forming hydrocarbon to an atmosphere. Recently, plasma technology is an alternative method that has an efficiency and safe to

use as a mean for waste destruction due to its higher temperature. This research is an improvement design of electrodes tip used for plasma head assembly using small scaled power supply. The designed shape and materials such as graphite, steel and tungsten were simulated and used to evaluate the generated plasma. In addition, electrode designed group were compared for a current density and current distribution from a simulation which will also determine for a plasma length, temperature and durability of material on actual experimental. Electrode shape was designed with sharp cornered that has cross sectional area indicated that it has highest current distribution at the tip of electrode surface. Based on the simulation results, the proposed designed electrode was capable of highest current density when compared with others. The simulated and experimental results have been shown to agreed well for plasma length and temperature.

# M048

Measurement of Mass Transfer Coefficient of CO2–Amine System From Absorption Process

**Thanakornkan Limlertchareonwanit**, Kreangkrai Maneeintr, Tawatchai Charinpanitkul
Chulalongkorn University, Thailand

Carbon dioxide ($CO_2$) is one of the main factors for climate change issues. Absorption is the technology to remove $CO_2$ from various industries. The equipment used is the packed column to promote high mass transfer rate and to study the overall mass transfer coefficient ($K_Ga_v$). The $K_Ga_v$ is an important parameter for designing and scaling up of packed column. Therefore, the objective of this work is to measure $K_Ga_v$ for $CO_2$ absorption into the aqueous solution of monoethanolamine (MEA) in a random-packed column and to investigate effect of parameters on $K_Ga_v$. The parameters are the solution flow rate from 5.3-15.9 $m^3/m^2h$, $CO_2$ initial loading from 0.0-0.2 mole/mole and $CO_2$ concentration in gas phase from 5-15 %v/v. The results show that $K_Ga_v$ increases as the solution flow rate and solution concentration increase. The $CO_2$ concentration in gas phase provides relatively high impact on $K_Ga_v$ with an increase in the $CO_2$ concentration.

# M007-A

**Effect of Ultra-nanocrystalline diamond interlayer on highly efficient ZnO based hybrid hydrogen sensor**

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Hydrogen is a convenient and versatile fuel that can be easily converted to the required form of energy without releasing harmful emissions. However, when about 4% by volume of H2 is explosive in the atmosphere; therefore, manufacturing a sensor with a highly sensitized hydrogen gas is essential for commercial and industrial applications. ZnO is an economic material that has been thoroughly studied. Due to its excellent sensing performance, it has a very large reverberation for hydrogen sensing. However, the prepared ZnO has poor stability, poor response time and poor indoor recovery time. Research efforts have been made to develop new ZnO heterostructures to further enhance gas sensors. Herein, we report highly enhanced H2-gas-sensing performance of N-UNCD /ZnO hybrid structure.
First section of this study focus on the fabrication of N-UNCD gas sensors. Use the different time and process parameters to find the best parameters. In the second section, we develop novel nanostructure using N-UNCD composites on ZNR substrates and studied their structural and gas sensing properties. This study found that the addition of UNCD of different thicknesses to the zinc oxide rods effectively improved the sensing value and improved the response rate. The systematic investigations were revealed that adding different amount of N-UNCD with different time add ZNRs, strongly influence the gas sensing performance. The N-UNCD/ZNR based gas sensor shows superb enhancement in hydrogen sensitivity of 47.2 % comparing to ZNR gas sensor (18.3%). It is believed that the N-UNCD nanoparticles onto ZNR induces more active sites for the adsorption of O2. Moreover, the electrons transfer from conduction band of N-UNCD to that of ZnO, leading to higher conductance of N-UNCD/ZNR nanocomposites than that of the pure ZNR.