2024 the 7th International Conference on Frontiers of Composite Materials (ICFCM2024)

ICFCM

2024 the 8th International Conference on Smart Material Research (ICSMR2024)

ICSMR

Singapore

June 14-16, 2024

Co-sponsored by

Contents

Conference Venue

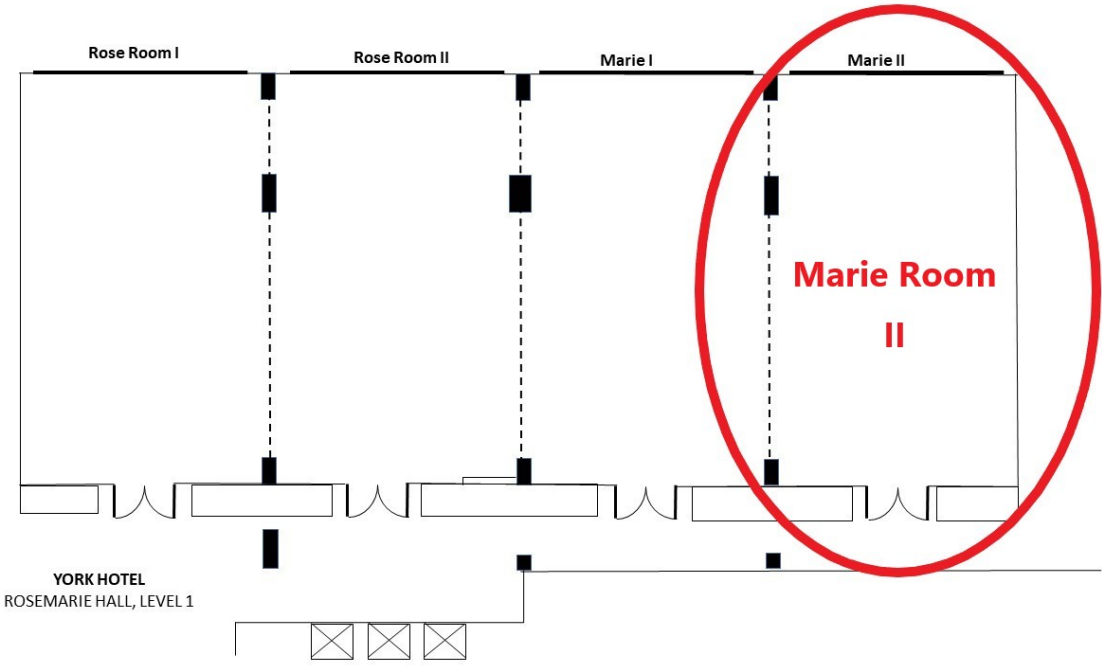
YORK HOTEL
SINGAPORE

York Hotel Singapore

Address: 21 Mount Elizabeth Singapore 228516

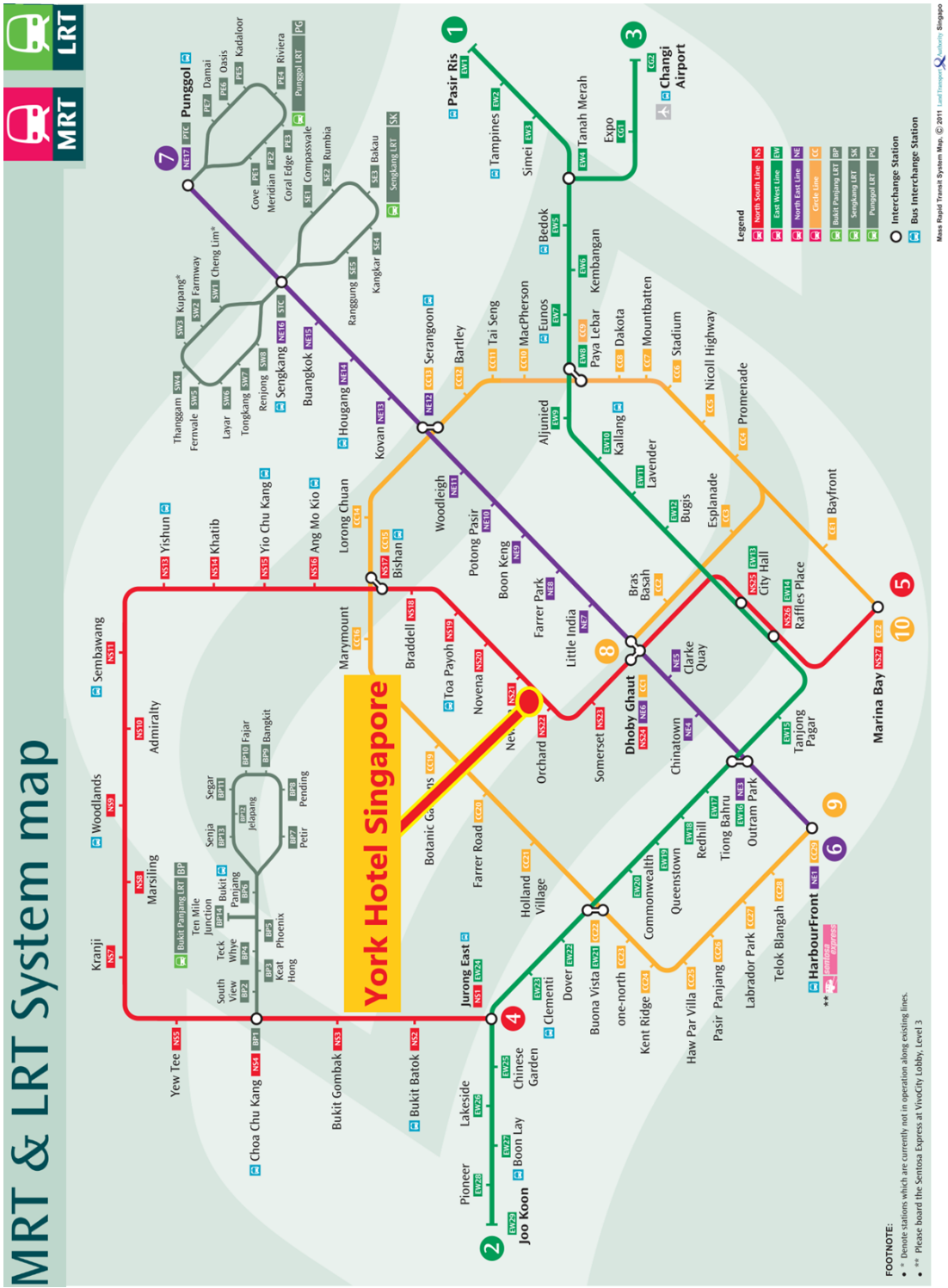
Location:
https://maps.app.goo.gl/XKzoUWkm6nNXUzKT8

Conference Room-Marie Room II (Level 1)



Conference Venue

Transportation Map:



Onsite Guideline

Time Zone

GMT+8

Schedule

- ❑ **June 14: Sign-in & Conference Kits Collection** ➔ Foyer of Marie Room II (Level 1)
- ❑ **June 15: Keynote & Invited Speeches & Technical Sessions**➔Marie Room II (Level 1)
- ❑ **June 16: Singapore One Day**

Language

- Please make presentation and discuss in English.

Oral Presentation

- ➢ Keynote Speech: 45 mins (including Q&A).
- ➢ Invited Speech: 30 mins (including Q&A).
- ➢ Paper Presentation:15 mins (including Q&A).

- Please make sure your presentation is well timed. Please keep in mind that the program is full and that the speaker after you would like their allocated time available to them.
- Each speaker is required to meet her/his session chair in the corresponding session rooms 10 minutes before the session starts and copy the slide file (PPT or PDF) to the computer.
- Please note that each session room will be equipped with a LCD projector, screen, point device, microphone, and a laptop with general presentation software such as Microsoft PowerPoint and Adobe Reader. Please make sure that your files are compatible and readable with our operation system by using commonly used fronts and symbols. If you plan to use your own computer, please try the connection and make sure it works before your presentation.
- Videos: If your PowerPoint files contain video clips, please make sure that they are well formatted and connected to the main files.

Reminder

Please attend the conference in formal attire.
Safety Reminder: Secure Valuable Items at All Times.
We remind you to secure your personal belongings at all times.
The conference organizer will not be responsible for the loss or damage to any personal belongings.

Conference Committees

Conference Committee Chair

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

Program Committee Chairs

Zhengyi Jiang, University of Wollongong, Australia
Hom Nath Dhakal, University of Portsmouth, UK
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Md Hasmizam Razali, Universiti Malaysia Terengganu, Malaysia
Mostafa Omidi Bidgoli, Azad University, Iran
Mitch-Irene Kate G. Oyales, University of the Philippines, Philippines
Ivy Ann C. Razonado, University of the Philippines, Philippines
Theodoros C. Rousakis, Democritus University of Thrace (D.U.Th.), Greece
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Mohammad Reza Toroghinejad, Isfahan University of Technology, Iran
Mohammadreza Vafaei, Universiti Teknologi Malaysia
Sathish Rao U, Manipal Institute of Technology, Manipal Academy of Higher Education, India
Akash Katoch,Indian Institute of Technology Roorkee, India
C. Y. Tan, University of Malaya, Malaysia
Yin Fong Yeong, Universiti Teknologi PETRONAS, Malaysia
Tanveer Hussain, National Textile University, Pakistan
BAO Yumei, Zhejiang University of Technology, China
Mohit Sharma, Institute of Materials Research and Engineering, Singapore
G. RAJARAJAN, Valluvar College of Science and Management, India
Vijay Sekar K.S., SSN College of Engineering, India

Program Overview

Day 1 | June 14, 2024 | Friday | (GMT+8)

Time	Activity
14:00-17:00	**Sign-in & Conference Kits Collection** **Venue: Foyer of Marie Room II (Level 1)**

Day 2 | June 15, 2024 | Saturday | (GMT+8)

Time	Activity
	Venue: Marie Room II (Level 1)
9:30-9:35	 **Opening Remarks - Prof. Ramesh K. Agarwal (Conference Chair)** Washington University in St. Louis, USA
9:35-10:20	 **Keynote Speech - Prof. Ramesh K. Agarwal** Washington University in St. Louis, USA ***"Environmentally Responsible Sustainable 'Green' Composites"***
10:20-10:40	**Group Photo & Coffee Break**
10:40-11:25	 **Keynote Speech - Prof. Jianyong Ouyang** National University of Singapore, Singapore ***"Conducting Polymers as Wearable Biopotential Electrodes for High-quality Healthcare Monitoring"***
11:25-11:55	 **Invited Speech - Assoc. Prof. Majid Al-Maharbi** Sultan Qaboos University, Sultanate of Oman ***"Manufacturing Aluminum-Based Nanocomposites via Stir-Squeeze Casting Combined with Ultrasonication"***
11:55-13:30	**Lunch Break**
13:30-15:30	**Session 1 - Materials Physics and Materials Chemistry** CM24-304-A, CM24-409A, CM24-312-A, CM24-308-A, CM24-314, CM24-303, CM24-307-A, CM24-413
15:30-15:45	**Coffee Break**
15:45-17:15	**Session 2 - Advanced Composite Materials and Manufacturing Technology** CM24-309-A, CM24-311-A, CM24-313, CM24-408A, CM24-310, CM24-414
17:20-17:45	**Posters** CM24-306, CM24-406A, CM24-420
18:00-20:00	**Dinner @ White Rose Cafe**

Day 3 | June 16, 2024 | Sunday | (GMT+8)

Activity
Singapore One Day

Keynote Speaker

Prof. Ramesh K. Agarwal (Conference Chair)

Washington University in St. Louis, USA

- Venue: Marie Room II (Level 1)
- Time: 9:35-10:20 (GMT+8), June 15, 2024
- Zoom ID: 897 0616 2541 https://us02web.zoom.us/j/89706162541

"Environmentally Responsible Sustainable 'Green' Composites"

Abstract Most advanced composites currently available are made using non-degradable polymeric resins such as epoxies, esters, polyurethane, etc., and high strength and/or high stiffness fibers such as graphite, aramids, and glass, designed for long term durability. While they have desirable mechanical, thermal and chemical properties, they have two major disadvantages. First, the materials used are not sustainable; the high performance fibers (except glass) and resins are almost entirely derived from petroleum, and secondly these composites are non-degradable under normal environmental conditions. In recent years, the growing environmental concerns have pushed research in the area of bio-degradable green composites since they do not require petroleum (source of greenhouse gas emissions) and land-fills at the end of their lives. In green polymer composites, one of the two chemicals from which they are synthesized can be produced sustainably reducing their carbon footprint. For example, polyurethanes (PU) can now be produced using polyols from soybean oil, polyethylene terephthalate (PET) from ethylene glycol, and polybutylene succinate (PBS) from succinic acid. Use of renewable plant-based lignocellulosic fibers has been a natural choice for reinforcing (or filling) polymers to make them greener. Plenty of examples can be found where plant-based fibers are used for reinforcing non-degradable thermoplastic polymers such as PP, high, medium, and low density polyethylene (HDPE, MDPE, LDPE), nylons, polyvinylchloride (PVC), and polyesters as well as thermoset resins such as epoxies and esters to produce greener composites. Due to their good mechanical properties, longer plant-based fibers, extracted from the stems or leaves of plants such as abaca, bamboo, flax, henequen, hemp, jute, kenaf, pineapple, ramie, sisal, etc., are being evaluated as low cost alternative reinforcements to commonly used glass fibers to make composites. These fibers are annually renewable, as compared to wood which takes 20–25 years to grow before it can be cut and used. Significant research efforts are currently being spent in developing a new class of fully biodegradable or compostable green composites by combining natural fibers with biodegradable resins. Most of the current technology is still in the research and development stage. This presentation will review some these developments and their current and potential applications.

Biography Professor 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.

Keynote Speaker

Prof. Jianyong Ouyang

National University of Singapore, Singapore

- **Venue: Marie Room II (Level 1)**
- **Time: 10:40-11:25 (GMT+8), June 15, 2024**

"Conducting Polymers as Wearable Biopotential Electrodes for High-quality Healthcare Monitoring"

Abstract The healthcare cost has been increasing, because to visit a doctor is costly and time-consuming. The advent and advance of wearable technologies can greatly lower the healthcare cost. However, the signals provided by wearable devices often exhibit low quality, particularly during body movement. For example, biopotential signals including electrocardiography (ECG), electromyography (EMG) and electroencephalography (EEG) can provide vital signal for diagnosis. However, the conventional Ag/AgCl gel electrodes are not suitable for long-term monitoring due to the evaporation of the liquid phase of the gel electrolyte and skin irritation. Stretchable strain sensors have been investigated to monitor the body movement, but their signals can be very noisy during body movement because they cannot always form conformal contact to skin. Here, I will present some of our results on developing conformal dry electrodes for biopotential monitoring. These dry electrodes can always form conformal contact to skin, and thus they can give rise to high-quality biopotential signals even during body movement.

Biography Prof. Jianyong Ouyang received his PhD, master and bachelor degrees from the Institute for Molecular Science in Japan, the Institute of Chemistry of the Chinese Academy of Science, and the Tsinghua university in Beijing, respectively. His research interests include flexible electronics and energy materials and devices. He invented the first polymer-nanoparticle resistive memory, the first hybrid ionic/electronic thermoelectric converter, the first adhesive intrinsically conducting polymers and the first strain sensor for food processing monitoring in the world, observed the ductilization on polymers for the first time in the world, and continually reported world-record conductivities and thermoelectric properties of solution-processable intrinsically conductive polymers and world-record thermoelectric properties of ionic conductors.

Invited Speaker

Assoc. Prof. Majid Al-Maharbi

Sultan Qaboos University, Sultanate of Oman

- **Venue: Marie Room II (Level 1)**
- **Time: 11:25-11:55 (GMT+8), June 15, 2024**

"Manufacturing Aluminum-Based Nanocomposites via Stir-Squeeze Casting Combined with Ultrasonication"

Abstract This study successfully produced aluminum nanocomposites using a stir-squeeze casting process, both with and without ultrasonication (US) assistance. The matrix material utilized was scrap automobile wheel aluminum alloy (A356), with 1% SiC nano particles, averaging a size of 40 nm, serving as the reinforcement material. A comparison was made by also producing A356 aluminum casts with and without the use of US. The produced casts underwent thorough chemical and mechanical characterization, including optical and scanning microscopy, porosity measurement, hardness measurement, compression and tensile testing, as well as wear testing. Additionally, energy-dispersive X-ray spectroscopy (EDS) and X-ray diffraction (XRD) analyses were conducted to assess compositions and confirm the presence of SiC nano particles in the aluminum matrix. Porosity levels were slightly higher in the nanocomposite samples compared to pure matrix samples, attributed to the tendency of pore formation due to improper distribution of ceramic particles, resulting in clustering and agglomeration. However, significant reduction in porosity was observed with the application of ultrasonication, effectively breaking up clusters and agglomerations of reinforcement particles. Regarding mechanical properties, the A356+SiC sample with US exhibited the highest hardness (70.8 HRB), tensile strength (163.25 MPa), and compressive strength (387.2 MPa), along with the lowest abrasive wear loss (0.0017 g) among all types of casts produced in this study.

Biography Finished Bachelor in Mechanical Engineering in June 2000 from Sultan Qaboos University and Joined Sultan Qaboos University since then. Completed Master degree in Materials Science from Arizona State University in July 2003. The Master thesis was in micro-indentation of single crystalline materials. Completed PhD in severe plastic deformation (SPD) of magnesium and zinc alloys from Texas A&M University on December 2009. Currently working as assistant head of the Department of Mechanical and Industrial Engineering in Sultan Qaboos University. Research interests are: severe plastic deformation of metallic materials, microstructure and texture engineering, lightweight materials: aluminum and magnesium alloys and composites, shape memory alloys and their applications.

Session 1

"Materials Physics and Materials Chemistry"

Session Chair: Prof. Jianyong Ouyang, National University of Singapore, Singapore

Time: 13:30-15:30 (GMT+8), June 15, 2024

Venue: Marie Room II (Level 1)

Note: The schedule of each presentation is for reference only. Authors are required to attend the whole session, in case there may be some changes on conference day. Please join in the room 5-10 minutes earlier.

13:30-13:45
CM24-304-A

Investigation on the Impacts of Sparsely Decorated Metal Nanoparticles on the Electrical Performance and Broadband Photoresponse in Mos_2 Phototransistors

Ke-Han Li, Xiao-Yang Zhang, Tong Zhang

Southeast University, China

Abstract: Metal nanoparticles have been proven effective for improving the photoresponse of two-dimensional (2D) material detectors through extraordinary plasmonic effects such as local field enhancement and hot electron injection. While in very few studies that explored the effects of sparsely distributed metal nanoparticles on the optical response of MoS_2 transistors, the results showed broadband uniform enhancement rather than significant plasmonic resonance enhancement at specific wavelengths. Recently researchers have observed metal nanostructure induced amplified photocurrent and photoluminescence signals without obviously influencing the optical absorption capacity of the phototransistors using different strategies. It was reported that by depositing silica-gold nanoshells sparsely on monolayer MoS_2, the photoresponsivity in a wide wavelength range was enhanced. Similarly, by decorating $Ag@SiO_2$ core-shell nanoparticles on multilayer MoS_2, we also observed uniformly enhanced photocurrent signal in MoS_2 transistors from visible to near-infrared wavelengths. Based on the above interesting observation, we focused our presentation on the following aspects. We verified through a series of comparative experiments that the uniform photocurrent enhancement is due to the improved efficiency of charge transport in the MoS_2 channel. To be specific, notable increases in carrier mobility (over 1 fold) and carrier concentration (over 10 fold) are obtained. We explained the mechanism from the perspective of electron density changes using DFT calculations, which matches well with the experimental results. We realized low-density nanoparticle distribution on the MoS_2 surface by a facile self-assembly approach and the $Ag@SiO_2$ core-shell nanoparticles we adopted can withstand high temperatures above 300°C without deformation, indicating that our device is suitable for practical applications. Finally, we concluded that both of these works are featured with very sparse nanoparticle distribution (around 1% coverage) despite the difference in the material, structure and morphology of metal nanoparticles adopted. The results of these works, similarly shown as uniform enhancement that is completely different from the wavelength-selective plasmonic effect, indicate that there may still exist undiscovered coupling effects between metal nanoparticles and 2D materials, which is worthy of future research. These discoveries are enlightening for future research on 2D material phototransistors and provide a more comprehensive evaluation of the effects of metal nanoparticles.

13:45-14:00
CM24-409A

Flexoelectric Polar Patterns in Wrinkled Thin Films

Hongxing Shang, Huiting Dong, Yihan Wu, Feng Deng, Xu Liang, Shuling Hu, and Shengping Shen

Xi'an Jiaotong University, China

Abstract: Intriguing topological polar patterns, such as labyrinthine domain patterns, polar merons, polar skyrmions, and polar vortices in oxide films have attracted enormous interest owing to their particular charge distributions and immense applications in the next-generation electronic devices. Previously, such polar structures are mainly observed in ferroelectric superlattices. Here, we report on the formation of polar structures in wrinkled nonferroelectric films, where large-area, self-assembled, and tunable strain gradients can be easily achieved, providing a novel route to mechanically manipulate polar patterns via flexoelectricity. Our results of theoretical analyses and atomistic simulations reveal that the flexoelectric polar stripes, meron- or anti-meron-like nanodomains, and polar labyrinths can be achieved in wrinkled oxide films without material symmetry restriction. To further understand the fundamentals of these flexoelectric polar patterns, the polar evolution mechanisms and their outstanding mechanical tunability were investigated. Our strategy based on flexoelectricity for generating nontrivial polar structures will no longer rely on the superlattice structure and can be widely applicable to all centrosymmetric or non-centrosymmetric materials, which in turn contribute to the advancement of polar pattern-based nanoelectronics.

14:00-14:15
CM24-312-A

Oxidative Reduction of Formaldehyde by N-Doped Gqds under LED Light Irradiation

Jin Ren Liou, Jing Yao Chen, Peiting Wu, **Yusen Lin**

National United University, Taiwan

Abstract: Research on graphene nanosheets (GNs) received the Nobel Prize in 2010 and has since found widespread applications in various products. Additionally, numerous derivatives of graphene have been developed for diverse purposes, including biotechnology and medicine. Notably, nitrogen-doped graphene quantum dots have exhibited the ability to hinder the transmission of coronaviruses under illumination, potentially serving as a tool for epidemic prevention, and can also catalyze oxidation-reduction reactions and the breakdown of organic compounds.

Indoor air quality (IAQ) significantly impacts human health and well-being, considering that people spend a considerable amount of time indoors, whether in residential, office, educational, or vehicular settings. Formaldehyde, commonly used in building materials and furniture production, has been classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC) since 2004, particularly posing a threat when used in synthetic products containing urea-formaldehyde resin adhesive. Prolonged exposure to indoor air pollution can lead to respiratory diseases, allergies, and irritation of the respiratory tract.

To promote the adoption of new building materials in Taiwan, this project aims to investigate the application of nitrogen-doped graphene quantum dots in indoor LED lighting conditions to catalyze the oxidation-reduction and decomposition of formaldehyde, effectively reducing the concentration of volatile organic compounds in indoor spaces. Subsequently, the research findings will be integrated with building materials for evaluation and validation of their efficacy, contributing to the sustainable enhancement of indoor air quality.

14:15-14:30
CM24-308-A

Biodegradable Microspheres Assist Anti-PD-L1 Drug KN035 in Enhancing Tumor Immunity of Hepatocellular Carcinoma

Xunzheng Su, Jinxin Huang, Fei Xiong

Southeast University, China

Abstract: Hepatocellular carcinoma (HCC) is the most common malignant primary tumor of the liver, and immunotherapy has emerged as an effective treatment method

employed in its management. Envafolimab (KN035) refers to a novel humanized single-domain anti-PD-L1 antibody recombinant protein, which has been proven to exhibit better initial anti-tumor activity in patients with advanced solid tumors, including HCC, when administered via subcutaneous injection. However, its drug utilization rate still needs to be further improved. To address this issue, a type of self-degradable microspheres was screened and identified to achieve the constant delivery of the anti-PD-L1 drug KN035. Results from experiments using mouse liver cancer models demonstrated that KN035-MS resulted in significant tumor shrinkage compared to the KN035 group. Additionally, KN035-MS injection led to increased CD8+ T cells, CD4+ T cells, ILC cells, and M1 macrophages, but decreased M2 macrophages and MDSC, which induced strong immune responses. This suggests that the drug utilization rate of KN035 was significantly improved.

14:30-14:45
CM24-314

Preparation of Flower-like Layered Double Hydroxides Supercapacitor Cathode Based on Biomineralization Strategy

Rongxin Chen, Li Cheng

Chongqing University, China

Abstract: Layered double hydroxides (LDHs) materials are widely used in the cathodes of high-performance supercapacitors. However, current preparation methods suffer from issues such as high energy consumption, complex processes, and significant safety hazards. In this study, based on a mild biomineralization reaction route, flower-like nano-sheet structured cobalt-based LDHs (COH) cathode was successfully prepared. The COH cathode achieved an outstanding specific capacitance of 829.0 F g^{-1} at a current density of 1 A g^{-1} and retained 90.9% of its initial capacitance after 4000 cycles. This biomineralization strategy holds promise for widespread application in the preparation of nanostructured electrode materials.

14:45-15:00
CM24-303

Recovery and Size-Tuning of Amorphous Silica from Geothermal Scales in Batangas, Philippines

Mitch-Irene Kate G. Oyales, Kirk Benedict Beau T. Damian and Tiffany Louise B. Lao

University of the Philippines Diliman, Philippines

Abstract: Scale deposits in geothermal power plants are well-known potential sources of minerals. Extensive research in mineral recovery is crucial due to the considerable variability in scale composition and geochemistry based on location. Geothermal scales from Batangas, Philippines, were used to synthesize size-modified amorphous silica (SiO_2) via sol-gel method. Initial analyses employing x-ray fluorescence spectroscopy (XRF), total dissolved solids (TDS), electrical conductivity (EC), and pH measurements confirmed that the scale is rich in silica and salts at neutral pH. Then, the effect of varying scale concentration, precipitation pH, and aging time on the particle size distribution of recovered amorphous silica were investigated. Dynamic light scattering (DLS) for particle size analysis (PSA) revealed that the sample with 2.5% (w/v) scale precursor in NaOH and precipitated until pH 10 had the lowest average cumulant diameter (1.66 µm). Moreover, the synergy of precipitation pH and aging time was found to significantly affect the polydispersity index and cumulative diameter of precipitated SiO_2 based on 2^3 factorial ANOVA at 0.05 significance level. X-ray diffractometry (XRD), Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM) confirmed that the precipitates were amorphous SiO_2 with spherical morphology. This study proves the viability of utilizing geothermal scales from Batangas, Philippines for the synthesis of amorphous SiO_2 with controlled particle size, which is a potential filler for composite materials.

15:00-15:15
CM24-307-A

A Study on Improving Post-TACE Drug Resistance in HCC based on Controllable Oxygen Release-Magnetic Hyperthermia Therapy

Jin-Xin Huang, Xun-Zhen Su, Fei Xiong

Southeast University, China

Abstract: Hepatocellular carcinoma (HCC), which accounts for approximately 75%-85% of primary liver cancers, poses a significant global health challenge with limited effective treatment options. Transcatheter arterial chemoembolization (TACE) is a widely accepted treatment for intermediate-stage HCC. However, the dual hypoxia microenvironment, resulting from inherent tumor hypoxia and TACE-induced hypoxia, can trigger drug resistance in HCC. To address this issue, we have developed multicavitary oxygen-encapsulated magnetothermal drug-eluting microspheres (OTD-Ms) and characterized them in vitro, confirming their ability to carry and release oxygen, generate heat through magnetocaloric effect, and efficiently deliver EPI. Our in vitro and in vivo experiments using a VX-2 rabbit tumor model demonstrated that OTD-Ms effectively reduced the levels of HIF-1α and VEGFA in tumor cells and decreased the expression of resistance-related proteins, such as P-gp. The OTD-Ms alleviate dual hypoxia post-TACE, significantly improve drug resistance, and greatly enhance TACE efficacy, suggesting their potential to improve clinical treatment strategies for HCC.

15:15-15:30
CM24-413

Analysis of Delay and Dynamic Crosstalk in Spatially Arranged Mixed CNT Bundle Interconnects at Different Technology nodes

Anurag Yadav, Nidhi Chandra, **Pankaj Kumar Das**

Sant Longowal Institute of Engineering and Technology, India

Abstract: In the present nanoscale regime, mixed carbon nanotube bundles (MCBs) are considered to be highly promising interconnect options. This research paper introduces a spatially arranged mixed carbon nanotubes (CNTs) bundle (MCB), wherein single-walled CNTs (SWCNTs) and multi-walled CNTs (MWCNTs) occupy equal halves in the MCB. An equivalent single conductor (ESC) model for MCB is employed to analyze the interconnect performances in terms of propagation delay and dynamic crosstalk delay at different technology nodes (i.e., 32nm, 22nm, and 16 nm). Encouragingly, a significant reduction in propagation delay and dynamic crosstalk induced delay are observed at 32 nm technology node. It is observed that at 32 nm technology node, the propagation delay and crosstalk induced delay significantly improves by 29.40% and 55.53%, respectively, compared to 22 nm technology node and 187.88% and 185.94%, respectively, compared to 16 nm technology node. The improvement in interconnect performances can primarily be attributed to the improvement in the number of conducting channels inside the MCB at 32 nm, which greatly impacted the interconnect parasitics such as quantum resistance, quantum capacitance, kinetic inductance etc.

Best Presentation Award & Group Photo

Session 2

"Advanced Composite Materials and Manufacturing Technology"

Session Chair: Assoc. Prof. Majid Al-Maharbi, Sultan Qaboos University, Sultanate of Oman

Time: 15:45-17:15 (GMT+8), June 15, 2024

Venue: Marie Room II (Level 1)

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15:45-16:00
CM24-309-A

Sustainable Carbon-Based Conductive Composite Materials for Biosensors and Beyond

Sandra Lepak-Kuc, Aleksandra Kądziela
Warsaw University of Technology, Poland

Abstract: Sustainable electronics is one of the major trends in today's world. Non-toxic chemical materials and recyclable parts open up pathways not only to environmental saving issues but also to novel solutions. Innovative conductive components may find applicability among others in biomedical applications. One such solution, in which we have undertaken research, could be modern electrocardiographic electrodes, which are not only disposable, but their production will be sustainable and, once used, they will be thermally recyclable by incineration without leaving a harmful trace. Here we present extensive research into modern sustainable electrically conductive **composite materials** dedicated to such an application. We have investigated the applicability of new matrices for electrically conductive composites in technologies like screen printing and flexography. We have investigated both established biopolymers and also other materials that have not yet been used in electronics.
A functional printing composite has to provide the relevant physical parameters. We have studied key properties of printing composites such as viscosity, printability, substrate compatibility and electrical parameters. In addition, due to biomedical applications, cytotoxicity was studied, and due to environmental friendliness, degradation issues under climatic loads.

16:00-16:15
CM24-311-A

Role of Hot Extrusion and T6 Heat Treatment on Microstructural and Mechanical Properties of Ce-Added Al-20%Mg2Si-2Cu Composite

Hamidreza Ghandvar
New Uzbekistan University (NUU), Uzbekistan

Abstract: In the present study, the combined effect of hot extrusion and T6 heat treatment on microstructural and mechanical properties of Al-20%Mg2Si composite treated with various contents of Ce addition was investigated. Experimental procedures were carried out using optical microscopy (OM), scanning electron microscopy (SEM) equipped with energy dispersive spectroscopy (EDS), tensile and hardness tests. In addition, cooling curve thermal analysis (CCTA) was conducted to examine the influence of Ce addition on characteristic parameters of primary Mg2Si in Al-20%Mg2Si-2Cu composites. The results showed that when Al-20%Mg2Si-0.8 wt. % Ce composite was subjected to hot extrusion followed by T6 heat treatment, the morphology of primary Mg2Si transformed

to spherical shape compared to the truncated octahedral morphology in the treated composite. Consequently, the average primary Mg2Si particle size decreased from 25 µm in the modified to 15 µm in the proceeded modified composite. In fact, formation of spherical primary Mg2Si particles can be attributed to the role of hot extrusion on Mg2Si particles fragmentation and enhancing the solid-state diffusion of Si and/or Mg atoms during T6 heat treatment. In addition, the tensile results showed that the UTS and El % of the Al-20%Mg2Si-0.8 wt. % Ce composite enhanced from 225 MPa and 3% to 250MPa and 4.2% after conducting hot extrusion and T6 heat treatment respectively which is due to the provision of high matrix/particle interface strength as well as high fracture stress by fine spherical primary Mg2Si particles which had a significant role in strengthening of the composite. The hardness test reveals that with addition of 0.8 wt. % Ce element to Al-20%Mg2Si composite, the hardness values increased from 95Hv in the modified composite to 110Hv in the proceeded composite which is due to formation of fine primary Mg2Si particles as well as hard Ce Intermetallic compounds (IMCs).

16:15-16:30
CM24-313

Tailoring SWNT Elastic Properties for Enhanced Durability in Additive Manufactured Prosthetic Devices

M.S.M. Al-Kharusi, Majid Al-Maharbi

Sultan Qaboos University, Sultanate of Oman

Abstract: This study focuses on the numerical estimation of the effective Young's modulus of single-walled carbon nanotubes (SWCNT) using a continuum mechanics approach tailored for additive manufacturing applications in prosthetic limbs. In our finite element model, the positions of carbon atoms within the SWCNT are represented as nodes linked by beam elements that embody the geometrical and elastic mechanical properties derived from interatomic forces. These forces are quantitatively assessed by equating them to the total interatomic potential energies of the SWCNT's molecular structure. Employing an equivalent continuum technique, we evaluate the effective elastic properties across various SWCNT configurations and benchmark our findings against existing numerical and experimental data from the literature. Our results, which align closely with published studies, demonstrate the isotropic behaviour of SWCNT and reveal a significant dependence of stiffness on the modelled wall thickness. These insights are critical for the development of enhanced prosthetic limbs through additive manufacturing, where material properties such as stiffness and durability are paramount.

16:30-16:45
CM24-408A

Optimization of process parameters in EDM of Nimonic 80A alloy using different electrode materials

Indraj Singh, Mahima Saxena, Hemant Kumar

Sant Longowal Institute of Engineering and Technology, India

Abstract: The current investigation is an attempt to optimize the EDM process parameters while machining Nimonic-80A alloy using brass and aluminium electrodes. Experiments were performed with machine variables which include: peak current, pulse on time, discharge voltage and electrode material. The important performance parameters selected for this study were material removal rate (MRR), tool wear rate (TWR) and surface roughness (SR). Response surface methodology (RSM) has been used to analyze the parameters. Analysis of variance (ANOVA) has been used to identify the significant process parameters. The input parameters have been optimized in order to maximize the MRR, minimize the TWR and SR. Results show the optimum values of MRR, TWR and SR obtained with brass electrode are 0.0427308 g/min, 0.0703686 g/min and 2.08999 µm respectively. With aluminium electrode the optimum values of MRR, TWR and SR obtained are 0.076363 g/min, 0.00759483 g/min and 3.96355 µm respectively. Based on the experimental results, aluminum electrode offers higher MRR nearly 43.98% and a very low TWR nearly 89.2% than brass electrode. Brass electrode produced 47.27 % less surface roughness than aluminium. Thus brass is preferred as tool electrode for requirement of better surface integrity but MRR is rather less and aluminium is preferred

as tool electrode for high MRR and low TWR.

16:45-17:00
CM24-310

Composites Recycling by Using Intumescent Flame-Retardant Concept

Oussema Kachouri, Julien Bardon, David Ruch, **Abdelghani Laachachi**

Luxembourg Institute of Science and Technology, Luxembourg

Abstract: A structural composite material is obtained by incorporating continuous and strong fibres in a polymer matrix. Such a design leads to materials with exceptional mechanical properties over a very small density. This family of composite materials can be extended further by combining special designs of composite sub-parts, like in honeycomb structures. Thanks to their performances, these composites are increasingly used in a range of applications mainly in the energy, construction, automotive and aerospace sectors. However, it is very difficult to dismantle composite materials in multi-material structures for recycling purposes; currently, they are mainly incinerated to produce energy. The present paper proposes adding "smart chemical additives" during composite manufacturing and assembly, which will facilitate both the separation of multi-material structures into single blocks, and the separation of composite sub-parts into raw materials. This innovative "debonding on-demand" function provides a significant incentive to using composite materials in a circular economy, i.e. promoting the repair, reuse and recycling of these materials.

17:00-17:15
CM24-414

Effect of alloying elements on weld characterization and wear resistance of hardfacing of structural steel with iron-based electrodes

Jaspal Singh Gill, Amrik Singh, Om veer Singh

Sant Longowal Institute of Engineering and Technology, India

Abstract: The present study is an attempt to provide the solutions to the problem encountered by the components subjected to metal-to-metal wear from grass root level to the advanced stages. In this paper the effect of alloying elements on the wear performance of hard-faced components prepared by Shielded Metal Arc Welding SMAW process has been undertaken on the low carbon steel substrate by different compositions of iron-based hard facing electrodes. The effect of alloying elements on the microstructure, microhardness, and wear resistance of the Fe-based hardfacing alloy were investigated by means of optical microscopy, and pin on disc wear test. The hardness and wear resistance were improved with the increase in chromium (Cr) content. The hardness of substrate material ranging from 100 HV increased up to 280 HV using electrode with Cr 2.5%, 330 HV using second electrode with Cr 4.5% and 350 HV using third electrode Cr 6%. The wear resistance was calculated in terms of the weight loss wear was found to be reduced by 45% approximately with chromium content from 2.5% to 4.5 %, whereas corresponding to 6% chromium electrode, it was reduced by 54%. The percentage of carbide was found to be more in hardfaced layer in the presence of the molybdenum (Mo). The improvement of hardness and wear resistance of the hardfacing layer is attributed to the solution strengthening of Mo alloying elements. It was further observed that samples that have higher Cr content possessed finer grains with martensitic structure.

Best Presentation Award & Group Photo

Posters

CM24-306

An Experimental Study on the Effect of Nano Zinc Oxide on Reflective Coatings and Building Roof Temperatures

Wurood Asaad M., Lina M. Shaker and Ahmed Mahdi

Ministry of Electricity, Iraq

Abstract: Most roofs on Earth are made of dark materials. Dark roof surfaces can retain heat better than light ones; in Iraq, summer time temperatures on the roofs of dark buildings reached 70–80 degrees Celsius in July and August. The effects of this temperature rise are detrimental to cooling and energy consumption. To lessen heat transfer into the building, use reflective surfaces that can reflect infrared radiation waves. Cool roofs have both short-term and long-term advantages. They can reduce a building's annual air conditioning energy consumption by up to 15%, extend the life of the roof and its service life, improve the energy efficiency of roofs particularly those with inadequate insulation at the front of the roof improve thermal comfort in buildings without air conditioning, and lower greenhouse gas emissions and air pollution. Solar heat is one of the main factors affecting the durability of roofing membranes, according to research and real-world experience with the deterioration of these materials over time. High solar reflectance materials can reflect more sunlight and maintain their coolness in the sun. This study examines a low-cost composite cool coating that uses 60% calcium carbonate and demonstrates a 15°C drop in surface concrete temperature for roof buildings when compared to an uncoated surface. Additionally, compared to 30%wt CaCO3, the effect of 60%CaCO3 in composite coating reduces adhesion strength. According to the study, the weight of CaCO3 in the composite coating increases while adhesion strength, surface roughness, and particle homogeneity distribution decrease. Conversely, the maximum weight of CaCO360% weight percent exhibits good IR reflectance and less tribological properties. While preserving good infrared reflectance, adding 10% ZnO to the coating solution (60% CaCO3/PVac) improves tribological properties. The adhesion strength of the 60% calcium carbonate polymer composite paint increased from 10.9 MPa to 40.2 MPa when the nano material was present, while this material maintained the superior optical qualities of infrared reflection. The coefficient of thermal expansion varies between concrete and coating solutions. For instance, the coating that has 10% weight added ZnO has a peel resistance coefficient of 8*10-6 1/K. The 60%CaCO3/10%ZnO/PVac coating effectively lowers the temperature by 15–12 °C when applied to a building roof.

CM24-406A

Synthesis and Characterization of Augite-Based Ceramic Pigments Obtained by Solid-State Sintering

Tsvetan Dimitrov, Rositsa Titorenkova, Yana Tzvetanova

University of Ruse, Bulgaria

Abstract: A series of ceramic pigments with initial composition corresponding to augite were synthesized in the systems CaO-Na_2O-Fe_2O_3-MgO-SiO_2 and CaO-Na_2O-Fe_2O_3-MgO-Al_2O_3-SiO_2 via solid-state high temperature sintering at 1000, 1100 and 1200°C. Augite is monoclinic, sub-calcium member of the diopside-hedenbergite pyroxene series with structural formula (M2)(M1)$(T)_2O_6$. The crystal structure allows incorporation of cations of different valence with charge compensation by substitution at all crystallographic positions: octahedral (M1, M2) and tetrahedral (T), which is suitable for the synthesis of pyroxene ceramics with a more complex chemical composition. The experiments aimed to demonstrate the possibility of incorporating sodium, iron and aluminium into the crystal lattice of augite. The resulting ceramic pigments were examined by powder X-ray diffraction, vibrational spectroscopy, scanning electron

microscopy, and UV-Vis spectrophotometer. It was found that as the sintering temperature increases and aluminium is added to the system, the number of mineral phases formed in the ceramic decreases. The ceramics in the system $CaO-Na_2O-Fe_2O_3-MgO-SiO_2$ and $CaO-Na_2O-Fe_2O_3-MgO-Al_2O_3-SiO_2$after sintering at 1200°C consist predominantly of augite with small amounts of wollastonite and cristobalite. When aluminum is added to the system, a single-phase augite $(Ca,Na)(Mg,Al, Fe)(Si, Al)O_6$ ceramic is formed.

CM24-420

Preparation and Performance Study of Thermally Conductive Silicone Adhesive Applying in Flip Chip Ball Grid Array

Yuwen Xu, Liangjun Liu, Kun Jia

U-Bond Mater. Tech. Inc., China

Abstract: A thermally conductive silicone adhesive UB-5715 was prepared using vinyl silicone oil of medium viscosity, hydrogen-containing silicone oil and micron alumina powder. The results revealed that UB-5715 demonstrated superior thermal and mechanical properties. Specifically, its thermal decomposition temperature exceeded 400 °C, the thermal conductivity coefficient surpassed 1.80 W/m·K, the thermal resistance was under 12.0 °C·cm2/W, the shear strength reached achieved was over 5.00 MPa. Meanwhile, after being subjected to uHAST for 384 hours, thermal cycle for 1000 times and heat aging for 1000 hours respectively, UB-5715 still maintained its high thermal conductivity coefficient and mechanical properties, UB-5715 still maintained its high thermal conductivity coefficient and mechanical properties. The thermal conductivity coefficient still exceeded 1.70 W/m·K, shear strength still surpassed 5.00 MPa, the tensile modulus remained below 100 MPa, the linear expansion coefficient was less than 160 ppm/°C, and its comprehensive performance met the reliability requirements for advanced packaging process substrates and heat dissipation cover assemblies.

Singapore One Day

The Merlion

Start your day early at the heart of Singapore with The Merlion, a mythical creature that represents Singapore's humble beginning.

The head of a lion represents Singapura, which translates to lion city, and the body of a fish describes the origins of Singapore as a fishing village.

- **Address:** Merlion Park, Singapore
- **Operating hours:** 24 hours daily
- **How to get there:**
  ➡Take a 10-minute walk from Raffles Place MRT, exit via Battery Road (Exit H), and walk towards Fullerton Road
  ➡Cross the road towards One Fullerton and walk to your left towards the Merlion.

National Gallery Singapore

Art and culture enthusiasts should pay the National Gallery Singapore a visit to catch the latest art exhibitions from the region. Home to 8,000 art pieces of famous local and regional artists, interactive exhibitions are also rolled out every few months to give you an immersive experience in the museum.Explore every corner of the museum and admire the architectural marvels like the high ceiling, dome, massive pillars, and symmetrical corridors.

- **Address:** 1 St. Andrew's Rd Singapore 178957
- **Operating hours:** Daily from 10am - 7pm (Admission ends 30 minutes before closing time)
- **How to get there:**
  ➡From Fullerton Jetty, cross Cavenagh Bridge and continue onto Connaught Drive
  ➡From there, turn left into Parliament Pl and follow the road till you reach the National Gallery or alight at City Hall MRT, take Exit B, and walk through the Art Connector

Gardens by the Bay

A nature park atop reclaimed land, Gardens by the Bay is one of Singapore's top attractions.

This futuristic-style botanic garden within the city is home to a wide range of internationally-sourced flora and fauna. Gardens by The Bay is divided into three distinctive waterfront gardens—Bay East, Bay South, and Bay Central.

If you've got a time-cramped itinerary, head to Bay South, which houses the iconic Supertrees, Flower Dome, and Cloud Forest. Step into the Cloud Dome to learn how the Cloud Forest functions and to admire the world's tallest indoor waterfall. Walking up the bridge, you can get close to the tropical highland vegetation and the mist waterfall.

Make sure to stay till dark and wind down with the exciting music and light performance slated at 7:45pm and 8:45pm daily by the Bay Garden Rhapsody at Supertree Grove.

- **Address**: 18 Marina Gardens Drive, Singapore 018953
- **Operating hours:**
  Daily from 9am to 9pm (last admission at 8:30pm)
  Bay Garden Rhapsody showtime: Daily 7:45pm and 8:45pm
- **How to get there:**
  ➡From The Shoppes at Marina Bay Sands, head towards Bayfront MRT
  ➡Take Exit B and follow the underground linkway
  ➡Exit and cross the Dragonfly Bridge or Meadow Bridge into Gardens by the Bay

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