ICCMME

2025 the 10th International Conference on Composite Materials and Material Engineering

ICSMA

2025 the 8th International Conference on Smart Materials Applications

Yonsei University, South Korea
January 8-10, 2025

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CONFERENCE VENUE

Engineering Research Park (Building 102)
공학원

Yonsei University
연세대학교

Address: 50 Yonsei-ro Seodaemun-gu, Seoul, 03722, Republic of Korea
03722 서울특별시 서대문구 연세로 50 연세대학교

< Map of Yonsei Univ.>

#102: Engineering Research Park - Conference Building

#130: The Commons - Lunch & Dinner Place

<Directions>

Subway Exits

Name of Station	Exit Information
Sinchon Station (Seoul Subway Line #2)	Exit no.2 and no. 3 (Yonsei University, Severance Hospital Direction)

Bus Routes

Bus Routes		Bus Number
Yonsei University / Infront of Yonsei University	blue bus	153, 163, 171, 272, 470, 601, 606, 672, 673, 700, 707, 710, 750A, 750B, 751
	green bus	6714, 7737
	red bus	9714, M6724, M7106, M7111, M7119
	airport bus	6011
	general bus	567, 73
	Reserved seat bus	770, 800
	Nonstop bus	1000, 1100, 1200, 1900, 2000, 2000-1
Main gate of Yonsei University	blue bus	163, 171, 172
	green bus	7017,7713, 7720, 7727, 7728, 7737
	red bus	M6724
	general bus	567, 72
	Public light bus	Seodaemun03, Seodaemun04
Infront of Severence Hospital Stop (Center lane)	blue bus	272, 470, 601, 606, 672, 673, 700, 707, 710, 750A, 750B, 751
	green bus	6714, 7737
	general bus	567, 73
	Reserved seat bus	770
Severence Hospital Stop	blue bus	163, 171, 172, 472
	green bus	7017, 7024, 7713
	Public light bus	Seodaemun03, Seodaemun04, Seodaemun05

GENERAL INFORMATION

Oral Presentation

1. Timing: a maximum of 15 minutes total, including speaking time and discussion. 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.
2. You can use USB flash drive (memory stick), make sure you scanned viruses in your own computer. 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.
3. It is suggested that you email a copy of your presentation to your personal inbox as a backup. If for some reason the files can't be accessed from your flash drive, you will be able to download them to the computer from your email.
4. 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.
5. Videos: If your PowerPoint files contain video clips please make sure that they are well formatted and connected to the main files.

Poster Presentation

- Bring your high-resolution printed poster with you to the meeting (size must not exceed A1 [594mm×841mm]).
- Set up your printed poster at least one hour before your session start time on the day you are scheduled to present.
- Presenters must remove their printed posters immediately after the poster session.

Dress Code

Please attend the conference in formal attire.

Conference Photos

All the conference photos will be available for download through conference website within one week after the conference.

Accommodation

The conference organizer doesn't provide free accommodation or room reservation service. Participants should book rooms by themselves.

Safety Reminder: Secure Valuable Items at All Times

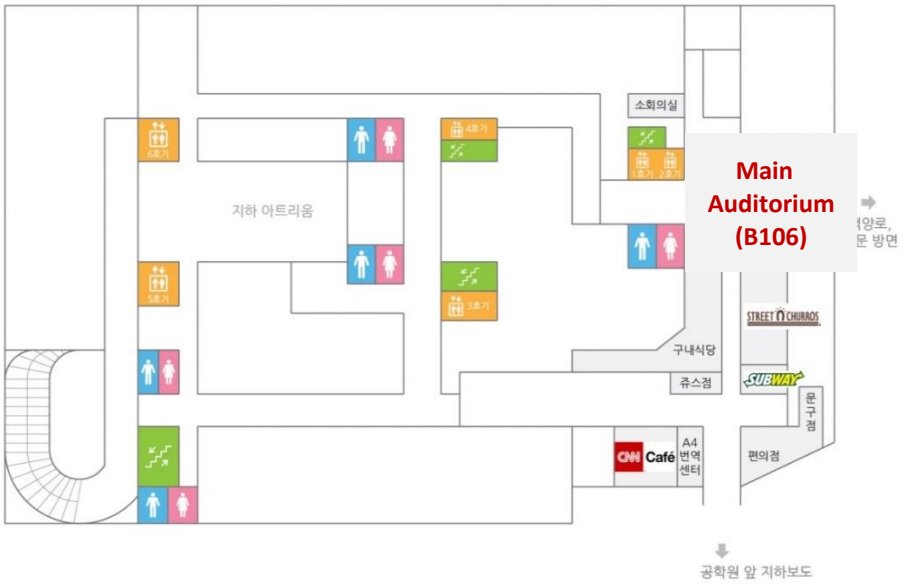
We remind you to secure your personal belongings at all times.
Please remember to:
* Wear your Conference Identification Badge at all times. Do not throw away Badge.
* If you are using a laptop computer, do not leave it unattended at any time.
* Keep your purse, wallet and other valuables with you at all times.
* The conference organizer will not be responsible for the loss or damage to any personal belongings.

SCHEDULE AT A GLANCE

January 8, 2025 | Wednesday Seminar Room 2 (173), 1F, Engineering Research Park, Yonsei University			
13:00-17:00	Participants Registration & Conference Kits Collection		
January 9, 2025 | Thursday Engineering Research Park, Yonsei University			**Room**
09:00-09:10	Opening Remarks	**Prof. Jong Hak Kim**, Yonsei University, South Korea	Main Auditorium (B106), B1F
09:10-09:55	Keynote Speech	"*Development of Hollow Fiber Membrane Modules with a Thin-Film Composite Structure for CO_2 Capture and the Gas Separation Performance*" **Prof. Ikuo Taniguchi**, Kyoto Institute of Technology, Japan	
09:55-10:40	Keynote Speech	*"Upcycling of Waste Plastic into Porous Carbon Materials and Their Application to Greenhouse Gas Capture"* **Prof. Ki Bong Lee**, Korea University, South Korea	
10:40-11:10	Group Photo & Coffee Break		
11:10-11:40	Invited Speech	*"Plasmonic Tungsten Oxide Nanocrystal Thin Films for Next-Generation Electrochromic Windows"* **Prof. Sungyeon Heo**, Seoul National University of Science and Technology, South Korea	Main Auditorium (B106), B1F
11:40-12:10	Invited Speech	*"Functional Carbon Composites with High Mechanical Strength"* **Dr. Seok-Keun Koh**, C&G Hitech Co., Ltd, South Korea	
12:10-13:30	Lunch @ The Commons (B110)		
13:30-15:45	Session 1	Composite Materials and Composite Structures	Seminar Room 1 (170E), 1F
13:30-15:30	Session 2	Materials Chemistry and Chemical Engineering	Seminar Room 3 (259), 2F
13:30-15:30	Session 3	Materials Physics and Materials Mechanics	Seminar Room 4 (372), 3F
15:30-16:00	Posters	Preparation, Properties and Application of Advanced Functional Materials	
15:30-16:00	Coffee Break		
16:00-18:00	Session 4	Functional Composite Materials and Building Materials	Seminar Room 1 (170E), 1F
16:00-18:00	Session 5	Biomedical Materials and Nanomedicine	Seminar Room 3 (259), 2F
16:00-18:00	Session 6	Thin Films, Coatings, and Surface Modification Technology	Seminar Room 4 (372), 3F
18:20-19:30	Award Banquet with K-pop Performance @ The Commons (B110)		
January 10, 2025 | Friday Yonsei University			
10:00-12:00	Visit Energy Materials Laboratory and Campus Tour Gathering Point @ Main Entrance of Engineering Research Park		

Floor Plan of Engineering Research Park

B1F



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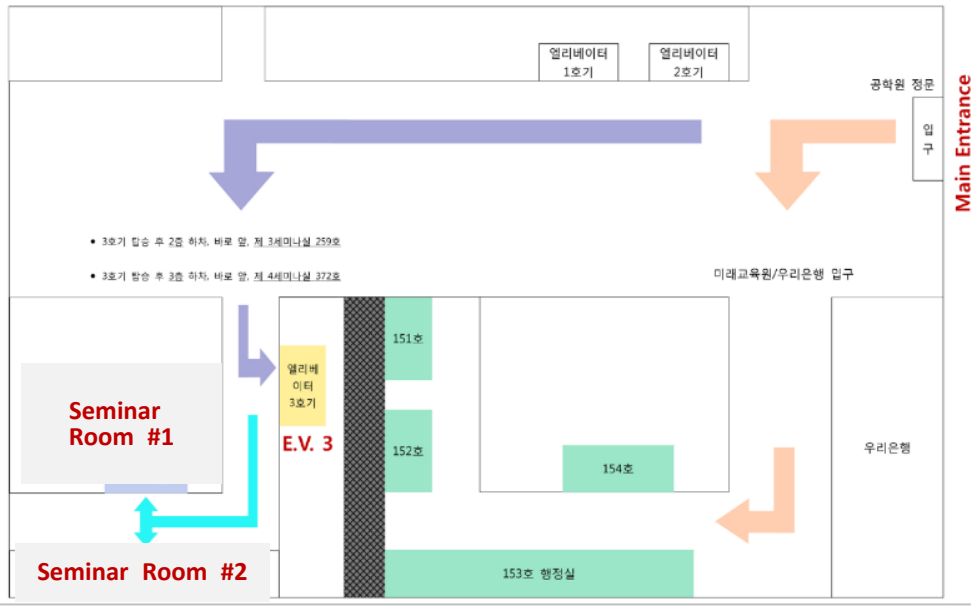

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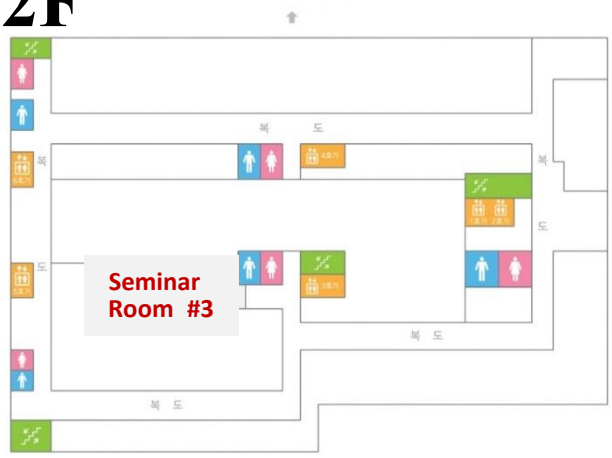

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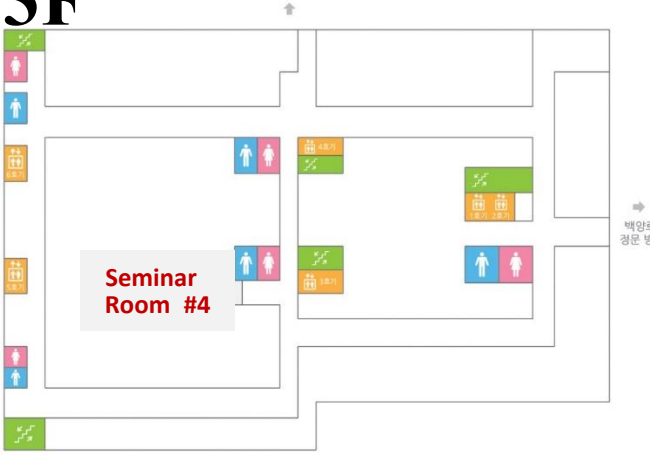


KEYNOTE SPEAKER

January 9th | 09:10-09:55
Main Auditorium (B106)

Prof. Ikuo Taniguchi

Kyoto Institute of Technology, Japan

Bio: Prof. Ikuo Taniguchi received his PhD in Engineering from Kyoto University in 1999. He was an assistant professor at Kyoto Institute of Technology until 2004, then a postdoctoral fellow at MIT until 2007, and then a principal investigator at the Research Institute of Innovative Technology for the Earth until 2012, where he conducted research on CO_2 capture. He continued his research as an associate professor at Kyushu University from 2012 to 2022, and returned to Kyoto Institute of Technology as a full professor in 2022. He has published 70 papers in refereed journals such as Science and holds 13 patents. He is currently playing a central role in various national projects based on polymer chemistry.

Development of Hollow Fiber Membrane Modules with a Thin-Film Composite Structure for CO_2 Capture and the Gas Separation Performance

Abstract: Global warming and climate change are serious global problems that we are facing today, and urgent action is required. Carbon Capture, Utilization and Storage (CCUS) technology has been internationally recognized as the most effective method, along with the development of energy-saving technologies and the promotion of the use of renewable resources. CCUS is a range of technologies designed to capture CO_2 from large sources of CO_2 emissions, such as thermal power plants and steelworks, before it is released into the atmosphere and use it effectively as a valuable resource, or transport it by pipeline etc. to a storage site and inject it into underground or sub-seabed aquifers. Demonstration tests of CCS are currently underway at around 80 sites around the world, and 40 Mt of CO_2 was stored by 2020. However, to achieve the Paris Agreement's goal of keeping the average global temperature increase at the end of this century to less than 1.5℃ above pre-industrial levels, 5 Gt of CO_2 will need to be stored by 2050, which is a very high hurdle. This is due in part to the high cost of CO_2 capture (around 40% of the cost of CCS, Fig. 1) as well as the social acceptance of the project.

KEYNOTE SPEAKER

January 9th | 09:55-10:40
Main Auditorium (B106)

Prof. Ki Bong Lee

Korea University, South Korea

Bio: Ki Bong Lee received his BE and MS from Department of Chemical Engineering, Korea University, Korea in 1999 and 2001, respectively, and PhD from the School of Chemical Engineering, Purdue University, USA in 2005. He worked as a post-Doctoral research associate in Department of Chemical Engineering, Lehigh University, USA from 2006 to 2007. He was a senior researcher at the Korea Institute of Energy Research from 2008 to 2009. He has been a professor at the Department of Chemical and Biological Engineering, Korea University since 2009. He has worked on separation technologies such as adsorption, membrane separation, solvent extraction, etc. for the application to energy and environmental fields. Particularly, he has interest in novel sorption-enhanced reaction for fuel-cell grade hydrogen production, novel adsorbents and adsorption processes for CO2 and CF4 capture, adsorbents and adsorption processes for gas sensor, adsorbents for CO, NOx, and sulfur compounds, and design and optimization of adsorption processes. He published more than 210 domestic and international technical papers and has 45 applied or registered patents. He has served as editors of Journal of Industrial and Engineering Chemistry and Scientific Reports.

Upcycling of Waste Plastic into Porous Carbon Materials and Their Application to Greenhouse Gas Capture

Abstract: Because of the development of industry and the increase in the use of fossil fuels, the concentration of CO_2, a greenhouse gas considered to be the main cause of global warming, is steadily increasing. Among various CO_2 reduction efforts, carbon dioxide capture and storage (CCS) technologies are being developed and applied in various forms. Analyzing the CCS technology, it takes 70% or more of the cost in the capture stage, so it is necessary to develop an efficient capture technology for an applicable CCS technology. Among various CO_2 capture methods, adsorption has the advantages of low energy consumption, flexible process operation, and easy scale-up. Materials such as zeolite, activated carbon, and metal organic framework are being considered adsorbents for capturing CO_2. Porous carbon materials have the advantages of being inexpensive, having excellent thermal/chemical stability, and being able to control the pore structure by varying treatment conditions. This talk will introduce research on synthesizing porous carbon materials with micropores through carbonization and activation of waste plastic discarded after use and applying them to CO_2 adsorption. In addition, research on the application of waste plastic-based porous carbons to the capture of other greenhouse gases will be discussed.

INVITED SPEAKER

January 9th | 11:10-11:40
Main Auditorium (B106)

Prof. Sungyeon Heo

Seoul National University of Science and Technology, South Korea

Bio: Prof. Sungyeon Heo received his BS and MS degrees in the Department of Chemical Engineering at Yonsei University and completed his PhD in the Department of Chemical Engineering at the University of Texas at Austin, USA. He then conducted postdoctoral research in the Department of Electrical Engineering at Princeton University, USA. Currently, he is an assistant professor in the Department of Chemical and Biomolecular Engineering at Seoul National University of Science and Technology. His group is working on colloidal metal oxide nanocrystal-based electrochemical applications, focusing on developing next-generation electrochromic devices and polymer-nanocrystal composite membranes for water electrolysis.

Plasmonic Tungsten Oxide Nanocrystal Thin Films for Next-Generation Electrochromic Windows

Abstract: Indoor thermal regulation is highly important in the building and transportation sectors, as it can reduce heating and cooling energy consumption. Classical electrochromic windows can modulate light transmittance by applying electrochemical potential, which primarily alters visible light modulation through polaronic absorption behavior. However, near-infrared modulation is limited in classical materials. In this presentation, plasmonic tungsten oxide nanocrystals, which exhibit near-infrared modulation due to localized surface plasmon resonance, will be discussed for electrochromic applications. To enhance electrochromic modulation, the crystalline structure and shape anisotropy of tungsten oxide nanocrystals have been studied in detail. First, different crystalline sites exhibit distinct optical activity, leading to the conclusion that different electrolytes produce varying modulation effects. Second, the impact of crystalline anisotropy in hexagonal cesium-doped tungsten oxide nanorods and nanoplatelets on key electrochromic metrics will be explored. Lastly, synthetic approaches to maximize the electrochromic modulation of tungsten oxide nanocrystals will be presented.

INVITED SPEAKER

January 9th | 11:40-12:10
Main Auditorium (B106)

Dr. Seok-Keun Koh

C&G Hitech Co., Ltd, South Korea

Bio: Dr. S. K. Koh received his Ph.D. at Department of Mechanics & Materials Science, Rutgers, the State University of New Jersey, U.S.A., and served as Research Associate at High Pressure Materials Research Lab. At Rutgers Univ. He worked at Ion Beam Engineering Laboratory, Kyoto Univ, Japan as a foreign Professor and Head of Lab. and served at Korea Institute of Science and Technology (KIST) as a Principal Researcher and adjunct Professor of Yonsei Univ. and Korea Univ. in Korea. He has been worked on surface modification and thin film growth by ion beam from his Ph.D. thesis" Enhancing adhesion between Cu thin films and Polyimide by 100keV Ar+ ion irradiation" for 35 years. He has many awards" One in hundred outstanding men in Korea" in 1995, "An Award of New Scientist in Korea" in 2000, "A Best scientist in KIST", in 2000, etc. His surface modification technology was nominated to "Best Seven technologies in Asia, Asiaweek, in 2001 and his inventions relating to surface modification technologies were broadcasted many times from Discovery News and ABC News in the U.S.A., NHK in Japan, and all Newspapers & Broadcast in Korea. He licensed and commercialized the technologies that were invented by him and his colleagues in surface modification by ion beam to more than 30 companies such as LG electronics, Samsung Electro - Mechanics, Plaworks, SamYang Co/,Silion, etc., and he managed companies" P&I Corp." funded by KIST as a CEO from 2002- 2007 and "GL Materials Inc." mainly focused on nano particles formation technology, namely "Nanoparticles on Powder: NPP" as a CEO from 2009- 2017. The applications by the NPP technologies has been transferred to various Korean, Chinese and Japanese companies. After resign the management of the Companies, he has served as CTO of the companies that commercialese his inventions (NPP and surface modifications by ion beam) such as Nanopharmasolutions, in U.S.A., Sandong iCube in China, iCube Global, Daemyung TS, and has managed as an R&D directors at C&G Hitech. Co. Ltd. for the industrialization of his inventions. He has 159 articles and 69 patents.

Functional Carbon Composites with High Mechanical Strength

Abstract: Carbonaceous materials (graphite, CNT, graphene) were modified by Ion Assisted reaction (IAR) in which Ar+ Ion beam is irradiated on the bare carbon powders with reactive gas environments in order to add new hydrophilic functional groups (-OH, - COOH, -CO, NH2, etc.). And metal nanoparticles (Cu, Ag, Ni, Zn, Cu/Zn alloy etc.) on the powders (NPP) are synthesized in physical vapor deposition system to add new metallic functions (antimicrobial, magnetic, electrical conductivity, etc.) in which the metal are deposited on the rotating the powders. The modified carbon powders by IAR and NPP were easily dispersed in water, organic solvent, and any polymer matrices. The carbon composites were synthesized by conventional hot melting process with mixing of the polymer and the modified carbonaceous powders. and their characteristics with various concentrations of powder addition were investigated. Mechanical properties of the polymer composite were not changed much until addition of 40wt.% of graphite, in which graphite polymer composite by conventional chemical surface modification of carbon possesses rapid drops of mechanical properties. Control of the electrical conductivity and thermal conductivity of the composite were successfully carried out by Ni magnetic metal nanoparticles on carbon fiber addition. Physical properties of the composites especially thermal and electrical conductivity, and mechanical properties were explained comparing with the data fabricated by conventional chemical process. Applications of the carbon added composite were presented in terms of fuel cell bipolar plate, LED heat sink, electronic enclosure, etc. and R&D directions of the carbon addition into metal, ceramic and polymer matrices were suggested what we want to cooperate.

Session 1 - Composite Materials and Composite Structures
Chairperson: Prof. Jong Hak Kim, Yonsei University, South Korea

Time: 13:30-15:45, January 9th | **Room: Seminar Room 1 (170E), 1F**

*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.

EA25-306-A

13:30-13:45

Manufacturing of Thermoplastic Mono-Polymer Composite Sandwich Structures with Honeycomb Core

Temuri Latsuzbaya
University of Stuttgart / Diehl Aviation Laupheim GmbH, Germany

Abstract: Thermoplastic mono-polymer sandwich structures with honeycomb cores offer great possibilities for aircraft, automotive, and other transportation applications. These structures have outstanding mechanical performance, a great stiffness-weight ratio and impact resistance and provide a major contribution to environmental sustainability due to their recyclability. Furthermore, the use of thermoplastic materials allows a great reduction of processing cycle times and the integration of additional functional elements such as ribs, inserts, or brackets by means of welding. All processing steps, such as compression molding, thermoforming, and integration of the functional elements, can be combined in a so-called in-line rapid production. Such process optimization leads to energy efficiency, thereby contributing to the reduction of CO_2 emissions.

EA25-381E-A

13:45-14:00

Stacking Sequence Optimization of Composite Laminates for Maximum Fundamental Frequency using Bayesian Optimization Computational Framework

Shih-Ting Yang, **Yu-Jui Liang**
National Cheng Kung University, Taiwan

Abstract: A computational framework combined with the commercial finite element software Abaqus and Bayesian optimization algorithm is proposed as shown in Fig. 1. The proposed computational framework leverages the Gaussian process based-probabilistic capability in Bayesian optimization as a surrogate model for minimizing the computational cost of objective function evaluations in the finite element analysis. The optimization problem in this work is to enhance the maximum fundamental frequency of the composite laminates, which is one of the critical parameters in the design for composite structures. The optimization of stacking sequence selection is investigated and validated by the results obtained from literatures. The effectiveness and efficiency of the proposed Bayesian optimization computational framework in maximizing the fundamental frequency of composite laminates are demonstrated by comparing the optimized results from different optimization techniques through a series of cases including the 8-layer rectangular plates with 11 different boundary conditions and the 10 to 20-layer trapezoidal plates with the same boundary condition. The proposed framework developed in this work has highly potential as an engineering tool to address a broader range of structural optimization in vibration problems.

EA25-305-A

14:00-14:15

Superior Wear Performance of Cocrni Matrix Composite Reinforced with Quasi-Continuously Networked Graphene Nanosheets and In-Situ Carbide

Wenting Ye
Northwestern Polytechnical University, China

Abstract: The biological materials evolved in nature generally exhibit interpenetrating network structures, which may offer useful inspiration for the architectural design of wear-resistant composites. Here, a strategy for designing self-lubricating medium entropy alloy (MEA) composites with high strength and excellent anti-wear performance was proposed through quasi-continuously networked in-situ carbides and graphene nanosheets. The discontinuous coating of graphene on the MEA powder surface inhibits continuous metallurgy bonding of the MEA powders during sintering, generating the typical quasi-continuously networked architecture. A good combination of mechanical properties with high fracture strength over 2 GPa and large compressive plasticity over 30% benefits from metallurgy bonding that prevents crack initiation and extension. The wear rate of an order of 10-6 m3N-1m-1 ascribing to an amorphous-crystalline nanocomposite surface, tribo-film induced by graphene, as well as the

gradient worn subsurface during friction was achieved by the MEA composite, which is an order of magnitude lower than the unreinforced MEA matrix.

EA25-313

14:15-14:30

Sandwich Panels and Polymer Blends from Recycled Polyethylene Terephthalate (PET) and Other Post-Consumer Plastics

Laongdaw Techawinyutham, Kuntida Somprou, Wongsaphak Hongsahin, Souwalauk Na Khampol
King Mongkut's University of Technology North Bangkok, Thailand

Abstract: The exponential increase in global plastic wastes dangerously impacts the environment and human health. In this study, Polyethylene Terephthalate (PET), High-density Polyethylene (HDPE), Polypropylene (PP), and Polymethyl methacrylate (PMMA) were recycled into sandwich panels and polymer blends. Recycled PET (rPET) fibers, with 25 and 50 fibers, were used as the middle layer for the sandwich panels. The face layers were made from the recycled HDPE (rHDPE), recycled PP (rPP), and recycled PMMA (rPMMA). The weak interaction between rPET fibers and the face panels resulted in low mechanical performance. The sandwich panel with rPMMA as the face layers and 25 rPET fibers as the core exhibited good overall mechanical performance. The stiffness of sandwich panels was improved. The polymer blends were prepared using rPET at 70 wt% and other plastic wastes at 30 wt%. The addition of a compatibilizer can enhance the mechanical properties of polymer blends. The rPET/ rPP blend and rPET/ rHDPE blend showed slightly higher mechanical performance compared to the rPET/ rPMMA blend. All polymer blends exhibited higher flexural strength, impact strength, and hardness compared to neat rPET.

EA25-332

14:30-14:45

Finite Element Modeling of Tractor Tire Composite Structure to Analyze Inflation Pressure Effects on Compression

Siwakorn Phakdee and **Chakrit Suvanjumrat**
Mahidol University, Thailand

Abstract: Tractors play a crucial role in alleviating the workload of farmers across various agricultural processes, including land preparation, seed sowing, pest control, and harvesting. However, the direct contact of tractor tires with the soil often results in soil compaction, which adversely affects soil quality. A common approach to mitigate soil compaction is to lower the inflation pressure of agricultural tires, as this increases the tire's contact area and distributes the load more evenly. Nonetheless, reduced inflation pressure decreases the tire's vertical stiffness, thereby elevating the risk of tire damage. This study investigates the effects of inflation pressure on tractor tires by employing the finite element method (FEM) to model their composite structure. The study utilized a composite finite element (FE) modeling technique, demonstrating high accuracy when compared to experimental tire compression tests. An image processing technique was also applied to validate the tire footprint model. The developed FE model exhibited an average error of 8.62% and was subsequently used to examine the effects of inflation pressure, resulting in the creation of a characteristic chart that provides farmers with practical guidance for maintaining optimal tire pressure to ensure efficient operation in cultivated fields.

EA25-309-A

14:45-15:00

New Composite Structures with Integrated Vacuum Insulation in Aircraft Cabin

Vakhtang Latsuzbaya
University of Stuttgart / Diehl Aviation Laupheim GmbH, Germany

Abstract: Passengers of commercial aircraft are spending an increasing amount of time in the aircraft cabin during travel. Therefore, they pay more attention to the comfort of the cabin. In order to achieve a satisfied passenger experience, the aircraft industry is seeking to improve cabin comfort continuously. Some of the main factors that affect passenger comfort are cabin climate, noise and space. With the intention of space increase and simultaneously improvement of the thermal and acoustic situation in the aircraft cabin, the search for better insulation materials led to Vacuum Insulation Panels (VIP).

EA25-327

15:00-15:15

Semi-Analytical Solution of Post-Filling Stage in Vacuum Assisted Resin Infusion

Ahmed Ouezgan, Mouhessine Chahbouni, Abdelghani Saouab, Aziz Maziri, El Hassan Mallil and Jamal Echaabi
Sidi Mohamed Ben Abdellah University, Morocco

Abstract: Vacuum Assisted Resin Infusion (VARI) process has known significant industrial and scientific attentions due to its ability for manufacturing large composite structures with a relatively high fiber volume fraction and low cost. However, it suffers simultaneously from long processing time and non-uniformity in part thickness along the part length due to respectively low pressure gradient between inlet and outlet and the flexible nature of the vacuum bag. One approach to improve thickness uniformity is allowing the excess resin to be drained out through the vent. This phase is called post infusion stage and has major influence on the quality of the part and production time. Therefore, the objective of the present study is to provide semi-analytical solution of resin pressure distribution, fiber volume fraction and part thickness during resin infusion and post-infusion phases in vacuum assisted resin infusion. The results show that the post filling constitutes a major part of the total process time and optimizing this stage can reduce the resin waste and process time and improve the composite part thickness uniformity.

EA25-337

15:15-15:30

Modeling the Pinch-Off Zone for the Handle of a Plastic Bottle via Extrusion Blow Molding Process: An Examination of Weld-Line Quality

Juthanee Phromjan and Seksan Sinbunluekul
King Mongkut’s University of Technology Thonburi (KMUTT), Thailand

Abstract: The extrusion blow molding (EBM) process employed in manufacturing plastic bottles necessitates a robust weld line at the pinch-off zone to ensure the durability of the final products. However, manually configuring this aspect via machine settings is often impracticable. This study seeks to address this challenge by modeling the pinch-off zone and simulating weld-line formation. Leveraging finite element analysis, a comprehensive 3D model of the pinch-off zone was meticulously developed. Subsequently, the model's fidelity was validated through experimental validation. Furthermore, simulations were conducted with varied key process parameters, including flash pocket characteristics, aiming to gauge their respective impacts on weld-line continuity. The findings of these simulations were instrumental in identifying critical factors influencing weld-line quality. This study represents a significant advancement in the manufacturing of high-quality plastic bottles, offering a precise approach to model and simulate critical weld-line regions, thereby facilitating the evaluation and enhancement of weld-line quality.

EA25-352

15:30-15:45

Investigating the Effects of Partial Replacement with Sewage Sludge, Calcined Clay, and Waste Marble Powder on Cement Paste properties

Abdul Rahim Al Umairi, Hamad Al Kindi
University of Technology and Applied Sciences, Oman

Abstract: The cement production process significantly contributes to greenhouse gas emissions, accounting for 25% of total industrial emissions. This study systematically examined new, underutilized materials—sewage sludge ash (SSA), marble waste (MW), and calcined clay (CC)—to evaluate their effects when partially replacing white Portland cement (WPC) in cement paste formulations. Various replacement proportions (10%, 20%, and 30%) were tested, along with different treatment temperatures (600° C, 630° C, 730° C, and 850° C) for SSA and CC. To gain a deeper understanding of the resulting materials, analyses such as XRF, XRD, and SEM were conducted. The highest compressive strength recorded for the 28-day cured cement paste was 91 MPa when 20% SSA (treated at 600° C) was used, compared to just 53 MPa for the control sample. Conversely, CC exhibited minimal enhancement in compressive strength, while MW had detrimental effects. Additionally, replacing WPC with SSA and CC at 9% and 21% resulted in slight improvements in compressive strength. This research highlights the potential of utilizing underexploited materials like SSA to improve the mechanical and chemical properties of cement paste, indicating that further investigation is necessary to enhance environmental sustainability.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Session 2 - Materials Chemistry and Chemical Engineering

Chairperson: Prof. Ikuo Taniguchi, Kyoto Institute of Technology, Japan

Time: 13:30-15:30, January 9th | **Room: Seminar Room 3 (259), 2F**

*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.

EA25-375E-A

13:30-13:45

Development of Acrylamide-Derived Heteroatom-Enriched Activated Carbon for CO_2 Adsorption

Moon-Kyung Cho, Ki Bong Lee
Korea University, South Korea

Abstract: The increasing concentration of CO_2 in the atmosphere is a major contributor to climate change, posing severe threats to humanity and environment. Among various strategies for addressing this challenge, carbon capture and storage (CCS) has gained significant attention due to its potential for direct integration with existing industrial facilities. In the CCS process, the CO_2 capture step accounts for the largest portion of the overall cost, necessitating the development of more efficient CO_2 capture technologies to enhance the feasibility of CCS. Adsorption-based CO_2 capture has emerged as a promising alternative to conventional absorption methods, offering advantages such as simple operation and relatively low energy requirements for regeneration. These benefits address the limitations of absorption methods, which often involve equipment corrosion and high energy demands for regeneration. Various porous materials, including metal-organic frameworks, zeolites, and activated carbons, have been explored for adsorption-based CO_2 capture. Among these, activated carbon stands out for its straightforward synthesis and low production costs. However, further improvements in CO_2 adsorption performance are required for it to compete with other advanced materials. Heteroatom doping has been demonstrated as an effective strategy to enhance the CO_2 adsorption performance of activated carbon. Nevertheless, traditional doping methods often involve additional materials and complex procedures, diminishing the inherent advantages of activated carbon. In this study, heteroatom-enriched activated carbon was synthesized without the need for additional doping materials and processes, using acrylamide as a precursor due to its intrinsic heteroatoms. We investigated the influence of the textural properties and heteroatom content of the activated carbon on its CO_2 adsorption performance.

EA25-601

13:45-14:00

Study of Copper Separation from Ternary Black Powder Leaching Solution Using P204 (D2EHPA) Multistage-Extraction

Edianta Jaya, Shengxi Wu, Yuhua Li, Dunpei Wei and Yaqian Zhu
Central South University, China

Abstract: Nickel and cobalt recovered from ternary leaching solutions have high market value and stability. In addition to preventing environmental damage, this recovery process is also very useful in the application of power energy storage and electric vehicles. Solvent extraction is an effective and selective method for separating elements in ternary leaching solutions. This research focuses on the separation stage of feed solution impurities, especially Cu, by optimizing the extraction process using multi-stage extraction. This method, which is adapted to a laboratory scale, mixes the feed solution with saponified P204 (prepared with NaOH) and then stirred until phase separation into a loaded organic phase and raffinate occurs. The use of P204 with 3-stage extractions with O/A= 1.5/1 and pH= 4.5 succeeded in separating 99.96% extraction of Cu with a primary yield of Cu value of 99.999%. This solvent extraction also successfully separated 99.23% of Mn, Ca=95.62%, and other impurity metals such as Fe, Zn, Li, and Si reaching a final concentration in the raffinate solution of only 10-3 g/L. The results of this research are very useful in the subsequent extraction process in the form of separating the valuable elements nickel and cobalt. This method can potentially overcome environmental problems resulting from the disposal of NCM battery waste in the metallurgical field.

EA25-336-A

14:00-14:15

Structural Engineering of Core-Shell $Ni_3B@Ni(BO_2)_2$ on V_2MoO_8 (0D@2D/1D) Composites: Advanced Strategies for Enhancing High Energy Density in Asymmetric Supercapacitors

Ramaraj Sukanya, Ahamed Milton, Raj Karthik, Carmel Breslin, Jae-Jin Shim
Maynooth University, Ireland

Abstract: The development of hierarchical core-shell structures and their composites, composed of multicomponent metal boride/metal oxide-based electrode materials, is a promising strategy to enhance SC performance. These composites offer excellent electrical conductivity, abundant reaction sites, and increased surface area for efficient charge transfer. In this study, we present the synthesis of core-shell $Ni_3B@Ni(BO_2)_2$ (0D@2D) integrated with V_2MoO_8 (VMO) rods (1D), forming $Ni_3B@Ni(BO_2)_2$/ V_2MoO_8 (0D@2D/1D) composites on a flexible carbon cloth (CC) substrate for use in SCs. The 1D-VMO rods were prepared from V-doped MoSe2 nanosheets via hydrothermal synthesis and calcination, while the $Ni_3B@Ni(BO_2)_2$/ V_2MoO_8 composite was produced through a liquid-phase method. The composite's structure, composition, and morphology were characterized using XRD, XPS, FE-SEM, and TEM. The unique core-shell architecture, which features abundant electroactive sites for redox reactions, enhanced faradic properties, reduced electron and ion diffusion paths, and improved contact between the electroactive material and electrolyte, results in a superior specific capacitance of 698 F g -1 at a current density of 1 A g^{-1}. The composite also demonstrates notable cyclic stability, retaining approximately 75.1% of its capacitance after 10,000 cycles at 10 A g^{-1}, outperforming pristine VMO, Ni_3B, and other $Ni_3B@Ni(BO_2)_2/V_2MoO_8$ ratios. Furthermore, the designed ASC device $Ni_3B@Ni(BO_2)_2$/ V_2MoO_8/CC//rGO achieved a maximum energy density of 40.5 Wh kg^{-1} at a power density of 800 W kg^{-1}, with an operational voltage of 1.6 V and a maximum power density of 16,000 W kg^{-1} at an energy density of 23.5 Wh kg^{-1}. The device also demonstrated a capacitance retention of 79.30 % and Coulombic efficiency (99.9 %) after 8,000 cycles, highlighting its potential for future energy storage applications.

EA25-602

14:15-14:30

Enhanced Purification of Mixed Hydroxide Precipitate Leachates via P_{204}: A Study on Process Efficiency

Kemal Fariz Ramadhani, Hu Yi, Dong Xizhi, Wang Qinmeng
Central South University, China

Abstract: The purification of mixed hydroxide precipitate leaching solution from impurities was conducted via solvent extraction using the commercial extractant di(2-ethylhexyl) phosphoric acid (P_{204} or D2EHPA). The impurities that were removed are Mn^{2+}, Cu^{2+}, Ca^{2+}, Mg^{2+}, and Zn^{2+}, while the desired metals remained in aqueous phase which are Co^{2+} and Ni^{2+}. Solvent extractions were studied on a batch scale to improve the effect of organic-to-aqueous phase ratio, extractant concentration, saponification rate, and feed solution pH to the removal of impurities. High selectivity of impurities was obtained at a phase ratio organic to aqueous of 1.6:1, extractant concentration of 30 vol%, with saponification rate of 40%, and feed solution pH of 5. The extraction rate achieved for Mn^{2+}, Cu^{2+}, Ca^{2+}, Mg^{2+}, and Zn^{2+} are 88.46%, 82.24%, 95.21%, 38.10%, and 99.99% respectively while the co-extracted of Co^{2+} and Ni^{2+} are 17.76%, and 12.52%.

EA25-325

14:30-14:45

Pectin and Chitosan Biofilm Composites Enriched with Rambutan Peel Anthocyanins for Colorimetric Intelligent Food Packaging

Arum Widyastuti Perdani, Supriyadi, Bambang Purwono, Arima Diah Setiowati
Universitas Gadjah Mada, Indonesia

Abstract: Colorimetric intelligent food packaging requires an environmentally friendly biopolymer matrix with robust physical properties to retain anthocyanins as sensitive dyes effectively. This retention is crucial for enhancing the colorimetric response used in monitoring food freshness. This study aimed to improve the physicochemical properties of biofilms for intelligent packaging by utilizing polysaccharide matrix carriers enriched with anthocyanins extracted from rambutan peels. Biofilms were prepared

from pectin (P), chitosan (C), pectin-chitosan (PC), pectin-anthocyanins (PA), chitosan-anthocyanins (CA), and various order of mixing biofilm solution consists of pectin, chitosan, and anthocyanins, including pectin-chitosan-anthocyanins (PCA), pectin-anthocyanins-chitosan (PAC), and chitosan-anthocyanins-pectin (CAP). The results demonstrated that the CAP biofilm exhibited favorable tensile strength (TS) of 2.3564 MPa and elongation at break (EAB) of 56.40%. Additionally, the CAP biofilm retained a significant number of total anthocyanins after drying, with a content of 19.01 mg/100g, a total phenolic content (TPC) of 3439.63 mg/100g, and a radical scavenging activity (RSA) of 95.54%. FTIR spectroscopy revealed spectral bands in the 3300-3600 cm^{-1} and 1200-1250 cm^{-1} regions, suggesting interactions or bonds between anthocyanins and either pectin or chitosan, possibly involving hydrogen bonding or modifications in C–O group structures. The color of the biofilms changed across a pH range of 5–10, transitioning from red pink to pale yellow and finally to greenish yellow. Based on these findings, the CAP biofilm is identified as a promising candidate for colorimetric intelligent packaging applications.

EA25-605

14:45-15:00

Comparative Study of LiPF6, LiTFSI, and LiBOB Electrolytes for Solid Polymer Electrolyte (SPEs) Cellulose: Evaluating Compatibility and Performance

Mohammad Wahyu Andriyan, **Muhammad Ragil Saputra**, Endah Puji Astuti, Zalfa Alfatinnisa, Rosydatul Khoiriyah, Paskaline Sophie Rinjani, Citra Intan Rizky Azzahra, Ilham Alkian
Diponegoro University, Indonesia

Abstract: This study presents a comparative analysis of LiBOB, LiPF6 and LiTFSI electrolytes for cellulose-based solid polymer electrolytes (SPEs). The cellulose-SPEs were evaluated based on their mechanical and electrochemical performance. Our findings reveal that cellulose-LiTFSI exhibited the highest electrolyte uptake (784%) and electrolyte retention (88.69%), followed by cellulose-LiPF6 (690% uptake and 87.34% retention), and cellulose-LiBOB (355.33% uptake and 78.04% retention). Morphological research reveals all SPEs exhibit porous structures and demonstrate contact with the electrolyte, however LiBOB cellulose does not effectively absorb the electrolyte. Heat treatment at 150° C for 4 hours demonstrated significant differences in thermal stability, where cellulose-LiBOB maintained structural integrity with negligible alteration in color, while cellulose-LiPF6 and cellulose-LiTFSI darkened and underwent decomposition. The cellulose LiTFSI has the greatest electrochemical stability, with a potential window of 4.25 V, and the highest ionic conductivity, measuring 1.359 x 10-6 C/m. Conversely, cellulose LiBOB (3.37) has better electrochemical stability than LiPF6 (2.91 V), while cellulose LiBOB has the lowest ionic conductivity (1.424 x 10-7 C/m). These results suggest that electrolyte selection profoundly impacts the mechanical and electrochemical properties of cellulose-based SPEs, with LiTFSI showing best possibility for potential application in lithium-ion batteries.

EA25-335

15:00-15:15

pH-Dependent Visible Light Photocatalytic Efficiency of Aminophenol-Functionalized ZnO for Brilliant Blue G Degradation

Rogie I. Bautista, Mark Ely A. Namoro, Princess Vinia Putulin, Aces Joseph L. San Pedro, Ken Aldren S. Usman, and **Yasmin D.G. Edañol**
University of the Philippines, Philippines

Abstract: Zinc oxide (ZnO) is a common photocatalyst for dye degradation, but its efficiency is limited by surface properties, photocorrosion, and pH sensitivity. This study functionalized ZnO with 2-aminophenol (ZnO-AP) to enhance dye adsorption and stability under varying pH. FTIR, XRD, and UV-Vis confirmed successful synthesis, with ZnO-AP showing a reduced band gap for improved visible light absorption. Photodegradation tests using Brilliant Blue G (BBG) revealed that ZnO-AP has the highest efficiency (36.17%) at pH 4, driven by strong electrostatic interactions. Performance decreased at pH 7 and 11 due to reduced dye adsorption, especially at basic pH with electrostatic repulsion. Functionalization also protected ZnO against photocorrosion, improving stability in acidic conditions. These results highlight 2-AP functionalization as a promising strategy to enhance the photocatalytic performance of ZnO across pH ranges.

EA25-604

15:15-15:30

Utilization of Geothermal Waste to Synthesize Janus Nanosilica as An Enhanced Oil Recovery (EOR) Material

Mohammad Wahyu Andriyan, Zahrah Salsabila Nalle, Aninda Farhannisa, Riski Wahyu Aprianto, Tika Pratiwi
Central South University, China

Abstract: The Janus nanosilica has excellent interfacial properties and shows great promise in Enhanced Oil Recovery (EOR). In this research, geothermal waste from silica scaling utilized to synthesis Janus nanosilica (JNS) using the Pickering emulsion method. SEM, XRD and FTIR characterization were carried out to determine the characteristics of the material. The effectiveness of JNS as EOR material was confirmed by stability and contact angle characterization. The characterization results indicates that JNS was successfully carried out, which was indicated by changes in the functional group from O-H to C-H, C=O and S=O. The JNS shows a yellowish white color and possesses a granular shape. Moreover, the XRD characterization indicated that the crystal structure remained unchanged throughout the synthesis procedure. JNS has various levels of stability. Materials with lower concentrations are more stable. Moreover, JNS is efficiently employed to alter the surface properties to shift from oil-wet to water-wet, as seen by a reduction in the contact angle. The greatest reduction observed when the highest concentration is utilized with the result was from 131.74° to 39.77o.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Session 3 - Materials Physics and Materials Mechanics
Chairperson: Prof. Sungyeon Heo, Seoul National University of Science and Technology, South Korea

Time: 13:30-15:30, January 9th | **Room: Seminar Room 4 (372), 3F**

*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.

EA25-362E-A

13:30-13:45

The Controllable Synthesis of Ultra-Long Ag_2Te Quantum Wires Applicable in TFTs

Yanjin Tang, Mose Park, Zhiyi Lyu and Hoo-Jeong Lee
Sungkyunkwan University, South Korea

Abstract: This study focuses on the controlled synthesis of ultrathin, super-long Ag_2Te nanowires as quantum-confined semiconductor materials for thin-film transistor (TFT) applications. Utilizing Te nanowires as templates, we achieved precise control over Ag_2Te morphology, resulting in nanowires with diameters of 8-10 nm and lengths of 50-100 μm. Characterization using STEM and EDS confirmed uniform elemental distribution and high crystallinity, while UV analysis indicated a bandgap of approximately 3.2 eV, verifying the quantum confinement effect. These properties make Ag_2Te nanowires highly suitable for applications requiring stable, flexible, and high-performance semiconductor materials, marking a significant step forward in scalable TFT manufacturing.

EA25-331-A

13:45-14:00

On-Demand Inverse Design of Multi-Functional Nano Patterns by Multi-Physics Artificial Intelligence and Light

In Ho Cho and Ashish Chapagain
Iowa State University, USA

Abstract: In nature, we can easily find multi-functional nano-scale surfaces that are realized by modulating nanopatterns, featuring transparent and bactericidal characteristics. A decisive enabling factor is the height distribution of nanopatterns. To mimic it, recent advancements can be a good means, but they often require laborious complex procedures, hindering fast manufacturing. This presentation will cover a novel computational framework that can enable the on-demand inverse design of multi-functional nano patterns by light. The framework's hybrid intelligence approach (i.e., a combination of human and artificial intelligence (AI)) can help learn rules of multi-physics processes behind the light-controlled nano patterning and enrich training data sets. The framework's inverse machine learning model can guide the required light intensity for the target heights of liquid in nano templates. In sum, the multiple functionalities can include nano-scale color, frictions, and bactericidal properties, all realized by the AI. Feasibility tests underpin the promising capability of the framework that can potentially enable more multi-functional nano-scale surface properties. This computational framework will serve as a multi-physics surrogate model to help accelerate fast fabrications of nanopatterns with light and AI.

EA25-370

14:00-14:15

Polymer Composite Based No-Core Fiber Structure as Refractive Index Sensor

Nur Najahatul Huda Saris, Nazirah Mohd Razali, Toshimi Fukui, Takaaki Ishigure, Marinah Othman, Azura Hamzah and Nurul Ashikin Daud
Universiti Teknologi Malaysia, Malaysia

Abstract: This study theoretically proposes a refractive index (RI) sensor based on a polymer composite with a no-core fiber (NCF) design structure. Sensor designs with diameter variations of 125 μm, 105 μm, and 85 μm are simulated using the Wave Optics Module of COMSOL Multiphysics® software. The sensors are characterized within an analyte range of 1.470 RIU to 1.500 RIU, at intervals of 0.005 RIU. The results demonstrate effective interaction between the structure and the sensing medium. The highest recorded sensitivity is 4×10^{-6} (dimensionless) for the 85 μm sensor, followed by 2×10^{-6} for the 105 μm sensor, and 1×10^{-6} for the 125 μm sensor. This study offers

valuable insights, guiding the optimal design of polymer-based RI sensors for future environmental monitoring, chemistry, and biomedicine applications.

EA25-374-A

14:15-14:30

2D Perovskite-Driven Nanocomposites in Negative Capacitance FET for Flexible Low-Power Application

Se Yeon Park, Moonjeong Jang, Jin Kim, Sam Yeon Cho, Sang Don Bu, Saewon Kang, Soonmin Yim, Sun Sook Lee, Dae Ho Yoon, and Ki-Seok An
Sungkyunkwan University, South Korea

Abstract: Two-dimensional (2D) layered nanosheets have emerged as a promising material for electronic applications due to their exceptional structural and morphological properties. Unlike other low-dimensional fillers like nanoparticles and nanowires, the high aspect ratio of 2D plate-like inorganic fillers significantly enhances their dielectric properties by reducing surface energy and preventing the formation of thermal and electromechanical breakdown paths under electric fields.

EA25-606-A

14:30-14:45

A Finite Element Analysis of Cold Deep Drawing of Al Alloy Considering Friction Condition and Corner Design of Plunger

I Putu Widiantara, **Warda Bahanan**
Yeungnam University, South Korea

Abstract: This study presents an innovative methodology that integrates experimental investigations with finite element simulations to ascertain the validity and reliability of Al 3104 sheet metals during cold deep drawing. Focusing on the nose plunger radius and coefficient of friction at a fixed speed and temperature (25 ◦C), five different scenarios are utilized to simulate the optimum parameters. Through a detailed strain history analysis from simulations, the initiation of bending in the corner is precisely identified, with a validation achieved through a strain analysis obtained via digital image correlation. The study delves into the influence of strain and strain rate on the microstructures and mechanical properties near the corner region. It highlights the superior efficacy of strain-based criteria in characterizing deformation behavior. Notably, the strain distributions during the onset of bending and severe bending align remarkably well with the established simulation data. In brief, this work introduces an integrated approach that harmoniously combines computational simulations with empirical observations, resulting in significant ramifications for precisely comprehending and forecasting the strain distribution in metal forming operations.

EA25-326-A

14:45-15:00

Predicting the High Strain Rate Behavior of Alumina Using Unified Mechanics Theory: An Fem-Micromechanics Approach with Pre-Cracked RVE

Brahmadathan V B and C Lakshmana Rao
Indian Institute of Technology, India

Abstract: Micro-mechanics-based constitutive models offer a deeper physical understanding of a material's mechanical behaviour. In this work, a constitutive model is developed by considering the micro-mechanical behaviour of alumina. This is achieved by simulating the micromechanical behaviour within a Representative Volume Element (RVE) consisting of pre-crack and wing crack models using the Finite Element Method (FEM). These simulations convert microscopic insights into a macroscopic constitutive model, capturing the overall mechanical response of alumina. Various crack lengths (function of grain size), crack distribution (Normal, Weibull and exponential distributions) and confining pressures are considered in the RVE and periodic boundary conditions are applied to the RVE. The stress near the crack tip is monitored from the FEM simulations under compression loading, and wing cracks propagate from the pre-existing crack whenever the stress near the crack tip is greater than the tensile strength of the material (crack propagation criteria). The stress near the crack tip and elastic modulus are formulated as a function of crack length, confining pressure, and crack density (RVE size) from the FEM simulations of various combinations of crack length and confining pressure. In this constitutive model, a crack growth law includes the strain rate effect, and Unified Mechanics Theory (UMT) quantifies the material's damage. Using UMT, the entropy generated due to various energy dissipating mechanisms, such

as energy dissipated during crack propagation and friction sliding due to the crack surfaces, is calculated and then converted to the Thermodynamic State Index (TSI), which varies from zero to one. The developed model can predict the mechanical behaviour of alumina at higher strain rates, and it is a thermodynamically consistent model since the damage in the material is derived from entropy.

EA25-314

15:00-15:15

Numerical Investigation on Failure Mechanism of Welding Reinforced Joint for Fiber Reinforced Thermoplastic Pipe

Jingwen Ren, Hanxiang Wang, Binghao Song, Yu Zhang and Heng Zhang
China University of Petroleum (East China)

Abstract: The various joints employed in high-pressure reinforced thermoplastic composite pipes (RTPs) face several challenges, including large outer diameters, complex traversal structures, and susceptibility to corrosion. To address these issues, this paper proposes a welding-reinforced joint structure and investigates its failure mechanism under tensile loading. Based on the 3D Hashin failure criterion, VUMAT subroutines were developed to model the exponential damage evolution of both unidirectional fiber-reinforced and woven composites. A three-dimensional finite element mode was established to perform dynamic analysis under tensile conditions, incorporating a cohesive zone model and VUMAT. The analysis results show that as tensile displacement increases, the bonding interface undergoes gradual debonding, with separation starting at the ends of the joint and propagating toward the middle. Once the interface is fully debonded, the high-density polyethylene (HDPE) in the welding region fails immediately. The maximum failure factors for both the RTP and the joint occur at the edges of the remaining bonding interface. his finding is consistent with the dynamic pattern of interface damage and failure.

EA25-348

15:15-15:30

Tensile Property Enhancement by Laying the Continuous Carbon Fiber During 3D Printing Process

Wongsathorn Rattanapreechachai, Kanjanaphorn Chansoda and Watcharapong Chookaew
Mahidol University, Thailand

Abstract: Fused Deposition Modeling (FDM) is widely used in additive manufacturing. The main limitations of 3-Dimentisonal (3D) printing are the expansive cost of the material and its low strength as compared to the traditional molding process. The supported material was more expensive because of the extrusion process. The high surface roughness in the nature of 3D printed objects is the principal reason for mechanical property weakness. To eliminate such problems, a pellet-based 3D printer coupled with the layup fiber technique was introduced in this preliminary study. The obtained result indicated that the sample produced by the pellet-based printer had the highest mechanical strength in the machine direction. A reduction in tensile strength was found at another raster angle. After considering the differences between carbon fiber (CF) formats, it was found that chopped fiber was ineffective in terms of printed strength. At the same time, the layup fabric type and continuous fiber could promote better mechanical properties. When analyzing the ratio of maximum strength/fiber weight, it should be noted that continuous fiber presented the highest reinforced efficiency.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Session 4 - Functional Composite Materials and Building Materials

Chairperson: Assoc. Prof. Abdul Rahim Al Umairi, University of Technology and Applied Sciences, Oman

Time: 16:00-18:00, January 9th | **Room: Seminar Room 1 (170E), 1F**

*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.

EA25-343

16:00-16:15

Mechanical, Durability and Thermal Performance of Cementitious Composites with Industrial By-Products

Andreas Kyriakidis, Hassan Jaber, Rafail Panagiotou, Antroula Georgiou, Ioannis Ioannou, Apostolos Michopoulos
University of Cyprus, Cyprus

Abstract: Serious efforts are currently undertaken to produce sustainable composite building materials by exploiting industrial by-products. This study examines the use of industrial by-products, specifically limestone filler and silica fume, as alternatives to cement and fine aggregates (washed or non-washed sand), for the production of a novel sustainable cementitious masonry block. The research involved the design of various mixtures with different proportions of the aforementioned raw materials and the evaluation of their mechanical, durability and thermal performance. The findings reveal that, depending on the type of sand used (washed or non-washed), high volumes of limestone filler can be incorporated into the mixtures, without compromising the overall performance of the end-product. This approach not only promotes the use of waste by-product materials in the design and production of composite building materials, but also contributes to more eco-friendly and sustainable construction practices.

EA25-378-A

16:15-16:30

Fabrication of a Sustainable Composite Using Cement Paste Waste, Hemicellulose, Chitosan, and Green Fibers

Ejazulhaq Rahimi, Yuma Kawasaki, Ayane Yui, Yuta Yamachi and Yusei Ishikura
Ritsumeikan University, Japan

Abstract: To address the growing reliance on natural resources and mitigate the environmental impact of construction waste disposal, waste utilization and eco-friendly production methods are essential. This study presents the development of a green composite using cement paste waste (CPW) and hemicellulose, with mechanical properties further enhanced by replacing 50% of the hemicellulose mass with chitosan. Additionally, the incorporation of natural fibers derived from bamboo and banana was investigated for their impact on the composite's performance. The composites were fabricated using a hot-pressing technique, and their mechanical properties were evaluated after a three-day curing period. The findings revealed significant influences of heat pressing, fiber reinforcement, and chitosan addition on the mechanical behavior of the composite. Among these factors, the inclusion of chitosan exhibited the most substantial effect, surpassing both fiber reinforcement and heat pressing. Fiber reinforcement demonstrated a greater impact on flexural strength, while heat pressing was more effective in enhancing compressive strength. Notably, the reduction in composite density caused by the partial replacement of hemicellulose with chitosan was compensated through the hot-pressing process. This research is part of foundational studies in the development of high-performance cement composites integrating chitosan and hemicellulose, offering a sustainable alternative to traditional materials in the construction industry.

EA25-316

16:30-16:45

Coupon-Level Experimental Material Screening of Carbon Fiber-Reinforced Polymers under Thermal Runaway Conditions for eVehicle Applications

Margarita Etchegaray Bello, Özge Özsoy, Jan Schöberl, The Anh Dieter Nguyen, Leo Heidemann, Evan O'Connor, Moritz Schuhmann and Klaus Drechsler
Technical University of Munich, Germany

Abstract: The shift towards electric mobility needs extensive research into battery modules, particularly in relation to safety due to the high energy density of Li-ion batteries. Battery casings must be able to protect the module from external impacts while also containing any potential danger in the event of internal failure. This study presents a comprehensive qualitative screening of thermoset and thermoplastic carbon fiber-reinforced polymers (FRP) used in automotive and aerospace applications under thermal runaway (TR) conditions, to identify suitable materials for battery enclosures. The test setup is an adaptation of the UL 2596 standard with a hexagonal array of seven 21700-format cells. The results indicate that CF-PEEK, CF-PPS, and an aerospace-grade epoxy, CF-EP_{str} (primary structural material) effectively contain the TR with low damage using the current setup. Medium damage was observed in CF-PC, CF-bio-based phenolic, while non-structural CF-epoxy and CF-PA6 failed to contain the TR. This qualitative study serves as an initial screening process to narrow down materials for further in-depth analysis, emphasizing the need for reproducible TR events for accurate assessment.

EA25-320

16:45-17:00

Grapevine Biochar/Biodegradable Polymer Composites and Its Application in Slow-Release Fertilizer

Chun-Wei Chang, Yeng-Fong Shih
Chaoyang University of Technology, Taiwan

Abstract: Our previous research has demonstrated that biochar derived from agricultural waste grapevines (GVBC) can enhance the degradation of polylactic acid (PLA). This effect can be harnessed to control the viscosity and degradation rate of composite materials, aiding in the production of slow-release fertilizers and reducing the persistence of polymers in the soil. Specifically, in the context of slow-release fertilizers, incorporating more than 5 phr of GVBC into the composite material provides a slow-release effect. The release rate of the fertilizer can be adjusted based on the GVBC content to match the different growth stages of plants. The biochar used in this study not only aids in carbon sequestration and improves soil conditions but also accelerates the degradation of PLA, thereby increasing the value of agricultural waste. Utilizing slow-release fertilizers enhances their economic value and makes them more environmentally and plant-friendly.

EA25-363-A

17:00-17:15

Assessing the Technical, Environmental, and Economic Viability of PET Residues as Fine Aggregates and Fibers in 3D Printable Concrete

Fernando Mendoza, Guido Silva, Laura Navarro, Karin Bartl and **Rafael Aguilar**
Pontificia Universidad Catolica del Peru

Abstract: The environmental challenges associated with excessive plastic use have become a pressing global issue. This has driven efforts to recycle plastic waste, notably in applications like textile fibers, straps, and non-food packaging. In this context, this research performs a technical, economic, and environmental evaluation of using polyethylene terephthalate (PET) flakes as a partial replacement for fine aggregate and PET strands as reinforcement fiber in concrete for 3D printing. The methodology consisted of three stages. The first stage involved the physical and chemical characterization of the raw materials. The second stage focused on testing five concrete mix designs to study the effects of using each type of PET residue on the fresh and hardened-state concrete properties: (i) unreinforced printable concrete (control mix), printable concrete with fine aggregate replacement by PET at (ii) 10% and (iii) 15% by volume, printable concrete reinforced with (iv) commercial polypropylene fibers and (v) PET strands. Then, the third stage presented the economic and environmental impact analysis of using this recycled material in concrete mixes. The technical analysis indicates the partial replacement of sand by PET flakes led to a reduction of the unit weight, a significant increase in the slump that may improve printability, but a slight reduction in both the compressive and tensile strength. In the case of the PET strands, the reinforcement with PET caused a negative effect in the modulus of rupture when compared with the unreinforced concrete, so it was discarded for further analysis. The cost analysis evidenced that the high cost of PET flakes resulted in no economic savings per cubic meter of concrete. Finally, the environmental analysis shows a small saving in global warming potential of around 0.9 and 1.4 kg CO_2-eq for 10% and 15% PET aggregate replacement, respectively.

EA25-609-A

17:15-17:30

Structural Features of Self-Healing Asphalt Concrete with Encapsulated Modifier

Inozemtcev Sergei
Moscow State University of Civil Engineering, Russia

Abstract: The objective of this study is to determine the sensitivity of asphalt concrete properties to self-healing, in particular, to assess the degree of restoration of various property indices through the use of encapsulated modifiers. Two types of capsules were studied, one containing sunflower oil and the other containing urethane AR polymer. Analysis of nine different asphalt concrete property indices shows their different sensitivity to self-healing through the use of an encapsulated modifier. Properties characterizing resistance to mechanical stress in a brittle and/or elastic-brittle state are more sensitive to self-healing. The use of capsules with sunflower oil increases the intensity of restoration of splitting strength by 25%, and capsules with AR polymer – by 28%. For the rigidity under dynamic bending of asphalt concrete at 10 ° C, due to the use of capsules with AR polymer, the self-healing index is 0.93, which is 15% more than that of traditional asphalt concrete. Properties characterizing resistance to mechanical impact in the elastic-plastic state have lower sensitivity to self-healing. The use of encapsulated AR polymer allows achieving a greater self-healing effect in comparison with encapsulated sunflower oil for all the considered physical and mechanical properties reflecting the strength properties of asphalt concrete.

EA25-344

17:30-17:45

Use of Alternative Limestone Fillers as Sand Replacement in Mortars

Andreas Kyriakidis, Hassan Jaber, Georgia Maria Christodoulou, Rafail Panagiotou, Ioannis Ioannou, **Apostolos Michopoulos**
University of Cyprus, Cyprus

Abstract: Limestone fillers are increasingly recognized as a sustainable alternative to cement and sand in mortar and concrete mixtures, driven by environmental concerns over the excessive use of natural resources and raw materials. This study investigates the potential exploitation of different limestone fillers, waste products of the quarrying industry, in the production of cementitious composites. The investigation includes the physico-mechanical characterization of a number of mixtures with different percentages of limestone fillers used as partial replacement to sand. The results show that increasing the limestone filler content negatively influences the mechanical performance of the hardened end-products, decreases their density and increases their open porosity. At the same time, increased clay particle content in the limestone filler decreases the workability of the fresh mixtures.

EA25-323

17:45-18:00

Biochar-Containing Microcapsule/Recycled Polyethylene Composite with Temperature Regulation Capabilities

Ting-Jui Yeh, Hong-Hao Chen, Yeng-Fong Shih
Chaoyang University of Technology, Taiwan

Abstract: A phase change material (PCM) was encapsulated within a novel polymer shell to prevent leakage during the phase transition. Additionally, biochar was incorporated into the shell to enhance its thermal conductivity. Initially, methyl methacrylate (MMA) and triethoxyvinylsilane (TEVS) were copolymerized to form a prepolymer. Following this, biochar was added to create phase-change microcapsules with biochar in the shell and octadecane in the core (BC-PCM), resulting in high thermal conductivity. The average size of the BC-PCM was approximately 30 nm. The BC-PCM was then added to recycled polyethylene (rPE) to produce a thermally conductive phase change composite. The results indicated that the tensile strength of the BC-PCM-containing composite was slightly higher than that of pure rPE. However, the impact strength of the BC-PCM-containing composite was lower than that of pure rPE. Moreover, the thermal conductivity of rPE increased after the addition of BC-PCM. The light exposure test showed that the temperature of BC-PCM-containing composite is lower than rPE by 1.4° C (from 26.2° C to 24.8° C) after 15 minutes of light exposure, confirming its thermal buffering properties and temperature regulation capabilities.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Session 5 - Biomedical Materials and Nanomedicine

Chairperson: Assoc. Prof. Seungkuk Ahn, University College Dublin, Ireland

Time: 16:00-18:00, January 9th | **Room: Seminar Room 3 (259), 2F**

*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.

EA25-354-A

16:00-16:15

Elucidate Spatiotemporal Integrin-Mediated Mechanotransduction of Engineered Biomimetic Fibrillar Extracellular Matrices

Seungkuk Ahn
University College Dublin, Ireland

Abstract: Naturally healed wounds do not perfectly regenerate cutaneous connective tissue, and they can often lead to extensive scarring (non-chronic) or can remain unhealed (chronic). As a result, engineering regenerative and cost- effective wound dressings, which is a $10 billion market globally, remains a challenge for primary healthcare. Current regenerative biomaterials mainly rely on empirically-driven and top-down engineered scaffolds that are suboptimal due to their poorly defined components, batch-to-batch variation, often carcinogenic origin, in turn poor reproducibility and biological outcomes. Importantly, how engineered biomaterials influence cellular behaviors across different spatial and temporal scales still remains unexplored since the current research analysis mostly focuses on user-defined few endpoint biological outcomes. To address the above-mentioned challenges, we first bottom-up engineered bio-mimetic fibrous extracellular matrix (ECM) scaffolds by recapitulating cutaneous ECM molecules (e.g., fibronectin, collagens, laminins) and their fibrillar mechanisms. Opposed to the current top-down approaches suffering from undefined compositions and lot-to-lot variations, our platform allows to modulate each ECM composition and fibrillar structure within the scaffolds in a controlled manner. We further systemically investigated how different cells sense and respond to the engineered bio-mimetic fibrous scaffolds at different biological and temporal scales for cell adhesion, migration, gene expression, and tissue morphogenesis. We also assessed how specific integrin-mediated signaling pathways modulate such mechanostransduction, since integrins are key players for regulating ECMs and tissues during physiopathology.

EA25-349-A

16:15-16:30

Recent Advancements in Microneedle Arrays for Transdermal Drug Delivery for Promising Potential of Wound Healing

Suyeon Kim
Pontificia Universidad Católica del Peru

Abstract: The wound healing process involves four overlapping phases: hemostasis, inflammation, proliferation, and remodeling. Current research aims to develop advanced dressing materials that not only protect wounds but also enhance healing, especially for complex cases. Microneedles (MNs) have gained attention for their ability to penetrate the stratum corneum, facilitating the transdermal delivery of various drugs. Their design varies in size and shape to suit different applications and treatment needs, impacting penetration depth and drug delivery efficiency. Recent researches demonstrated the synergetic effects on the drugs delivery on the wound healing using therapeutic drugs with microneedles. In this review, the recent case studies (since 2020) on the drugs delivery with MNs for wound treatments are presented.

EA25-382E-A

16:30-16:45

A Magnetically Embedded Pump-Free LoC-SERS Device Based on Enzyme-Mediated Cascade Reaction for Gastric Cancer-Related D-amino Acids Detection

Kang Shen, Dong Zhang, Hongjun Yin and Xiaowei Cao
Yangzhou University, China

Abstract: Here, we proposed a surface-enhanced Raman scattering (SERS) pump-free microfluidic chip (LoC-SERS) based on a D-amino acid oxidase (D-AAO)-mediated cascade reaction to accomplish rapid quantitative analysis of D-proline (D-Pro) and D-alanine (D-Ala) associated with gastric cancer (GC). Novel Sesame seed globular Fe_3O_4@Au magnetic nanoparticles (SAuMNPs) modified with boronic acid probe 3-mercaptophenylboronic acid (3-MPBA) were first prepared as SERS nanolabels. Then, D-AAO selectively catalyzed D-Pro (or D-Ala) to generate H_2O_2 oxidized borates, with a new Raman peak at 882 cm^{-1}. Based on this, a ratiometric analytical method was

established for the quantitative analysis of D-Pro (or D-Ala). Utilizing a magnet-loaded pump-free LoC-SERS device as the detection platform, the magnetic SERS nanolabels passed through the reaction zone and aggregated under the action of the miniature magnets, generating abundant “hot spots” for signal enhancement. Employing this strategy, D-Pro and D-Ala in saliva could be rapidly and accurately quantified with the limit of detection (LOD) down to the M level. Moreover, with capillary drive technology, the analysis process was automatically integrated, eliminating the need for manual cleaning and heavy syringe pumps, making it highly simple and portable. A satisfactory specificity, stability, and reproducibility were achieved with this LoC-SERS device. Finally, the favorable results of saliva testing in GC patients suggested that this LoC-SERS strategy, combining the advantages of the highly specific enzymatic reaction and magnetic aggregation signal amplification, could provide a promising alternative tool for the dynamic monitoring of D-AAs.

EA25-308-A

16:45-17:00

In Situ Assembly FeS_2-Tetrathiomolybdate Nanosheets for Imaging-Guided Tumor Vascular Collapse and Amplified Catalytic Therapy

Jiajia Yin
Southeast University, China

Abstract: Catalytic therapy has recently gained considerable attention as a novel tumor microenvironment (TME)-responsive treatment. While conventional nano-catalysts have demonstrated the ability to induce the death of tumor cells through oxidative damage via the generation of reactive oxygen species (ROS), their therapeutic efficacy is impeded by several factors, including limited tissue penetration depth and suboptimal catalytic efficiency. Herein, the FeS_2-tetrathiomolybdate (FeS_2-TTM) nanosheet was synthesized via in-situ self-assembled in the specific redox TME using metal precursors of divalent iron and tetrathiomolybdate, and these metal precursors could easily enter tumor cells through vascular penetration to avoid the blood-brain barrier. This nanosheet has been proved to possess peroxidase (POD)-like catalytic activity, which overcomes the limitations of traditional nanoparticals by the bimetallic electron transfer effect in the TME to amplify the catalytic treatment effect. Importantly, it retains the chelating copper characteristics of TTM, and inhibits tumor angiogenesis by depriving the necessary copper in cells and angiogenesis, resulting in vascular embolization to cause tumor blood vessels to collapse. Additionally, it can also act as a nanoprobe that supports both real-time fluorescence imaging monitoring and T1/T2 dual-modality magnetic resonance imaging (MRI). As a promising nanomaterial, this new type of in-situ self-assembled nanosheet provides more varieties for the construction of an integrative platform of tumor diagnosis and treatment.

EA25-312-A

17:00-17:15

SERS Analytical Platform Based on Aptamer Recognition-Release Strategy for Efficient and Sensitive Detection of Protein Markers in Colorectal Precancerous Lesions

Yanwen Zhuang, Fengsong Chen, Xiaogang Qin and Xiaowei Cao
Yangzhou University, China

Abstract: Colorectal cancer (CRC) has become a major challenge in global public health that requires urgent attention and response due to its high incidence and mortality. Regular CRC screening is crucial for early detection of precancerous lesions and CRC. In this study, we constructed a novel surface-enhanced Raman scattering (SERS) analysis platform. This platform uses high-throughput microarray chips as carriers and Au/SnO_2 nanoring arrays (Au/SnO_2 NRAs) as substrates. Based on an aptamer recognition-release strategy, it achieves efficient and sensitive detection of protein tumor markers. During the detection process, due to the strong affinity and high specificity between the aptamer and the target protein, the SERS nanoprobes originally bound to the substrate surface are competitively replaced, and the SERS nanoprobes carrying Raman reporter genes are dislodged, which leads to a decrease in the intensity of the SERS signal. The platform has excellent detection performance, with rapid detection within 15 minutes and limits of detection (LOD) as low as 6.20pg/mL for hnRNP A1 and 6.51 pg/mL for S100P. Clinical samples detected using the SERS platform showed high consistency of results when compared to enzyme-linked immunosorbent assay (ELISA). Therefore, this platform can provide powerful support for the early detection, risk assessment and treatment monitoring of colorectal cancer precancerous lesions, and has a broad application prospect.

EA25-319

17:15-17:30

Design and Analysis of a Composite SACH Foot: Experimental Validation and Finite Element Modeling

Natnaree Worajinda, Juthanee Phromjan, Ravivat Rugsaj, Siwakorn Phakdee and Chakrit Suvanjumrat
Mahidol University, Thailand

Abstract: One of the critical components in the rehabilitation of lower limb amputees is the prosthetic foot. The solid ankle cushion heel (SACH) foot is commonly prescribed to patients due to its ability to reduce impact loading at heel strike, as well as its durability and cost-effectiveness. This research focuses on developing a composite SACH foot using two different polymers. The keel was constructed from Nylon fiber, while the shell, designed to resemble an amputee's foot, was made from Polyurethane (PU) foam. The keel functions as a surrogate for the amputee's bone and is therefore specifically designed and embedded within the shell. The developed SACH foot underwent static testing according to the ISO 10328:2016 standard at various angles. Additionally, it was modeled and analyzed using the finite element method (FEM). Material tests were conducted on both the keel and shell to establish their material models for FEM. The finite element analysis (FEA) demonstrated an average error of less than 15.22%. Moreover, the FEA provided insights into the deformation and stress experienced by both the keel and the shell. This detailed investigation into the structural behavior of both SACH components offers valuable guidance for the future design and development of composite SACH feet.

EA25-390E-A

17:30-17:45

Simultaneous Detection of Urea and Lactate In Sweat Based on Wearable Sweat Biosensor

Haifan Yang, Cao Xiaowei
Yangzhou University, China

Abstract: Urea and lactate are biomarkers in sweat that is closely associated with human health. This study introduces portable, rapid, sensitive, stable, and high-throughput wearable sweat biosensors utilizing Au-Ag nanoshuttles (Au-Ag NSs) for the simultaneous detection of sweat urea and lactate. The Au-Ag NSs arrays within the biosensor's microfluidic cavity provide a substantial surface-enhanced Raman scattering (SERS) enhancement effect. The limit of detection (LOD) for urea and lactate are 2.35×10^{-6} and 8.66×10^{-7} mol/L, respectively. This wearable sweat biosensor demonstrates high resistance to compression bending, repeatability, and stability, and can be securely attached to various body parts. Real-time sweat analysis of volunteers wearing the biosensors during exercise demonstrated the method's practicality. This wearable sweat biosensor holds significant potential for monitoring sweat dynamics and serves as a valuable tool for assessing bioinformation in sweat.

EA25-307-A

17:45-18:00

Assembly of Metal-Phenolic Networks onto Microbubbles for One-Step Generation of Functional Microcapsules

Xin Tan, Renwang Sheng
Southeast University, China

Abstract: The one-step assembly of metal-phenolic networks (MPNs) onto particle templates facilitates the straightforward, rapid, and robust construction of hollow microcapsules. However, the necessity of template removal may impede the refilling of functional species into the hollow interior or the in-situ encapsulation of guest molecules during the shell formation process. In this study, we introduce a simple strategy for the one-step generation of functional MPN microcapsules. Our approach utilizes bovine serum albumin microbubbles (BSA MBs) as soft templates and carriers, allowing for the efficient pre-encapsulation of guest species through the coordination assembly of tannic acid (TA) and Fe^{III} ions. The addition of TA and Fe^{III} causes a conformational change in the BSA MB protein structure, resulting in the formation of semi-permeable capsule shells that enable gas escape from the MBs without the need for template removal. This MBs-templated strategy can produce highly biocompatible capsules with controllable structure and size, and it is versatile enough to be applied to other MPN systems such as BSA-TA-CuII and BSA-TA-Ni^{II}. Furthermore, these MBs-templated MPN capsules can be further functionalized or modified to load magnetic nanoparticles and pre-encapsulate model molecules through covalent bonding or physical adsorption, demonstrating significant potential for biomedical applications.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Session 6 - Thin Films, Coatings, and Surface Modification Technology

Chairperson: Dr. Seok-Keun Koh, C&G Hitech Co., Ltd, Korea

Time: 16:00-18:00, January 9th | **Room: Seminar Room 4 (372), 3F**

*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.

EA25-356-A

16:00-16:15

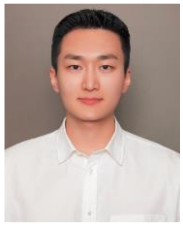
Magnetron Deposited Thin TiOx Films: X-Ray Photoelectron Spectroscopy Study

Rishat Valeev, Andrey Chukavin, Artemii Beltiukov, Tatiana Kartapova
Udmurt Federal Research Center of UB RAS, Russia

Abstract: Currently, one of the most relevant modern electronic devices are memristors. A memristor is an electrical element that can change its resistance depending on the electric charge that has passed through it. Due to its properties, the prospects for using memristors are wide: from neuromorphic memory storage and processing devices to creating supercomputers. Usually the design of the device consists of two electrodes between which a dielectric layer is located. Thin films of non-stoichiometric metal oxides can be used as a functional layer. The main properties of resistive switching depend on the thickness and defectiveness of the functional layer. Also there is a problem of additional oxidation of the non-stoichiometric oxide layer, which can lead to deterioration of the resistive properties and a decrease in the service life of the device.

EA25-368-A

16:15-16:30



Synthesis of Partially Fluorinated Block and Random Copolymers and Preparation of High-Performance, All-Polymeric Thin-Film Composite Membranes

Seung Jae Moon, Jong Hak Kim
Yonsei University, South Korea

Abstract: High-performance, all-polymeric gas separation membranes were fabricated using partially fluorinated block and random copolymers (PTF copolymers) comprising superhydrophobic poly(2,2,2-trifluoroethyl methacrylate) (PTFEMA) and hydrophilic poly(ethylene glycol) methyl ether methacrylate (POEM) chains. The PTF random copolymer, synthesized *via* free-radical polymerization (FRP), showed a disordered and irregular morphology. On the other hand, the PTF block copolymer, synthesized via reversible addition-fragmentation chain transfer (RAFT) polymerization, exhibited a distinct self-assembled cylindrical morphology that can serve as efficient gas transport channels enriched with ether oxygen. Both copolymers showed similar CO_2 permeance due to their similar CO_2 diffusivity and solubility. However, the block copolymer demonstrated significantly lower N_2 permeance than the random copolymer, leading to nearly quadruple the CO_2/N_2 selectivity. This improvement in selectivity was corroborated by molecular dynamics (MD) simulations, which indicated reduced N_2 diffusivity in the block copolymer, reflected by its lower mean squared displacement. The PTF block copolymer membrane achieved exceptional gas separation performance with CO_2 permeance of 1950 GPU and CO_2/N_2 selectivity of 34.3, along with CO_2/CH_4 selectivity of 12.4, surpassing industrial standards for CO_2 separation and capture (CO_2 permeance > 1000 GPU, CO_2/N_2 selectivity > 20).

EA25-350-A

16:30-16:45

Mechanical Properties and Durability of MXene Films

Abdallah Hamouda, Baosong Li, **Kin Liao**
Khalifa University of Science & Technology, United Arab Emirates

Abstract: Two-dimensional (2D) materials, such as graphene, are thin-layered materials consisting of a single or a few layers of atoms. 2D materials are attractive for their potentially diverse applications in key technological areas due to their unique properties in terms of electrostatic efficiency, mechanical strength, tunable electronic structure, and optical transparency. Isolation/synthesis of graphene from its precursor some twenty years ago has opened the door for the discovery and exploration of other emerging 2D materials; more than 2,000 of them that can be easily exfoliated have been discovered or synthesized to date, and yet their physical and chemical properties are largely unexplored. In this talk, we focus on studying the mechanical properties of

thin films of $Ti_3C_2T_x$ MXene. Effect of fabrication technique, size (thickness), strain rate, solution concentration, packing density, as well as annealing temperature on the mechanical behavior and fracture toughness of the MXene thin film will be reported. In addition, we will also report the durability of MXene composite film under moisture environment for the purpose of effective electromagnetic interference (EMI) shielding. These fundamental understandings on the mechanical properties/behavior of Mxene will enable this class of 2D materials to be incorporated into composites for a wide range of applications.

EA25-345E-A

16:45-17:00

Fabrication of All-Polymeric Thin-Film Composite Membrane for Hydrogen Separation via Reverse Method

Young Jae Son, Jong Hak Kim
Yonsei University, South Korea

Abstract: With the increasing need to achieve a net-zero society, hydrogen has been actively researched as one of the renewable energy sources with high potential. Industrial gases such as coke oven gas mainly contain hydrogen and other substances like CH_4. Membrane separation technology can separate these materials at a low cost, small carbon footprint, and without energy consumption. However, fabricating thin-film composite(TFC) membranes with polymeric materials is challenging due to the materials' similarity in solubility parameters. Herein, we report a reverse fabrication method that allows us to fabricate TFC membranes using polymeric materials with similar solubility parameters without dissolving. The TFC membrane was prepared by spin-coating the Matrimid layer and adding porous polysulfone support by non-solvent induced phase separation(NIPS). Then, PDMS was used to block the defects of thin matrimid layer. The fabricated membrane showed an H_2 permeance of 27.9 GPU and H_2/CH_4 selectivity of 69.3, with permeance and selectivity adjustable by controlling the delay time during the NIPS procedure.

EA25-376-A

17:00-17:15

Antimicrobial Non-Woven Fabrics Including Cu Nanoparticles Synthesized Using Physical Vapor Deposition on Polypropylene

Sanghoon Lee, Chang-Hyun Kim,Ho-Seok Lee, Sang-Jun Lee, Min-Ho Shin, Min-Woo Choi, Young-Woong Noh, Seung-Woo Choi, Ju-Sung Park and Seok-Keun Koh
C&G Hitech Co., Ltd., South Korea

Abstract: A porous nonwoven fabric with antimicrobial properties was manufactured by depositing copper metal nanoparticles onto moving polypropylene powder using a PVD method at a concentration of 0.3 wt.%. Following deposition, the material was diluted and melt-spun. The dilution ratio consisted of mixing 1 part by weight of polypropylene containing the deposited copper metal nanoparticles with 9 parts by weight of unmodified polypropylene. Micron-sized nozzles were employed to form microfibers, resulting in a three-dimensional irregular porous structure. The polymer membrane produced utilizing this method demonstrated that the metal nanoparticles were uniformly dispersed without re-agglomeration, maximizing antimicrobial efficacy even with a minimal concentration of metal nanoparticles. To evaluate the antimicrobial performance, tests were conducted against Staphylococcus aureus, Klebsiella pneumoniae, Salmonella typhimurium, Pseudomonas aeruginosa, and methicillin-resistant Staphylococcus aureus. The results indicated a 99.9% bacterial reduction in bacterial counts after 18 hours in all cases. Furthermore, to assess safety, leaching tests of copper nanoparticles and cytotoxicity assays using Human Lung Fibroblasts were performed. The leaching of copper nanoparticles reached a maximum of 1.098 μg/kg under extreme conditions, while the maximum reduction in cell viability was 22%. The antimicrobial nonwoven fabric produced using this methodology possesses excellent antimicrobial efficacy and safety, enabling its application in various products such as masks, air filters, band-aids, wet wipes, cleaning cloths, and dishcloths.

EA25-339-A

17:15-17:30

Environmentally Friendly Silica-Based Material: Surface Modification for Fluid Repellency through Slippery Properties

Linda Karlina, Masaki Ujihara
National Taiwan University of Science and Technology, Taiwan

Abstract: Traditional approaches to creating omniphobic surfaces involve fluorinated compounds, but environmental concerns have shifted attention to fluorine-free

alternatives. This study explores surface modification to increase durability and resistance to water and oil, with a focus on developing omniphobic properties. Silica-based materials, due to their flexibility, biocompatibility, and cost-effectiveness, are emerging as promising candidates for fluorine-free coatings. Using a simple sol-gel method with tetraethyl orthosilicate (TEOS) and hexadecyltrimethoxysilane (HDTMS), a water- and oil- resistant silica-based surface was designed by inducing slipping behavior. While higher HDTMS compositions increased hydrophobicity, samples with an HDTMS/TEOS ratio of 3:5 showed the lowest surface energy and sliding properties against oil liquids with surface tension of up to 27.6 mN/m. The results of FTIR, XPS and DSC measurements revealed the role of long alkyl chains and small -OH groups as lubricants. In addition, to contributing to environmentally friendly omniphobic surfaces, this research also demonstrates potential applications across various industries. Future research should focus on optimizing large-scale production and broader applications in manufacturing, healthcare, and infrastructure.

EA25-377-A

17:30-17:45

Hydrophilic surface of MWCNT and Boron Nitride by Oxygen Ion beam Irradiation

Ho-Seok Lee, Sang-Hoon Lee, Chang-Hyun Kim, Sang-Jun Lee, Min-Ho Shin, Min-Woo choi, Young-Woong Noh, Seung-Woo Choi, Ju-Sung Park and Seok-Keun Koh
C&G Hitech Co., Ltd., South Korea

Abstract: Permanent hydrophilic surface of multi-wall carbon nanotubes (MWCNTs) and boron nitride (BN) powder was synthesis by using an oxygen (O_2) ion beam to improve dispersibility in NMP solvent and water. The oxygen ion beam was generated by End hole type ion source with energy of 500-1000eV and ion dose of 4.42×10^{15} to 1.06×10^{16} ions/cm^2·s, and the beam were irradiated on the powder surface to form oxygen-containing functional groups. To ensure uniform surface treatment, the powders were agitated during the process.

EA25-603

17:45-18:00

Oxidation Resistance Evaluation at High Temperature of Ni5Al and Fe13Cr Coatings on an AISI 321 Stainless Steel Preparing by Plasma Spray Method

Stella Cheny Agnes, Mohammad Wahyu Andriyan, Djoko Hadi Prajitno, R. Henny Mulyani
Central South University, China

Abstract: This study examines the application of depositing Ni5Al and Fe13Cr alloy coatings onto AISI 321 stainless steel substrates and evaluates their mechanical and oxidative resistance qualities. The Ni5Al coating was found to have a hardness value that is 38% greater than the Fe13Cr coating, as determined by Micro-Vickers hardness testing. Additionally, the Ni5Al coating displayed a more homogenous microstructure. The cyclic oxidation measurements provide evidence of the better performance of the Ni5Al coating in elevated temperatures. The better performance can be attributed mainly to the presence of Al_2O_3 as the predominant oxide, which is well-known for its exceptional heat resistance and protective properties. However, the overall performance of the Fe13Cr coating is negatively impacted by the presence of Fe_2O_3, even though there are other favorable oxides such as Cr_2O_3, $NiCr_2O$, NiO, and Mn_2Co_3. The Fe_2O_3 presence greatly diminishes the oxidative stability of the Fe13Cr coating. The results emphasize the capability of Ni5Al as a highly efficient coating material for applications that require exceptional hardness and strong resistance to oxidation. This indicates that it is suitable for high-temperature industrial applications where durability and performance are crucial.

Session Group Photo | Best Presenter will be Awarded during Dinner Banquet

Posters:
Preparation, Properties and Application of Advanced Functional Materials

Time: 15:30-16:00, January 9th | **Room: Seminar Room 4 (372), 3F**

*Note: Please paste poster on the wall at least 10 minutes before the session starts. Please take it away after the session, otherwise conference team will dispose the posters.

EA25-330-A Preparation of Salt Porogen Based Sodium (carboxymethyl cellulose-g-polyacrylate) Photocurable Absorbent for Trapping Ammonia Nitrogen and Heavy Metal Ions

Zi-Han Chen, Yung-Chung Chen
National Kaohsiung University of Science and Technology, Taiwan

Abstract: Hydrogels are the most commonly used 3D polymer mesh materials for trapping pollutants in wastewater. To enhance the adsorption sites of the hydrogel, this study presents a simple method for preparing porous structures by incorporating various amounts of NaCl salts (5 wt%, 10 wt%, 20 wt%, 40 wt%) and utilizing a leaching process. The hydrogel backbone (NaCMC-g-PANa) was created using sodium acrylate (ANa) and sodium carboxymethyl cellulose (NaCMC) and crosslinked with N-N′-methylene bisacrylamide (MBA) via free radical photopolymerization. The research found the NaCMC-g-PANa-10 hydrogel (NaCl salt with 10 wt%) exhibited the highest ammonia nitrogen adsorption capacity, at 32.39 mg/g, which is greater than that of the reference salt-free sample NaCMC-g-PANa (15.52 mg/g). Moreover, the adsorption capacity of NaCMC-g-PANa-10 remained above 90% after five adsorption-desorption cycles and demonstrated excellent regeneration properties. The adsorption process of the porous hydrogel is well fitted by the Freundlich isotherm and pseudo-second-order model. Additionally, low concentrations of heavy metal ions may exist in treated industrial wastewater. Thus, Cu (II), Zn (II) and Fe (II) were selected as target low-concentration heavy metal contaminants to evaluate the adsorbent for removal from the aqueous solution. Cu(II) and Zn(II) can enter the hydrogel through smaller pore sizes and form multilayer chemisorption, while Fe(II) leads to a decrease in adsorption capability. The present study demonstrated the advantages of NaCMC-g-PANa-10 hydrogel, which exhibits excellent adsorption, outstanding selectivity, recyclability, and great chemical and thermal stability.

EA25-341-A Revolutionizing Photovoltaics: Flexible and Opaque Stainless-Steel-Based Perovskite Solar Cells

Vandana Nagal, Varun Adiga, Sushobhan Avasthi
Indian Institute of Science, India

Abstract: Since the 2009 breakthrough in metal halide perovskites, researchers have achieved efficiencies of up to 25% in perovskite solar cells. These organic/inorganic composites are heralded for their potential in next-generation photovoltaic technologies due to their low cost, high performance, and solution processability, which are particularly advantageous for flexible applications. However, maintaining stability and sustainability in ambient conditions continues to pose significant challenges. This study explores the use of flexible stainless-steel (FSS) substrates, which are distinguished by their superior water and oxygen barrier properties, as well as high thermal and electrical conductivities. These attributes make FSS substrates ideally suited for lightweight and flexible perovskite solar cells. We focus on the n-i-p architecture of perovskite solar cells on FSS substrates, where light is illuminated from the p-side through a transparent conductive oxide. The absorber layer employed is an acetamidinium (AA)-substituted methylammonium (MA) lead iodide double cation perovskite, specifically $MA_{0.9}AA_{0.1}PbI_3$. A 100 nm-thick sputtered layer of ITO/IZO serves as the top electrode, while a 100 nm-thick sputtered Al layer acts as the bottom electrode. The thickness of the FSS substrates tested ranged from 50 μm to 1.2 mm. Our champion device reached a power conversion efficiency of over 5%, with a short-circuit current density (Jsc) of 20 mA/cm^2 and an open-circuit voltage (Voc) of 1.2 V, although the fill factor (FF) was low. Continuous light exposure tests demonstrated that stainless-steel substrates offer greater stability than their polymer counterparts. This methodology paves the way for the development of lightweight, cost-effective, and large-area solar cells, positioning it as a viable solution for advancing the field of flexible photovoltaics.

EA25-342-A Synthesis and Application of Tungsten Oxide Nanostructure for Ascorbic Acid Sensing

Rafiq Ahmad, Aisha Akhtar, Myunggi Yi and Byeong-Il Lee
Pukyong National University, South Korea

Abstract: Engineered nanomaterials that exhibit enzyme-like activity are highly sought after for designing enzymeless sensors, which circumvent the need for costly enzymes. In this context, we synthesized tungsten oxide (WO3) nanostructures via the hydrothermal method and characterized them using various techniques. A slurry of the resulting WO_3 nanostructure was prepared and drop-cast onto a screen-printed carbon electrode (SPCE) to construct an enzymeless sensor. The electrochemical characteristics of the WO3/SPCE sensor were evaluated using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). An optimized WO_3/SPCE sensor was electrochemically evaluated for ascorbic acid (AA) detection at varying concentrations employing CV analysis. The CV response exhibited a significant oxidation peak for AA, which gradually intensified with an increment in the AA concentration. The sensor demonstrated a linear response up to 1000 μM, high sensitivity (5.62 μA/μ Mcm^2), and a detection limit (DL) of 0.6 μM. Moreover, the engineered enzymeless WO_3/SPCE sensor displayed excellent selectivity, stability (94.5% over 5 weeks), and fabrication reproducibility (RSD of 8.5% across 4 devices). Thus, this WO_3 nanostructure proves to be a promising candidate for the large-scale, cost-effective sensor development for AA detection and holds potential for the fabrication of enzyme-based biosensors.

EA25-346-A Synergistic Photocatalysis of Cu-VOx Nanosheets for Boosting CO_2 Photoreduction

Jing-Wei Lai, Yong-Ming Dai and Jih-Mirn Jehng
National Chin-Yi University of Technology, Taiwan

Abstract: To achieve sustainable development and mitigate climate change, this study developed a novel copper-modified VO_x nanostructured photocatalyst aming at improving the efficiency of photocatalytic CO_2 reduction and converting it into high-value-added chemicals. We synthesized this photocatalyst using a simple natural combustion method and systematically investigated the effects of synthesis conditions (citric acid to ammonium metavanadate ratio, copper metal incorporation) on the photocatalytic performance.

EA25-378E-A ZIF-67 electrocatalyst synthesized various cobalt metal precursors for Oxygen Evolution Reaction in alkaline water splitting

Da Hye Sim, Uoon Chul Baek, Gyuwan Kim and Jung Tae Park
Yonsei University, South Korea

Abstract: Electrocatalytic water splitting is a sustainable method to produce green hydrogen. Highly efficient electrocatalysts with excellent activity and durability are required. Metal-organic frameworks (MOFs) have gathered considerable attention as electrocatalysts due to their high specific surface area and unique pore characteristics. Herein, ZIF-67 was synthesized using cobalt salts (chloride, acetate, and nitrate) to investigate the effect of precursor selection on morphology, size, and electrocatalytic performance. ZIF-67 obtained from cobalt chloride and acetate exhibited typical dodecahedral structures, while cobalt nitrate resulted in dumpy morphologies. The electrochemical performance of various ZIF-67 was evaluated to highlight the impact of structural differences on catalytic efficiency.

EA25-372 Enhancing Copper-Graphene Composites for Sustainable Industry Applications

Mohd Azwan Ahmad, Nurul Izzati Muhammad Rasid, Norhamidi Muhamad, Nur Azalina Suzianti Feisal, Nashrah Hani Jamadon
Management & Science University, Malaysia

Abstract: Graphene known as a groundbreaking nanomaterial for its outstanding mechanical strength, superior thermal conductivity, and excellent electrical properties, has gained recognition as an innovative additive for enhancing metal matrix composites. However, challenges such as agglomeration, uneven dispersion, and porosity limit its

widespread application. This study aims to investigate the effects of varying graphene concentrations (0%, 0.5%, 1.0%, and 1.5%) on the microstructural, mechanical, and thermal properties of copper-graphene composites fabricated using the powder injection molding (PIM) method. The samples underwent systematic preparation and were analyzed through hardness and tensile testing, along with Scanning Electron Microscopy (SEM) for microstructural evaluation. Results revealed that incorporating 0.5% graphene significantly enhanced tensile strength (205.22 MPa), hardness (94.2 HRL), and thermal conductivity due to uniform dispersion, efficient load transfer, and reduced porosity. However, increasing graphene content to 1.0% and 1.5% led to agglomeration, increased porosity, and disrupted microstructures, resulting in reduced mechanical and thermal performance. SEM images corroborated these findings, showing a progression from smooth, well-bonded structures at 0.5% graphene to irregular, void-filled morphologies at higher concentrations, making it suitable for applications requiring efficient heat dissipation and mechanical reinforcement.

EA25-379E-A Nanoporous Double-Layer Films Based on Metal-Oxide for Anti-Reflection Coating on Display Applications

Gyuwan Kim, Uoon Chul Baek, Da Hye Sim and Jung Tae Park
Yonsei University, South Korea

Abstract: In recent advancements in optoelectronic devices, particularly in display technologies, the development of low-reflectivity coating films has gained significant importance due to the evolving requirements of light-emitting devices. This study presents nanoporous double-layer films based on metal oxide for anti-reflection coating (ARC) on substrates. The coating is achieved *via* an aggregation process induced by pH neutralization, enabling low reflectance and reduced refractive index across a broad range within the visible light spectrum. This approach demonstrates potential for application in various optoelectronic devices such as light-emitting diodes and solar cells.

EA25-358-A Synthesis of GaxBiyOz/COFs Composite With Enhanced Interfacial Charge Separation for Efficient Photocatalytic CO_2 Reduction

Ya-Ching Wu and **Yong-Ming Dai**
National Chin-Yi University of Technology, Taiwan

Abstract: The primary objective of this research is to explore the potential of $Ga_xBi_yO_z$/COFs composite photocatalysts for the photocatalytic reduction of CO_2 to methanol. Covalent Organic Frameworks (COFs) are organic-inorganic hybrid porous crystalline materials with exceptionally high surface areas and adjustable pore sizes. Therefore, it is anticipated that the incorporation of gallium and bismuth into the porphyrin structure will form GaxBiyOz/COFs, enhancing the visible light response and accelerating the spatial separation and preservation of photogenerated charge carriers with high oxidative capacity. This process reduces electron-hole recombination to significantly improve the photocatalytic activity and stability of the material.

EA25-380E-A Electrochemical Performance of EDLCs with PVDF-g-POEM Based Polymer-Gel-Electrolytes

Uoon Chul Baek, Da Hye Sim, Gyuwan Kim and Jung Tae Park
Yonsei University, South Korea

Abstract: This work focuses on the development of electrochemical double-layer capacitors (EDLCs) utilizing polymer-gel-electrolytes. The electrolytes derived from amphiphilic PVDF-g-POEM graft copolymers. These copolymers were synthesized using atom transfer radical polymerization (ATRP) method. The polymers act as matrices to create polymer-gel-based electrolytes, where PVDF-based matrices are used. PVDF-based polymer-gel electrolytes are employed as quasi-solid-state

electrolytes due to its high dielectric constant and its robust chemical and thermal tolerance. As safer alternatives to conventional liquid electrolytes, polymer electrolytes can overcome challenges such as leakage, flammability, and limited operational stability. However, challenge arise where their lower ionic conductivity compared to liquid electrolytes hinder their application for electrochemical devices. To overcome this limitation, hydrophilic POEM chains are introduced to hydrophobic PVDF chain to reduce crystallinity and induce microphase separation. This enables enhanced ionic transport pathways and higher segmental motion within the polymer matrix. The developed electrolytes demonstrated high ionic conductivity and high electrochemical stability, which are applied as high-performance EDLC electrolytes. EDLCs achieved a specific capacitance of 38.07 F g^{-1} at 0.5 A g^{-1} and an energy density of 25.59 Wh kg^{-1} at a power density of 2750 W kg^{-1}. Additionally, the EDLCs exhibited excellent cycling stability, with 95.6% capacitance retention after 8000 cycles at 1 A g^{-1}.

EA25-315 Structural Response of Tall RC Systems under Blast Pressure Loading

Abla Krouma, Zubair Imam Syed
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Abstract: Tall buildings with different structural systems can be exposed to explosive loading, and a proper understanding of their structural response under blast loads is crucial for robust structural design. This study investigates the structural performance of selected tall structural systems - shear wall frame, outrigger, and tube-in-tube systems - under different blast load effects. Nonlinear finite element analysis was performed using commercial package ETABS with blast loads applied as time-history functions for various charge weights and standoff distances. Structural responses were compared in terms of displacement and inter-story drift. Results showed that the tube-in-tube system performed relatively better in terms of displacement and inter-story drift as standoff distance increased and charge weight was constant. When explosive charge weights increased, and standoff distance was constant, the tube-in-tube system displayed better performance with respect to displacement, whereas the outrigger system was the optimum with reference to inter-story drift. The overall study indicates that selecting a tall structural system for better resilience against blast loading depends on specific aspects of structural behavior, identified as the required criteria.

18:20-19:30, January 9, 2025

Dinner Banquet

The Commons (B110)

- Best Oral Presentation Award
- K-pop Performance

10:00-12:00, January 10, 2025

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