



UNIVERSITI
MALAYSIA
PERLIS

INSTITUTE OF
NANO ELECTRONIC
ENGINEERING



ICONMAR 2025

THE 2ND INTERNATIONAL CONFERENCE ON NANOTECHNOLOGY & MATERIALS RESEARCH

BAHANG BAY HOTEL, PENANG
2 OCTOBER 2025

PROGRAMME BOOK

CO-ORGANIZERS



IPB University
— Bogor Indonesia —



FuNTech
Functional Materials & Nanotechnology
CoE



UMS
UNIVERSITI MALAYSIA SABAH

SPONSORS



**Gaia
Science**



everlife
Chemopharm
Enabling Better Outcomes



SUPPORTED BY



PETAC

Penang State EXCO Office
for Tourism And Creative Economy



penang
convention &
exhibition
bureau

PENANG
2030



PG

WELCOMING REMARKS



First and foremost, I would like to welcome all distinguished guests, esteemed delegates, and colleagues to the 2nd International Conference on Nanotechnology and Materials Research (ICONMAR 2025). As an academic institution dedicated to technological advancement, Universiti Malaysia Perlis (UniMAP) has consistently led the way in research and education.

The Institute of Nano Electronic Engineering (INEE), in particular, has been at the forefront of addressing real-world challenges in nanomaterials and nanobiotechnology through interdisciplinary programs and impactful collaborations.

This conference, organized by INEE, marks a significant milestone in our shared pursuit of knowledge and innovation. It provides a platform for us to converge, exchange ideas, and explore the boundless possibilities of the nanoscale world and the transformative materials that will shape our future.

I would like to take this opportunity to express my deepest appreciation to the organizing committee, sponsors, volunteers, and all those who have worked tirelessly behind the scenes. Your commitment and dedication have made this event a reality, bringing us all together today.

On behalf of UniMAP, I warmly welcome you to the International Conference on Nanotechnology & Materials Research. May this gathering inspire collaboration, spark transformative ideas, and pave the way for new breakthroughs. I wish all participants a fruitful, productive, and memorable conference.

PROF. DATO' TS. DR. ZALIMAN SAULI
Vice Chancellor
Universiti Malaysia Perlis

WELCOMING REMARKS

It is with great pleasure and a true honor to welcome you to the second edition of the International Conference on Nanotechnology and Materials Research (ICONMAR 2025). This year, the conference has received an impressive 102 submissions, with an acceptance rate of 80 percent, reflecting both the strong interest and the high quality of research in this field.



We are privileged to feature a distinguished line-up of keynote and invited speakers who will share their expertise and insights. On behalf of the organizing committee, I would like to extend my sincere appreciation to the speakers, moderators, and participants for your valuable contributions, support, and engagement toward the success of ICONMAR 2025.

I'd like to take a moment to acknowledge our wonderful co-organizers — the National Nanotechnology Centre (NNC) MOSTI; Walailak University, Thailand; IPB Bogor, Indonesia; IPPT Bertam, USM; and Universiti Malaysia Sabah (UMS). A big thank you also goes to our generous sponsors: Gaia Science Sdn Bhd, BT Science Sdn Bhd, and Chemopharm Sdn Bhd. Your support truly makes this event possible.

I must also give special appreciation to our organizing team. This conference would not have been possible without your commitment, and the strong support of our partners and institutions. Finally, on behalf of the committee, I want to thank all of you — our participants — for being here. We hope you enjoy the sessions, make valuable connections, and take away fresh ideas from the inspiring speakers we've brought together. And of course, enjoy your time here in beautiful Penang!

ASSOC PROF. IR. TS. DR. MUHAMMAD MAHYIDDIN RAMLI

**Director
Institute of Nano Electronic Engineering
Universiti Malaysia Perlis**

WELCOMING REMARKS

It is with great pleasure and a true honor to welcome you to the second edition of the International Conference on Nanotechnology and Materials Research (ICONMAR 2025). We are truly honored to welcome an outstanding lineup of distinguished keynote and invited speakers to this conference.



My heartfelt appreciation goes to all our speakers and moderators for sharing their expertise, as well as to the participants for your interest, enthusiasm, and support of this event. I would also like to extend special recognition to our esteemed co-organizers: NNC MOSTI, IPPT Bertam, USM; UMS; IPB University, Indonesia and Walailak University, Thailand. Your collaboration has been invaluable.

Our deepest gratitude also goes to our generous sponsors—Penang Convention & Exhibition Bureau, Gaia Science Sdn Bhd, BT Science Sdn Bhd and Chemopharm Sdn Bhd—for their unwavering support and contribution to the success of this conference.

Equally, I wish to commend the organizing team for their dedication, commitment, and tireless efforts. A conference of this scale could not have been realized without the collective support of the committee members, sponsors, partner institutions, and all collaborating organizations.

On behalf of the organizing committee, I extend my sincere thanks to each of you for your active participation. I wish you a pleasant stay here in Penang and a truly rewarding and memorable conference experience.
Thank you.

ASSOC PROF. DR. VOON CHUN HONG
Conference Chair
ICONMAR 2025

KEYNOTE SPEAKER



Prof. Dr. Hafsa Korri-Yousoufi
Director of Research CNRS (HDR), Institute of Molecular
Chemistry & Material of Orsay (ICCMO),
University Paris-Saclay, France

Dr. Hafsa Korri-Yousoufi is CNRS Research Director and responsible for the team "Design of biosensors and biochips for diagnosis and analysis" at ICCMO at University Paris-Saclay. Her research activities concern the development and characterization of new conducting materials as electrochemical transducers for the detection of molecular recognition phenomena. This research aims at understanding and controlling the effects of chemical and biological processes at the electrode interface modified by nanomaterials and their effect on charge transfer. The team study new methodologies for the immobilization of biomolecules such as antibodies DNA and enzymes and the approaches to obtain sensitive and selective sensors and biosensors. She has published more than 100 papers and invented several patents. She managed various research program national and European and is a co-founder of a company on analytical devices for food control.

KEYNOTE TITLE

Organic Conjugated Polymer for Biomedical Applications: Sensing and Therapy

The last decade has witnessed great progress in the use of organic conjugated polymer (OCPs) as an emerging class of multifunctional materials for biomedical applications including biosensor, Imaging and therapy for microbial infections and cancer. OCPs can be obtained with accessible synthetic schemes and thus providing a much larger platform for material manipulation to meet the specific requirements for different biomedical applications. Their chemical structures, band gap energy, functionalities, topology and morphology, could easily be tuned through methods of synthesis and their functionalization. Thus OCPs could be obtained in many forms, as nanofiber, nanotube and nanoparticles. In bio-sensing applications OCPs could be functionalized for subsequent bio-conjugation to guide the OCPs toward a selective target, specific cells or organelles. Such functionalization can be achieved following direct functionalization of OCPs or an affinity-driven binding. Their electronics and optoelectronics properties in combination with functionalization allow their application in various sensing devices and as drug for therapy and now recent work show the possible application as theragnostic agent providing both diagnosis and therapy. In addition, OCPs could be associated with others nanomaterials such biopolymers, 2D nanomaterials, metal nanoparticles or metal organics Frameworks (MOFs) to form nanocomposite with enhanced or news properties improving their biomedical applications. This presentation will provide an overview of various kind of CPs and the effect of the synthesis methods in their morphology, structural electronic and optoelectronics properties as well as their conjugation with others nanomaterials. Some example of biomedical application in biosensing and therapy will be provided and a future prospect of their use in theragnostic applications will be discussed.

KEYNOTE SPEAKER



Prof. Dr. Khairunisak Abdul Razak
School of Materials & Mineral Resources Engineering,
Institute for Research in Molecular Medicine (INFORMM),
Universiti Sains Malaysia

Prof. Dr. Khairunisak Abdul Razak is a leading researcher in nanomaterials synthesis and their transformative applications in sensors, biosensors, and energy storage technologies. With over 200 international journal publications and 10 book chapters, her work spans a wide spectrum—from nanostructured electrodes and electrochemical sensors to advanced supercapacitors and energy harvesting systems. Renowned for her pioneering contributions, she has advanced the design of nanostructured electrodes for sensors and biosensors, high-performance supercapacitors, developed, and applied functional nanomaterials in biomedical innovations such as radiotherapy enhancement. Her research consistently bridges fundamental materials science with electrochemical mechanisms and device-level engineering, creating impactful pathways toward real-world sensing platforms and sustainable energy solutions.

Prof. Khairunisak currently serves as a Professor at the School of Materials and Mineral Resources Engineering and as Head of the Research Advancement Cluster: Transdisciplinary and Sustainability at Universiti Sains Malaysia (USM). In this role, she continues to work cross-disciplinary collaborations that integrate materials science, energy technologies, and healthcare innovations—driving research that is not only scientifically rigorous but also socially relevant, sustainable, and globally impactful.

KEYNOTE TITLE

Surface Matters: Advanced Electrode Modification Strategies for Electrochemical Performance Boost

Electrode modification has emerged as a transformative strategy in electrochemistry, enabling remarkable improvements in sensitivity, selectivity, and long-term stability across a wide spectrum of applications. By engineering surface morphology, chemistry, and electronic properties, modified electrodes accelerate charge transfer, increase the density of electroactive sites, and strengthen analyte–surface interactions. In glucose biosensing, nanostructured modifications with nanoparticles such as gold, platinum nanoparticles, ZnO nanorods, and γ - Fe_2O_3 nanoparticles have significantly enhanced enzyme immobilization, while also enabling direct glucose oxidation, resulting in superior stability and lower detection limits. For heavy-metal ion detection, nanoparticle-modified electrodes harness synergistic adsorption–redox mechanisms, effectively lowering charge-transfer resistance and achieving highly sensitive detection of Pb^{2+} , Cd^{2+} , Cu^{2+} , and related toxic contaminants. Beyond sensing, electrode modification has become increasingly attractive for energy storage, where tailored nanostructures enhance conductivity, ion accessibility, and active surface area. These engineered electrodes demonstrate improved charge storage capacity, reduced internal resistance, and higher energy and power densities compared to unmodified counterparts. Collectively, nanomaterial-modified electrodes represent a versatile and powerful platform that not only advances glucose and heavy-metal sensors but also drives the development of high-performance supercapacitors, underscoring their pivotal role at the intersection of electrochemical sensing and energy storage technologies.

INVITED SPEAKER



**Professor Dr Yamuna Munusamy,
Assoc. Fellow, ASEAN Academy of
Engineering & Technology,
Universiti Tunku Abdul Rahman**

Effect of Ruthenium Catalyst on the Thermal Performance of Polyamide-Based Phase Change Materials

The development of polymer-based phase change materials (PCMs) with enhanced thermal performance is essential for advancing thermal energy storage technologies. This study investigates the effect of a ruthenium catalyst on the thermal behavior of polyamide 610 (PA610), focusing on its role in modifying both heat transfer and phase change characteristics. Catalyst-modified PA610 samples were prepared at varying loadings and characterized using Fourier-transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and thermal conductivity measurements. The incorporation of the catalyst led to a noticeable enhancement in thermal conductivity, accompanied by a reduction in latent heat due to suppressed crystallinity. Despite this trade-off, thermal cycling tests revealed improved thermal stability at higher catalyst concentrations, with minimal degradation in enthalpy over multiple heating cycles. FTIR results supported structural modification through altered hydrogen bonding rather than the formation of new chemical functionalities. These findings demonstrate the potential of catalyst-assisted polymer modification as a viable strategy for tuning the thermal performance of PCMs, enabling application-specific optimization where conductivity and stability are prioritized.

INVITED SPEAKER



Assoc. Prof. Dr. Mudtorlep Nisoa
Head of CoE in Plasma Science &
Electromagnetic Waves,
Walailak University, Thailand

Microwave Processing Technologies for Sustainable Bioresource Utilization: From Herbal Extraction to High-Value Carbon Materials

Microwave heating technology offers a versatile and energy-efficient alternative to conventional thermal processes, particularly in the context of sustainable bioresource utilization. This presentation explores two key applications developed by the Plasmas and Electromagnetic Wave Research Laboratory (PEwave) at Walailak University: (1) low-temperature microwave processing for drying and phytochemical extraction, and (2) high-temperature microwave pyrolysis for the production of functional carbon materials. In the low-temperature regime (below 80 °C), microwave energy has been applied to efficiently dry herbs and extract bioactive compounds such as essential oils, curcuminoids, and flavonoids from Thai medicinal plants. A notable example is the drying of oil palm mesocarp for the production of red palm oil (RPO) using a batch-type microwave system. This process eliminates the need for water boiling, thereby preventing wastewater generation and preserving high levels of carotenoids and vitamin E—offering a green alternative to traditional palm oil processing. In the high-temperature domain, PEwave has developed a high-power microwave pyrolysis reactor operating at up to 1000 °C to convert local biomass such as oil palm empty fruit bunches (EFB) and rubber wood chips into biochar and green graphite. The system utilizes 1-4 kW microwave magnetrons, coupled with waveguide-based resonant cavity design for uniform heating and energy efficiency. Characterization of the solid products reveals high surface area biochar and layered graphitic carbon structures with potential applications in energy storage, electrocatalysis, and soil amendment. These technologies demonstrate the scalability and environmental advantages of microwave processing—from zero-waste herbal extraction to CO₂-reduced carbon material production. The integrated approach supports Thailand's Bio-Circular-Green (BCG) economy and aligns with global efforts toward sustainable material transformation and climate resilience.

INVITED SPEAKER



Assoc. Prof. Dr. Rafeezul Mohamed
Department of Biomedical Science,
Advanced Medical & Dental Institute,
Universiti Sains Malaysia

Graphene-Based Nanomaterials as Novel Modulators of Lipid Metabolism and Inflammation in Atherosclerosis

Atherosclerosis, a chronic inflammatory disease marked by lipid accumulation and macrophage-driven foam cell formation, remains a leading cause of cardiovascular morbidity. Graphene oxide (GO) and reduced graphene oxide (rGO), synthesized from oil palm biomass, offer tunable surface chemistries enabling therapeutic modulation of lipid metabolism and immune pathways. This study integrates computational and experimental approaches to elucidate their mechanisms of action. Molecular docking and dynamics simulations revealed that rGO interacts with lipid-associated proteins (CD36, LOX1, ApoB) predominantly via hydrophobic forces, while GO forms more stable hydrogen-bonded complexes, modulating lipid uptake and inflammatory signaling. Characterization (Raman, FTIR, XRD, AFM) confirmed GO's higher oxygen functionalization (hydrophilicity) and rGO's partial hydrophobicity. In macrophages, neither material induced foam cell formation, yet both inhibited oxidized LDL (oxLDL)-driven lipid accumulation, with GO showing greater efficacy. GO enhanced cholesterol efflux via ABCA1 upregulation while suppressing scavenger receptors (CD36, SRA1) and pro-inflammatory cytokines (IL-1 β , TNF- α , NF- κ B). rGO also promoted ABCA1 but increased IL-1 β and SRA1, reflecting divergent immunometabolic effects. Metabolomics revealed that GO influenced glucosinolate and estrogenic pathways, while rGO modulated phenylalanine metabolism. These results highlight surface functionalization as a determinant of graphene bioactivity. GO, with its oxygen-rich chemistry, exhibits superior anti-atherogenic potential by enhancing cholesterol clearance and mitigating inflammation, underscoring its promise as a nanotherapeutic platform for atherosclerosis.

INVITED SPEAKER



Dr. Renan Prasta Jenie
Department of Physics, FMIPA IPB
University, and Graduate
Department of Public Health, FIKT,
Binawan University

Review on cases of potential photovoltaic implementation in duck farming

This review objective is to find case of implementable photovoltaics technology for duck farming. To be included, the studies must mention about place of implementation, photovoltaics technology used, photovoltaics implementation, and photovoltaics impacts. The studies does not have to be specifically about duck farming, but the design must be implementable to duck farming. We have included research journal and proceedings articles from Scispace Database from 1980 to present. We have extracted four specific data from each articles, place of implementation, photovoltaics technology used, photovoltaics implementation, and photovoltaics impacts. We use tabulation for data synthesis. We have screened 20 articles to be included in this study. Photovoltaic systems can significantly reduce energy consumption in duck farming by providing a renewable energy source. Similarly, the integration of agrivoltaic systems in agricultural settings can optimize land use while generating clean energy, making it a viable solution for duck farming. The integration of photovoltaic systems in duck farming offers numerous benefits, including energy efficiency, cost reduction, and improved animal welfare. However, the success of such implementations depends on careful design, economic viability, and supportive policies. By addressing these factors, photovoltaic systems can play a key role in promoting sustainable and profitable duck farming operations.

The background is a light gray with faint, stylized molecular structures and hexagonal patterns. A prominent white molecular structure with spheres and connecting rods is visible in the lower half. Swirling pink and purple ribbons frame the top and bottom edges.

ABSTRACTS

ICONMAR 02: Nanotechnology-Based Transdermal Drug Delivery: Characterization of Electrospun Temozolomide-Cellulose Acetate Nanofibers

Mohamad Ikhwan Jamaludin, Asyikin Sasha Mohd Hanif

Transdermal drug delivery systems (TDDS) using nanobiotechnologies enhance treatment effectiveness by bypassing gastrointestinal metabolism, allowing for better drug targeting and improved outcomes. This study describes the preparation of cellulose acetate (CA)-based nanofibrous membranes as sophisticated biomaterials enabled with Temozolomide (TMZ), an anticancer drug commonly used in treating brain tumours, including glioblastoma. Cellulose acetate (CA) nanofibers loaded with TMZ were synthesized by electrospinning using CA at a constant concentration of 17% (w/v) and with different TMZ loadings (5 mg, 10 mg and 15 mg). Electrospun TMZ–CA nanofiber membranes were comprehensively characterized by scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and energy-dispersive X-ray spectroscopy (EDX). SEM analysis revealed that the fibers were smooth and bead-free, indicating successful electrospinning. FTIR and UV spectroscopy analysis confirmed that TMZ retained its stability and molecular integrity within the cellulose acetate (CA) matrix following fabrication. In-vitro drug release profiles using phosphate-buffered saline (PBS) showed that the controlled drug-releasing behaviours from membranes by loading 10mg and 15mg TMZ from these membranes are in the optimal range. Also, sessile drop contact angle studies showed hydrophobicity (angles above 90°), indicating continued drug release. The study illustrates the possibilities of using functional nanomaterials, in this case, electrospun TMZ-loaded CA nanofibers. They retain the stability of the drug, sustain release properties, and provide appropriate surface characteristics. This study highlights the potential of TDDS in cancer therapy, paving the way for future in-vivo experiments and clinical applications of nanotechnology-based implantable devices.

ICONMAR 03: Effect of TiC Nanoparticles Deposition on UNS S31803 Surface using Tungsten Arc Melting Method

Lailatul Harina Paijan, Alin Qistina Shamsuri

This study focused on the application of nanoceramic particles to enhance the surface properties of UNS S31803 steel through the deposition of titanium carbide (TiC) nanoparticles, sized 5 nm and 10 nm, using the tungsten arc melting technique. Despite its advantages, UNS S31803's soft material and low wear resistance are significant challenges for engineering applications, requiring innovative durability solutions. The primary objective is to investigate the impact of varying melting processes on the composite coating layer, with an emphasis on improving hardness and wear resistance. The methodology involved precise control of tungsten arc melting parameters, including a constant arcing current of 140 A and varying pulse rates of 15, 20, and 25 Hz, to ensure optimal particle bonding and uniform distribution of TiC nanoparticles. Microstructural analysis, hardness testing, and wear performance were assessed using Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive X-Ray Spectroscopy (EDX) analyzer, Vickers microhardness testing, and reciprocating wear tests. Results indicate that the 5 nm TiC nanoparticles, processed at 140 A with 25 Hz, achieved the best outcomes, with a high element composition of TiC with 91.6%, a maximum microhardness of 415.96 Hv, and the lowest wear rate of $1.01 \times 10^{-5} \text{ mm}^3/\text{Nm}$, with shallow surface grooves. This study provides valuable insights for industries seeking to improve the durability of wear resistant components, contributing to advancements in surface engineering and sustainability.

ICONMAR 05: Investigation on Geometrical Effects of FinFET Electronic Device Properties Using TCAD Simulations and Taguchi Optimization

Hanim Hussin

To ensure optimal operating conditions and performance, transistor dimension parameters must be determined accurately. This work investigates the Taguchi approach for device parameter optimization in a 7nm Silicon FinFET, employing design of experiments (DOE) methodologies to improve device performance and efficiency. In this work, the geometric scaling that affect FinFET performance, with an emphasis on the ratio of on-state current (I_{ON}) over off-state current (I_{OFF}), threshold voltage (V_{TH}), subthreshold swing (SS) and drain induced barrier lowering (DIBL) are investigated. The Taguchi approach is used to optimize the FinFET model, resulting in improved performance. Furthermore, investigation on the impact of optimized FinFETs on logic circuit performance, notably delay and power characteristics. Moreover, the Silvaco TCAD Simulator is used as the medium of simulation and analysis. The Taguchi method was implemented to determine the most appropriate combination of factors for robust device performance using orthogonal arrays, and signal-to-noise (SN) ratio as the quality characteristic of choices. The factors involved in the design of experiments include the length (LG) and height (HFIN) of the fin as well as the width (WFIN) of the fin at the top region. Using Taguchi's robust performance signal-to-noise ratio, the combination of parameters was obtained for the I_{ON}/I_{OFF} ratio, V_{TH} , DIBL, and SS. The V_{TH} value is 0.7461V for FinFET with LG, WFIN, HFIN being 13 nm, 7 nm, and 35 nm, respectively. The current ratio of 262.072 and SS of 69.4 mV/dec obtained from FinFET when LG is 13 nm, WFIN is 5 nm, and HFIN is 40 nm. For the optimum DIBL, which is 232 mV/V, is gained when the FinFET has LG, WFIN, and HFIN 10 nm, 10 nm, and 35 nm, respectively. The analysis confirms that dimension optimization can significantly enhance FinFET performance. The use of the Taguchi method proved effective in identifying the optimal parameter combinations, and the subsequent application to logic circuits for the development of low-power FinFETs.

ICONMAR 06: Electrical Performance Evaluation Based on Design Parameters of Silicon Nanowire Gate-All-Around (GAA) TFET

Hanim Hussin

The SiNW GAA is one of the technologies with potential for better short channel behavior and gate control over conductivity. This work investigates the effect of various geometrical dimensions of Silicon Nanowire Gate-All-Around Tunneling Field Effect Transistor (SiNW GAA TFET) on electrical characteristics. The design parameters consist of gate oxide thickness (TOX), channel radius, dielectric material, gate metal work function and low/high drain voltage are varied in the simulation process to analyze the electrical performance of SiNW GAA TFET. Subthreshold Slope (SS), I_{ON}/I_{OFF} current ratio and threshold voltage (V_{th}) are extracted. The result shows that the oxide thickness of 3 nm, the channel radius of 10 nm - 18 nm and SiO₂ as a dielectric material tend to have the best SiNW GAA TFET characteristics. While the work function of gate metal TiN and drain voltage of 0.5V are the most effective for the device performance. This study highlights the potential of GAA nanowire TFETs to drive innovation in semiconductor technology through superior electrical performance.

ICONMAR 07: Development and Preliminary Analysis of 3D Printing Filament from Post-consumer Polypropylene

Khaw Ming Yee, Ming Yeng Chan, Seong Chun Koay, Thai Kiat Ong

In recent years, a lot of attention has been directed toward the use of recycled materials in three-dimensional (3D) printing, driven by the need for better plastic waste management and sustainable practices. This study focuses on the development of sustainable post-consumer polypropylene (rPP) filaments for use in fused filament fabrication (FFF). The rPP were produced by blending injection-grade and extrusion-grade post-consumer polypropylene at various ratios. The influence of different grade ratios on filament diameter consistency and melt flow behavior was evaluated. The 50:50 ratio of injection-grade to extrusion grade rPP exhibited greater consistency in filament thickness compared to the 100% injection-grade and 60:40 ratios. Based on the melt flow rate (MFR) results, the MFR reduce when more extrusion grade rPP is added. In addition, the tensile properties of 3D printed parts made from rPP and commercial PP filaments were evaluated and compared. Overall, this research demonstrates the potential of upcycling waste materials into functional composite filaments for sustainable 3D printing applications.

ICONMAR 08: The Stress Analysis Of Polymethyl Methacrylate (Pmma) Nanocube Using Molecular Dynamics Simulation

Nur Fatiha Mohd Hasni

Polymethyl methacrylate is a widely used polymer valued for its mechanical properties, chemical stability, and ease of fabrication. This study investigates the mechanical behavior of PMMA nanostructures under uniaxial tensile loading using molecular dynamics (MD) simulations. The objectives include understanding deformation mechanisms, mechanical stability, and tensile response at the nanoscale. PMMA nanostructures were constructed with JMOL and PACKMOL software, and simulations were performed using the COMPASS force field within the LAMMPS framework. Energy minimization and equilibration under NVT and NPT ensembles at 300 K and 1 atm ensured stable molecular configurations before mechanical loading. The effects of temperature and pressure variations on structural stability were also examined. Results show that PMMA nanostructures with high aspect ratios exhibit significant elongation under tensile stress. Stress-strain analysis reveals distinct elastic and plastic deformation phases, providing insights into nanoscale mechanical properties and limitations. Comparison with generic polymer nanostructures and bulk PMMA highlights enhanced mechanical performance due to nanoscale structuring. These findings deepen the understanding of PMMA's tensile behavior at the nanoscale and offer guidance for designing optimized nanostructured polymeric materials. The study's outcomes have potential applications in developing more durable flexible electronics, improved biomedical devices, and advanced nanotechnology.

ICONMAR 09: Characterization of SnO₂ nanoparticles via Morinda citrifolia leaf extract

Irmaizatussyehdany Buniyamin, Kevin Alvin Eswar, Mohd Yusri Idorus, Zuraida Khusaimi, Mohamad Rusop Mahmood, Mohd Khairil Adzhar Mahmood, Salifairus Mohammad Jafar, Hanis Mohd Yusoff, Zahidah Othman, Nur Fairuz Rostan, Mohamad Azri Tukimon

This study presents a green synthesis approach for fabricating tin oxide nanoparticles (SnO₂ NPs) using Morinda citrifolia leaf extract as a reducing and capping agent. The influence of varying extract concentrations (ratios 1:1, 1:3, 1:5, 1:7 and 1:10) on the structural, optical and compositional properties of SnO₂ NPs was systematically investigated. Characterization was performed using FTIR, XRD, UV-DRS and XPS techniques. FTIR confirmed the formation of Sn-O-Sn and Sn-OH functional groups, while XRD analysis revealed rutile tetragonal crystalline structure with varying degrees of crystallinity, highest at the 1:3 extract ratio. UV-DRS analysis indicated tunable optical properties, with the energy band gap ranging from 3.17 to 3.71 eV depending on extract concentration. XPS characterization of the optimal low-band-gap sample (1:10) confirmed the presence of Sn⁴⁺ and lattice oxygen. The study demonstrates that extract concentration significantly affects properties of SnO₂ NPs, highlighting the potential of M. citrifolia for eco-friendly nanoparticle synthesis.

ICONMAR 10: Comparative Analysis of Bovine Serum Albumin Detection Using Cuvettes, Biofunctionalized and Non-Biofunctionalized Tapered Optical Fiber

Ahmad Ashrif A Bakar, Nurul Huda Abd Karim, Norhana Arsad, Retna Aspari, Nur Nadia Bachok, Norhafizah Burham, Ahmad Razi Othman

Advances in optical sensor technologies have been substantial in recent years, especially in the detection of biomolecules like Bovine Serum Albumin (BSA), driven by the need for more sensitive and precise diagnostic tools. The detection of BSA plays a critical role, particularly in the early diagnostic tools for chronic kidney disease. This work aims to investigate the performance of three different BSA detection methods: biofunctionalized and non-biofunctionalized tapered optical fiber sensors, and conventional cuvettes. This study conducted an experimental investigation, utilizing 3.5 ml cuvette and tapered optical fibers with design parameters including upper and lower taper lengths of 10 mm, a waist length of 10 mm, and a waist diameter of 10 μm. The sensors were fabricated using the Vytran GPX 3400 machine. Measurements of time response, intensity, and absorbance were carried out using a Deuterium-Tungsten DT-2-GS light source and an Ocean Optics Flame spectrometer. The biofunctionalization of the sensing area involved three sequential steps: hydroxylation with a 0.1M sodium hydroxide solution, salinization with a 2% (3-aminopropyl) triethoxysilane solution, and aldehyde activation using a 2% glutaraldehyde solution. The experiment used 120 ml of BSA solutions at concentrations of 31.25 mg/dl, 62.5 mg/dl, and 125 mg/dl. Each method exhibits a unique spectral response across the ultraviolet, visible, and near-infrared, regions. Both intensity and absorbance assessments reveal a significant reduction in sensitivity when transitioning from the cuvette to the tapered optical fiber. Notably, the sensitivity decreases by 99.96% for intensity measurements and by 97.76% for absorbance. Nonetheless, after biofunctionalization, the tapered optical fiber's sensitivity increased, showing a 207.5% increase in absorbance and a 1494.72% increase in intensity measurements.

ICONMAR 12: Lead-Free Piezoelectric Performance of BCZT-PDMS Composites for Sustainable Energy Harvesting

Norhafizah Burham; Swee Leong Kok; Ahmad Arsyad Mohd Noordin; Masitah Othman; Dayana Kamaruzaman; Faisal Mohd-Yassin; Habibah Zulkefle; Anees Abdul Aziz

This article presents the synthesis and characterisation of lead free BCZT ($\text{Ba}_{0.85}\text{Ca}_{0.15}\text{Ti}_{0.9}\text{Zr}_{0.1}\text{O}_3$) nanopowder produced by the solid-state reaction technique, employing two grinding cycles to enhance crystallinity. X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM) verified that grinding the materials five times yielded a highly crystalline BCZT with a cubic perovskite structure. The BCZT powder was filled into a polydimethylsiloxane (PDMS) matrix at different weight percentages (1%, 3%, 5%, and 10%) to investigate the performance in term of piezoelectric coefficient and generated voltage. The BCZT-PDMS composites displayed an amorphous form attributable to the polymer matrix. While preserving the functional piezoelectric characteristics of the ceramic filler, the result shows 10% wt exhibit higher d_{33} measurement with 45 pC/N which increased approximately 50% compared to 5% wt. Furthermore, the piezoelectric performance was assessed using d_{33} measurements and voltage production during mechanical excitation utilising a solenoid with a constant force of 20 Nm and a frequency of 10 Hz. The findings indicated that the piezoelectric generate voltage well with BCZT-PDMS composite with 5 wt%, yielding a maximum output voltage of 8 V. However, by increasing BCZT to 10%w.t, piezoelectric performance reduced 20% which generate 6 V. Finally, the capability of BCZT-PDMS composites for application in self-sustaining is verified for energy harvesting application.

ICONMAR 13: The Effect of Temperature on Sweet Corrosion Behaviour of Mild Steel in 3.5% NaCl

Engku Sofiyyah Hanan Engku Omar Amiruddin; Norinsan Kamil Othman; Rabiahtul Zulkafli

CO_2 corrosion of mild steel constitutes a significant integrity threat within hydrocarbon transport systems, particularly in crude oil and natural gas pipelines. This study comparatively investigates the temperature-dependent corrosion behaviour of mild steel in CO_2 -saturated and CO_2 -free environments using weight loss test, surface morphology and phase characterisation. Mild steel samples were exposed to two media which are CO_2 -saturated 3.5% NaCl solution and 3.5% NaCl solution without CO_2 , at 25°C, 40°C, 60°C and 80°C for 7 days. Morphology changes, microstructure of corrosion products, cross sections and phase characterisation were analysed using field emission scanning electron microscopy (FESEM), optical microscope (OM) and X-ray diffraction (XRD). Results from weight loss tests found that an increase in temperature resulted in accelerated corrosion rate. However, in CO_2 environment, a decrease in corrosion rate was observed at higher temperatures attributed to the emergence of protective layers. FESEM images revealed that mild steel in CO_2 environment underwent uniform corrosion whereas localised corrosion was observed in the absence of CO_2 . The corrosion scale thickened with increasing temperature in both media, however, the development of a protective carbonate layer in the CO_2 environment inhibited further deposition, leading to a thinner final layer. XRD analysis confirmed the formation of siderite, hematite and ferrous hydroxide in a CO_2 environment while cementite, hematite and ferric oxyhydroxide were identified in a non- CO_2 environment. These findings demonstrate that temperature and environmental conditions critically influence the corrosion mechanisms and product formation where the protective siderite scales significantly mitigate corrosion in CO_2 -rich systems at higher temperatures.

ICONMAR 14: Formulation and characterization of lemon myrtle essential oil in water nanoemulsion prepared via ultrasonication

Mohd Yunus Abd Shukor; Siti Noraini Bunawan; Mohd Izuan Effendi Halmi; Noor Azlina Masdor; Nor Adeela Yasid

This study focused on the formulation and characterization of a lemon myrtle essential oil in water nanoemulsion prepared via ultrasonication. The effects of key process parameters, specifically sonication power amplitude, sonication time and concentration of surfactant, were optimized based on droplet size, polydispersity index (PDI) and the stability of the nanoemulsion. The optimum formulation that produced the smallest droplet size of approximately 12.52 nm and PDI of 0.153 was obtained at 100 % sonication power amplitude for 5 min, using 1 % (w/w) lemon myrtle essential oil and 4 % (w/w) surfactant. The optimized nanoemulsion was then characterized based on its physical appearance, droplet distribution, zeta potential, morphological shape, Fourier-transform infrared spectroscopy (FTIR) analysis, and storage stability. The nanoemulsion displayed a clear appearance with a zeta potential of -38.1 mV, and transmission electron microscopy (TEM) exhibited a spherical morphology. FTIR analysis confirmed that there were no chemical changes in the lemon myrtle essential oil components following the ultrasonication process. The nanoemulsion remained physically stable for up to 180 days when kept at both room temperature and 4 °C. This work demonstrates the successful development of a stable lemon myrtle essential oil in water nanoemulsion by an ultrasonication-assisted method with prospective applications in agricultural industries, food and pharmaceutical.

ICONMAR 15: A Comparative Study In Fused Filament Fabrication Using Recycled Polystyrene And Commercial High-Impact Polystyrene

Ng Hue Thung Calista; Seong Chun Koay; Chen Hunt Ting; Ming Yeng Chan

Discarded expanded polystyrene (EPS) poses significant environmental challenges due to its accumulation in landfills and resistance to degradation. Upcycling EPS into 3D-printable recycled polystyrene (rPS) filament for use in fused filament fabrication (FFF) shows a promising sustainable solution. This study explores the mechanical recycling of EPS into rPS resin, which is then extruded into 3D-printable filament using a 3DEVO filament maker. A key focus is on studying the filament's properties and properties of its printed specimen. Filament diameter was monitored in real-time during extrusion using DevoVision software. The results showed that rPS filament achieved an average diameter of 1.75 mm with a standard deviation of ± 0.03 mm when extruded at 200 °C. Extrusion at temperatures above 200 °C resulted in filament diameters exceeding 1.75 mm. Specimens printed with rPS filament exhibited higher tensile strength, tensile modulus, and elongation at break, but lower impact strength compared to those printed with commercial high-impact polystyrene (HIPS) filament. Micrographs show that HIPS is a more ductile material, which contributes to its better impact strength. However, due to poor layer adhesion during printing, it exhibited lower tensile properties. The onset thermal degradation temperature of rPS decreased by about 3% during the recycling process from EPS to filament. However, this reduction does not limit the use of rPS for FFF printing applications, as the printing temperature remains lower than its thermal degradation onset. Despite HIPS displaying greater thermal stability, rPS demonstrates strong potential as a sustainable printing material.

ICONMAR 16: Electrospun Nanofibers from Durian Rind-Derived Nanocellulose: Influence of Tween 20 And Tween 80 On Morphology and Structure for Livestock Semen Preservation

Azima Azmi

This study explores the utilization of nanocellulose derived from durian rind as a reinforcing agent in electrospun nanofibers intended for potential use in livestock semen preservation. Nanocellulose was extracted through alkaline treatment followed by acid hydrolysis and incorporated into polyvinyl alcohol (PVA) solutions. Two surfactants, Tween 20 and Tween 80, were investigated to assess their influence on nanocellulose dispersion and fiber morphology during electrospinning. The electrospun nanofibers were characterized using Field Emission Scanning Electron Microscopy (FESEM), Fourier-Transform Infrared Spectroscopy (FTIR), and X-ray Diffraction (XRD). FESEM analysis showed that fibers produced with Tween 80 had more uniform diameters and smoother morphologies compared to those with Tween 20, indicating better nanocellulose dispersion and solution stability. FTIR spectra confirmed the presence of characteristic cellulose and PVA functional groups, with evidence of hydrogen bonding interactions between the matrix and nanocellulose. XRD analysis revealed that nanofibers containing Tween 80 exhibited higher crystallinity, suggesting enhanced molecular alignment and structural integrity. The improved morphology and crystallinity of fibers with Tween 80 imply better physical stability and potential barrier properties, which are desirable for preservation applications. This research demonstrates the feasibility of converting agricultural waste into high-value nanomaterials and highlights the importance of surfactant selection in tailoring electrospun fiber properties. The resulting nanocellulose-based electrospun membranes show promise as a novel, biocompatible material for livestock semen preservation, offering a sustainable alternative to conventional synthetic supports.

ICONMAR 17: Exploring Electrospun Nanofiber Encapsulation As An Alternative To Cryopreservation For Semen Preservation

Ainaa Abdul Kahar; Muhammad Zaidi Abu Bakar; Azima Azmi; Mohamad Izwan Dzulkifli; Abdul Mu'in Hassan Basri; Khalisanni Khalid; Ainu Husna M.S. Suhaimi; Julie Marzlinda Mohd. Razaki

Preservation of semen plays a crucial role in artificial insemination and livestock genetic improvement programs. Traditional cryopreservation techniques have limitations, including ice crystal formation, oxidative stress, and reduced post-thaw viability. As a solution, nanotechnology and electrospinning techniques have been explored to enhance the stability, viability, and motility of preserved semen at room temperature storage. This study investigates the use of polyvinyl alcohol (PVA) and sucrose nanofibers as a novel matrix for semen preservation. This research aims to develop a nanofiber-based medium composed of polyvinyl alcohol (PVA) and sucrose using the electrospinning process, to enhance the viability and preservation of semen. The PVA and sucrose solution was prepared by dissolving PVA in water and adding sucrose as a cryoprotectant. The mixture was electrospun under controlled conditions to produce a nanofiber matrix. Semen was mixed with the electrospun nanofibers polymeric mixture into five different formulations and the distribution of semen within the nanofiber network were evaluated using field emission scanning electron microscopy (FESEM).

The semen samples were dissolved in saline and assessed for motility and viability. The electrospun PVA-sucrose nanofibers demonstrated excellent encapsulation properties, providing a protective environment for semen structure. Post-electrospinning analysis revealed that the nanofiber-based preservation medium significantly improved sperm viability and motility at Formulation 5 (reduced concentration of PVA with sucrose addition). The combination of PVA and sucrose in the nanofiber structure played a key role in maintaining semen integrity during electrospinning. This approach enhances semen quality, offering a potential alternative to conventional cryopreservation techniques. Further research is needed to optimise fiber composition, explore the incorporation of other polymeric matrix, and evaluation long-term storage effects in developing new methods for assisted reproduction material preservation without the need for freezing.

ICONMAR 18: Effect of Size and Humidity Variations on Rhenium Disulfide-coated Fiber Optic Humidity Sensors: Experimental Analysis and Performance Evaluation

Maizatul Zolkapli

The correlation between humidity control, measurement, and daily human life is significant. Precise humidity measurement plays a crucial role in various applications, including industrial manufacturing, agricultural output, environmental monitoring, and food safety. This research focuses on the development and evaluation of a fiber optic humidity sensor incorporating rhenium disulfide (ReS_2) as a sensitive coating material. Leveraging the unique electronic and optical properties of ReS_2 , a two-dimensional material, it is applied as a coating on the surface of the fiber optic sensor. The experiment begins with fabricating tapered optical fibers using the pull-heat method to achieve diameters of 4 μm , 7 μm , and 10 μm . The tapered fiber is then connected to a tunable laser light source and an Optical Spectrum Analyzer to assess sensor performance under humidity levels ranging from 40% to 80% RH. The sensor's performance is analyzed in terms of sensitivity and linearity with the ReS_2 -coated fiber optic humidity sensors. The results indicate that tapered fibers with diameters of 4 μm , 7 μm , and 10 μm coated with rhenium disulfide exhibit increased sensitivity compared to non-coated fibers. Specifically, the ReS_2 -coated sensors demonstrated a 6–8% improvement in sensitivity for the 7 μm and 10 μm fibers under relative humidity conditions of 40% to 80% RH. In conclusion, coating optical fibers with ReS_2 enhances sensor sensitivity, making them more effective for environmental humidity sensing.

ICONMAR 19: TTapered Optical Fiber Coated With Rhenium Disulfide (ReS₂) For Formaldehyde Sensing

Aziati Binti Awang; Norhafizah Burham; Naimah Isa; Amir Syazwan Tukiman; Maizatul Zolkepli

Formaldehyde (CH₂O), a toxic, colorless, and flammable gas, is widely used in various industries and household products. Prolonged exposure to formaldehyde poses serious health risks, including irritation of the respiratory tract and an increased risk of cancer. Current formaldehyde detection methods often suffer from limitations such as low sensitivity, high cost, and impracticality for broad adoption in residential and industrial settings. This research explores the development of a novel formaldehyde sensing solution utilizing tapered optical fibers (TOFs) coated with Rhenium Disulfide (ReS₂). The study focuses on fabricating TOFs with precise heating length 3mm and waist diameter (5μm and 10μm) using the heat and pull method and characterizing TOF with ReS₂ coatings. The TOFs performance has been tested by using tunable light source and optical power meter. Experimental evaluations are carried out by exposing the TOFs to formaldehyde vapor at concentrations of 1%, 2%, 3%, 4%, and 5% at different relative humidity conditions of 30% to 90%. Results depicted that the 5μm TOF has better stability and sensitivity for formaldehyde sensing as compared to 10μm TOF. Additionally, coating the TOF with Rhenium Disulfide (ReS₂) improved the sensitivity by 60-80%. The optimized sensor achieved the sensitivity of -0.05839 dB/%RH and linearity over 95%. The measurements showed excellent stability when all tested concentrations on both TOFs were maintained for 600 seconds at 90% RH. This proves that it's demonstrated the precise formaldehyde sensing for environmental sensing applications.

ICONMAR 20: Effect of Calcination on The Structure of Montmorillonite and Their Adsorption Of Aflatoxin B1

Noor Azlina Masdor

Aflatoxins are secondary metabolites produced by *Aspergillus flavus* and *Aspergillus parasiticus*. Among them, aflatoxin B1 (AFB1) has garnered the most attention due to its toxigenic, mutagenic, and carcinogenic properties. Researchers worldwide have explored various strategies to mitigate the presence of these hazardous toxins. One of the most cost-effective approaches for reducing AFB1 contamination is the addition of clay as a toxin binder in animal feeds. Montmorillonite (MMT), a type of clay, exhibits excellent adsorption capacity for AFB1, non-toxic and safe for animals. MMT adsorbs AFB1 in the gastrointestinal tract, facilitating its excretion through feces and thereby reducing its toxic effects. Modification of MMT by heat treatment, also called calcination, can alter their adsorption characteristics and enhancing its ability to bind AFB1. In this study, the physical structure and the adsorption capacity of a modified calcined MMT and raw MMT on AFB1 were compared. The adsorption capacity of AFB1 was evaluated through in vitro experiments. Each modified and raw MMT sample was mixed with AFB1 at a concentration of 100 ppb and incubated at 30°C for 2 hours under constant agitation at three different pH (pH 2.5, 5.2, and 6.6). Following centrifugation at 4,000 rpm for 30 minutes, the supernatant containing unbound AFB1 was analysed using high-performance liquid chromatography (HPLC). The percentage of AFB1 adsorption was calculated by comparing its initial and final concentrations in the supernatant. The results indicated that MMT calcined at 300°C exhibited the highest AFB1 adsorption, with removal efficiencies of 79.19% at pH 2.5, 92.16% at pH 5.2, and 91.55% at pH 6.6. These values represent increases of 15.2%, 19.2%, and 5.87% of binding capacity, respectively, compared to raw MMT.

ICONMAR 21: Synthesis And Characterization Of Activated Carbon From Bamboo Charcoal

Anis Syafiqa Rosman, Shazlina Johari, Muhammad Mahyiddin Ramli, Norizah Abd Karim, Ismariza Ismail, Nurul Aishah Amran

This study focuses on the synthesis and characterization of activated carbon derived from bamboo charcoal using a pyrolysis method. By varying the heating temperatures (300°C, 400°C, and 500°C) and soaking times in a nitrogen environment, the effects of thermal treatment on the structural and adsorption properties of the activated carbon were investigated. Characterization was carried out using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), and Ultraviolet-Visible Spectroscopy (UV-Vis). The findings revealed that higher heating temperatures, particularly at 500°C with a 3-hour soaking period, yielded activated carbon with enhanced porosity, crystallinity, and adsorption characteristics. This research demonstrates the potential of bamboo charcoal as a sustainable precursor for high-quality activated carbon, aligning with growing demands in environmental and industrial applications.

ICONMAR 22: Optimizing BaTiO₃ Content in Flexible PVDF Films for Enhanced Piezoelectric Nanogenerator Performance

Muhammad Izz Danial Mohd Muzaini; Habibah Zulkefle; Nurfadzilah Ahmad; Norhafizah Burham; Dayana Kamaruzaman; Nor Diyana Md Sin; Puteri Sarah Mohamad Saad

This study addresses the underutilization potential of harvesting mechanical energy from routine human activities, while also addressing environmental and flexibility concerns associated with conventional lead-based piezoelectric materials. With increasing demand for sustainable and eco-friendly energy solutions, lead-free piezoelectric technologies have emerged as a promising alternative, particularly in the development of flexible nanogenerators. In this study, the flexible PVDF/BaTiO₃ composite films fabricated via drop casting with variation of BaTiO₃ filler loadings (1 wt%, 3 wt%, and 5 wt%) were analyzed for their influence on piezoelectric performance. Characterization techniques included contact angle, FESEM, XRD, FTIR, and piezoelectric output. Results showed that 1 wt% BaTiO₃ yielded the highest output voltage (8.24 V), attributed to optimal β -phase formation. However, loadings beyond 3 wt% led to void formation and particle agglomeration, reducing β -phase crystallinity and overall performance. The findings demonstrate that controlled BaTiO₃ loading enhances energy harvesting efficiency while promoting environmental safety and device flexibility.

ICONMAR 23: Dual-sensitizer loaded nanodroplets effects on reactive oxygen species production under microwave hyperthermia exposure

Shazwan Abd Shukor

Microwave hyperthermia (MWH) is an application using mild heat at a temperature range of 40-42°C to treat cancers. The source of local mild heat is emitted from the friction forces of oscillated dipole actions of water molecules in tissues. The local mild heat attracts temperature-sensitive anticancer drugs which allows efficient chemotherapy and reduce side effects. Unfortunately, studies which link MWH with the production of reactive oxygen species (ROS) are still lacking. Therefore, in this study, the aim is to screen and evaluate ROS production of dual-sensitizer loaded nanodroplets under MWH exposure in cell-free solution. This study will act as an alternative intervention to ultrasound. Two types of phantoms were used namely agar phantom (AP) and gelatine-based tumour mimicking phantom (TMP) which acted as tissue barrier models. An ROS assay, potassium iodide (KI) was used to detect and quantify ROS production mainly hydrogen peroxide upon UV light absorbance at 350nm. Experiments were run in dark. Based on results, ROS mainly hydrogen peroxide was clearly produced only when sensitizers were encapsulated in nanodroplets under MWH exposure. There were no significant differences in ROS productions between the dual and single-sensitizer loaded nanodroplets under MWH exposure in each phantom ($p > 0.05$). However, significant differences in ROS productions were recorded where a higher ROS production was obtained in the dual-sensitizer loaded nanodroplets compared to their corresponding unencapsulated form under MWH exposure in AP ($p < 0.01$) and TMP ($p < 0.05$). Significant differences in ROS production did not clearly occur between the dual and single-sensitizer loaded nanodroplets but developed between dual-sensitizer loaded nanodroplets and their corresponding unencapsulated sensitizer form under MWH exposure in each phantom. Therefore, nanodroplets may play a role in promoting significant ROS production through the influence of MWH exposure, similarly to outcomes found with ultrasound exposure. However, further studies should be performed to elucidate underlying mechanisms which stimulate sensitizers to generate ROS under MWH exposure.

ICONMAR 24: Ecological Sustainability of N Utilisation and Leaching in *Solanum lycopersicum* var. *cerasiforme* via Green Synthesis of Zeolite LTA

Norsuhailizah sazali; Zawati Harun; Norazlianie Sazali

A sustainable green synthesis of zeolite from kaolin was cooperated in soil to reduce the leaching effect for environmental sustainability. An experiment was conducted to determine the effects of cation-binding mineral zeolite on nitrogen leaching, yield, and nitrogen absorption of cherry tomatoes in a pot. There are seven distinct experimental treatments: Control High (CH); Control Standard (CS); Control Low (CL); 2g of zeolite(2gZ); 4g of zeolite(4gZ); 6g of zeolite(6gZ); and 6g of industrial zeolite (6gIZ) grown in a greenhouse with randomized design. According to the results, 6g of zeolite demonstrates the smallest significant difference between the concentration mean values of nitrite and nitrate compared to the other treatments. Regarding the average nitrogen concentration in the soil at each harvest, 6g of zeolite added to the soil has the highest value compared to other treatments. There is no significant difference in fruit weight for all treatments, but 6g of zeolite results in the highest aggregate mean weight compared to other treatments. With its capacity as a CEC, this green synthesis zeolite reduced the discharge of water from a container while increasing the average nitrogen concentration in the soil. The elevated CEC of zeolite also demonstrates an increase in cherry tomato weight.

ICONMAR 26: Comparative Analysis on Performances of PDMS based Electromagnetic Vibrational Energy Harvester (EM-VEH): Functionality Test on Rotating Machinery

Nur Indah Asmantowi

This study evaluates the performances of an energy harvester prototype. The fabricated energy harvester comprises of a PDMS-based mechanical membrane and an electromagnetic component, designed to convert vibrational energy into low power electricity. The prototype was tested on three distinct vibrating machines: a Dynamic Rotor Machine, a motorcycle engine, and a Boeing 737-600 aircraft turbine. Vibrational frequency was measured using an FFT CF360A analyzer, while output voltage was recorded via a Hantek 20MHz 2-channel digital oscilloscope connected to a PC. The highest output voltage 0.989 Volt was achieved at 40 Hz (14,800 RPM) using the Dynamic Rotor Machine. In contrast, the aircraft turbine yielded significantly lower voltage (0.25 V) despite higher vibrational frequency (200 Hz). These results demonstrate the prototype's efficacy in low-frequency environments and highlight its potential for applications in rotating machinery energy harvesting.

ICONMAR 27: Enhancing Electron Transport in Silicon Self-Switching Devices: A Study on Triangular Barrier-Induced Ballistic Effects

Tan Yi Liang; Faradilla Aziz; Shahrir Rizal Kasjoo; Ili Salwani Mohamad; Mohd Natashah Norizan; Banu Poobalan; Zarimawaty Zailan; Nor Farhani Zakaria; Mohd Fairus Ahmad

With the increasing demand for high-frequency applications due to congestion in lower frequency bands, the need for high-performance diode detectors has become critical. Achieving fast and efficient high-frequency response requires diodes with strong rectification capability and sharp nonlinearity. These electrical characteristics, particularly the I–V behavior of the device, strongly influence key performance metrics such as the curvature coefficient and current responsivity. Derived from the I–V curve shape, these metrics reflect the device's nonlinear behavior. This study investigates how geometrical modifications influence ballistic transport and electrical performance in silicon-based self-switching devices (SSDs). A triangular potential barrier is introduced within the channel to promote ballistic-like electron transport, especially when the channel dimensions are comparable to or smaller than the mean free path (MFP) of charge carriers. Device structures are designed using Silvaco Devedit 3D and simulated in ATLAS. I–V characteristics are extracted, and corresponding curvature coefficients and current responsivity calculated to assess rectification. A curvature coefficient of at least 3.5 V^{-1} was targeted to indicate strong rectification. Among the simulated structures, the SSD with integrated planar and triangular trenches achieved the highest curvature coefficient and significantly enhanced forward current. This geometry is considered the most promising within the scope of the simulations, with its narrow trench width and short channel length suggesting the possibility of quasi-ballistic or ballistic-like transport. Results further indicate that both the size and shape of the triangular barrier critically affect electrical characteristics, showing their importance for future SSD optimization.

ICONMAR 28: Influence of Nb doped TiO₂ synthesized via the solvothermal method on the efficiency of dye-sensitized solar cells.

Hidayani Jaafar

In this study, niobium (Nb) doped TiO₂ nanoparticles, synthesized via the solvothermal method, were utilized to fabricate TiO₂ based dye-sensitized solar cells (DSSCs), with *E. conferta* fruit extract serving as the photosensitizer and ethanol used as the solvent. The synthesized metal oxide semiconductor nanoparticles were characterized using XRD, FESEM, BET, and UV-Vis spectroscopy. The electrochemical parameters, including open-circuit voltage, short-circuit current density, and fill factor, were determined through J-V characterization. The influence of Nb doping on the efficiency of TiO₂ based DSSCs was investigated, revealing an improvement in the light-harvesting efficiency of the cells. The results confirm that doping TiO₂ nanoparticles is an effective strategy for enhancing the efficiency of solar cell applications.

ICONMAR 30: Cellulose Nanocrystal-Aluminium Oxide (CNC-Al₂O₃) for Tribology Application in Internal Combustion Engine: Stability, Thermophysical and Tribological Behavior

Sakinah Muhamad Hisham; Kumaran Kadirgama; Syahmi Saari; Norazlianie Sazali; Mohd Kamal bin Kamarulzaman

The experimental study investigates the stability, thermophysical, and tribological characteristics of cellulose nanocrystal (CNC), aluminum oxide (Al₂O₃), and hybrid CNC-Al₂O₃ nanolubricants as additives in SAE 40 engine oil. Stability assessments were conducted through sedimentation observation, UV-visible spectroscopy, and zeta potential analysis at various concentrations (0.01% to 0.05%) and temperatures (30°C to 90°C). The hybrid CNC-Al₂O₃ nanolubricants demonstrated excellent dispersion stability with zeta potential values exceeding 150 mV at optimal concentrations. Thermophysical property analysis revealed that dynamic viscosity increased significantly, with the hybrid system showing a 56% enhancement at 0.03% concentration and 30°C. The coefficient of friction (COF) results showed remarkable improvement, with 0.01% CNC-Al₂O₃ concentration achieving a 78.6% reduction compared to base oil. The specific wear rate demonstrated progressive improvement with increasing concentration, reaching optimal values of 0.016 mm³/Nm at 0.05% concentration. These findings indicate that CNC-Al₂O₃ hybrid nanolubricants at optimal concentrations provide enhanced tribological performance and improved thermophysical properties, making them promising candidates for internal combustion engine applications.

ICONMAR 32: Functional Groups Analysis and Optical Properties of Oyster Mushroom's Mycelium Using Sorghum Media with FTIR Spectrophotometer

Lusia Anita Br. Sagala; Nazopatul Patonah Har; Irzaman

The successful establishment of oyster mushroom seeds depends on Potato Dextrose Agar (PDA). In this study, the sterilization level of media varied from level 1 to 3. For each sterilization level, PDA were steamed at 102 °C for 60 minutes. The best result was found at the third level which was shown by growing of mycelium. All of spread seeds (F1) produced were good and not contaminated. The result of growing spread seeds by using sorghum media were not contaminated. The characterization result of FTIR mycelium from pure culture (F0), spread seeds (F1), and planting seeds (F2) indicated the stretching vibration. Stretching vibration showed of several functional groups. They were C-O, C-N, C=O, C-H, O-H, and β -D-glukan. These results suggest that the energy required for mycelium growth in the spread seedling culture media is smaller than that required for planting seedling culture media. This is following the relationship between photon energy which is directly proportional to the wave number.

ICONMAR 38: The Influence of Network Topology on the Sensitivity of Fiber Bragg Grating Sensors: Serial and Parallel Approaches

Anas Hambali Ahmad Abas; Mohammad Syuhaimi Ab-Rahman; Norhidayah Ahmad; Muhamad Hazwan Wahab

The sensing configuration of Fiber Bragg Grating (FBG) plays a crucial role in ensuring the accuracy and reliability of monitoring systems. This study presents a comparative analysis between two primary network topologies (serial and parallel) to evaluate their sensitivity towards temperature and strain variations. Simulations were conducted using OptiSystem 21.0 software, modeling three FBG sensors in each configuration. Results indicate that the parallel configuration provides a more stable signal response, uniform power distribution, and lower crosstalk compared to the serial setup. The average temperature and strain sensitivities in the parallel arrangement were 10.17 pm/°C and 1.11 pm/ $\mu\epsilon$, respectively, which are higher than the 8.32 pm/°C and 0.89 pm/ $\mu\epsilon$ observed in the serial configuration. Additionally, the parallel system exhibited lower standard deviations, reflecting more consistent measurement stability. These findings confirm that the parallel FBG configuration is more suitable for multi-point sensing applications requiring high performance, signal stability, and measurement accuracy. This research offers valuable insights for engineers and researchers in selecting the most appropriate FBG network architecture for real-time monitoring in modern optical systems.

ICONMAR 41: Effect of Silica Compositions on Phase Transformation and Compressive Strength of Sintered Perlis Dolomite

***Nur Hasnidah Ahmad Shukeri; Heah Cheng Yong; Hasmaliza Mohamad;
Syed Nuzul Fadzli Syed Adam***

Natural dolomite sedimentary rocks, which can be found in abundance in Perlis is a carbonate mineral rich with calcium and magnesium elements. These both elements were important and typically found in bioceramic materials especially for hard tissue implant material. Even though raw Perlis dolomite powder has other various elemental compositions, it lacks important component such as silica which commonly acts as glass network former, in resulting limits its potential application as bioceramic materials. This study investigates the effects of different compositions of silica addition on sintered Perlis dolomite and the changes in its phase transformation, structure and compressive strength were analyzed. Perlis dolomite with different ratios of silica (30, 35 and 40 wt. %) were ball milled, compacted into pellets and sintered at 1300°C for 4 hours. The results show that the silica contents gave a significant impact on the phase transformation of the resulting materials involving akermanite, monticellite and merwinite. At lower silica content (30S), monticellite and merwinite become the dominant phase with slight amount of akermanite. But increasing the silica content leads to the formation of akermanite phase, while reduces the monticellite and merwinite phase before merwinite phase completely disappearing at 40S. Higher silica content in dolomite enhances phase stability by increasing akermanite phase in the sintered samples with improvement in compressive strength (14-18 MPa), which promising for bone tissue regenerations.

ICONMAR 42: Effect of Bending Radius on Signal Attenuation in Single- and Multi-Mode Optical Fibers: Application Toward miRNA Biosensing in *Crocodylus porosus*

Mackerina Awing; Noor Azie Azura Mohd Arif

This study investigates the effect of bending radius on signal attenuation in single-mode and multimode optical fibers to support the future development of microRNA (miRNA) biosensors for *Crocodylus porosus* detection in Sarawak. Experiments were conducted at 1310 nm, 1490 nm, and 1550 nm wavelengths with bending radii from 0.5 cm to 2.0 cm. Single-mode fibers showed high bending sensitivity, with maximum loss reaching 65.12 dB at 1550 nm and 0.5 cm radius. Multimode fibers showed minimal loss. These results provide baseline data for designing U-shaped fiber biosensors for species-specific miRNA detection.

ICONMAR 43: Computational Analysis on The Influence of Heterojunction Geometries to Electrical Performance of Photovoltaic Cells

Prasanna Dass; Shamsul Amir Abd Rais; Mohd Fairus Ahmad; Shahrir Rizal Kasjoo; Ili Salwani Mohamad; Mohd Natashah Norizan; Safizan Shaari; Sora-at Tanusilp; Nor Farhani Zakaria

The increasing demand for renewable energy sources has high-lighted the importance of optimizing photovoltaic cell technologies. Hetero-junction (HJT) silicon photovoltaic (PV) cells are recognized for their high efficiency, but the challenges remain in maximizing their performance through structural optimization. The efficiency of HJT cells is often hindered by issues related to charge carrier recombination and suboptimal electric field distribution, necessitating innovative solutions to overcome these limitations. This study investigates the optimization and enhancement of HJT silicon PV cells by varying their structural geometries. The primary geometries analyzed include planar, columnar, and pyramid configurations, each with different variations. Using Silvaco TCAD Simulator software, the research focuses on optimizing the electric field distribution, hole density, and charge carrier concentrations to improve the overall performance of HJT PV cells. The findings reveal that the planar geometry with an N-type top region achieves the highest efficiency of 16.5247%, due to its uniform electric field distribution and effective charge separation. The pyramid geometry also shows significant potential due to its enhanced light trapping capabilities, while the columnar geometry, despite its innovative design, requires further optimization. This study provides valuable insights into the effects of geometric modifications on the essential characteristics of HJT cells and offers recommendations for future research to further enhance photovoltaic cell performance.

ICONMAR 49: Comparative Analysis of Near-Infrared Light Absorption in Glucose and Simulated Blood Component Solutions with and without Ultrasound Enhancement

Muhamad Amin Abd Wahab; Puteri Eryiena Maysara Yazit; Mohamad Ikhwan Jamaludin; Mohamad Ikhwan Kori; Nasrul Humaimi Mahmood; Muhammad Faiz Md Shakhiah; Azli Yahya

Diabetes is a major global health issue, with approximately 537 million adults affected in 2021—a figure projected to reach 783 million by 2045. Early diagnosis and continuous monitoring are essential for effective management. However, current tools such as glucometers and sensor patches are either invasive or minimally invasive, causing discomfort, especially in children and the elderly. Recent advances in non-invasive monitoring using near-infrared (NIR) light show promise, but challenges remain, including interference from ambient light, water absorption, and reducing substances. Studies suggest that integrating ultrasound with NIR can improve measurement contrast and sensitivity. This study aims to enhance the correlation between glucose concentration and NIR absorption by incorporating 1 MHz ultrasound. A NIR transmitter and silicon photodiode circuit were developed, and measurements were conducted on glucose solutions (0–300 mg/dL) with and without 30 mg/dL ascorbic acid to evaluate selectivity. Results showed that ultrasound improved sensitivity from $72.24 \mu\text{V}/\text{mg}\cdot\text{dL}^{-1}$ to $77.56 \mu\text{V}/\text{mg}\cdot\text{dL}^{-1}$ in glucose-only samples and from $105.6 \mu\text{V}/\text{mg}\cdot\text{dL}^{-1}$ to $126.3 \mu\text{V}/\text{mg}\cdot\text{dL}^{-1}$ in glucose + acid samples, corresponding to 7.4% and 19.6% improvements, respectively. Linearity (R^2) also improved, especially in glucose + acid samples (from 0.7859 to 0.9634), indicating higher measurement reliability. Selectivity remained consistently high across all concentrations (>98%), with minor variations, confirming the system's ability to distinguish glucose from interfering substances. In conclusion, the NIR prototype integrated with ultrasound demonstrated improved sensitivity, stronger linear correlation, and high selectivity, supporting its potential as a non-invasive glucose monitoring solution.

ICONMAR 52: Electrochemical Performance of Electrodeposited Gold Nanoparticles on Graphene Oxide for Hydrogen Peroxide Detection

Nur Syakimah Ismail; Nur Hamidah Abdul Halim; Tamiya Eiichi; Nurjuliana Juhari; Norhayati Sabani

Electrochemical metal deposition offers a simple and rapid approach to synthesizing metal nanoparticles on conductive surfaces via nucleation and growth mechanisms. In this study, gold nanoparticles (AuNPs) were electrodeposited onto bare carbon sheets (CS) and graphene oxide-modified carbon sheets (GO/CS) using the chronoamperometry method. Scanning Electron Microscopy (SEM) confirmed the successful formation of AuNPs on both substrates, with a 47.19% reduction in nanoparticle size observed on GO/CS. The electrocatalytic performance of CS, GO/CS, AuNPs/CS, and AuNPs/GO/CS was evaluated in ferricyanide solution, where the AuNPs/GO/CS electrode exhibited the highest current density and fastest electron transfer. Hydrogen evolution reaction (HER) studies in acidic medium further demonstrated the enhanced catalytic performance of AuNPs/CS and AuNPs/GO/CS, with current increases of 283.74% and 363.37%, respectively, indicating efficient proton reduction to hydrogen. Additionally, only AuNPs/CS and AuNPs/GO/CS electrodes detected a distinct hydrogen peroxide (H_2O_2) oxidation peak at 0.98 V, with the AuNPs/GO/CS electrode showing a 12.11% higher peak current density. A linear correlation between charge and H_2O_2 concentration was observed over a range of 0.001–10 mM, highlighting the potential of AuNPs/GO/CS electrodes for sensitive electrochemical sensing applications.

ICONMAR 54: Shape and Size Dependent Sensing Enhancement by Gold Nanomaterials

Mohamad Danial Hairul Anuar; Thangavel Lakshmipriya; Subash C. B. Gopinath; Tijjani Adam; Mohammed Mohammed; Evan T. Salim; Makram A. Fakhri

Gold nanomaterials (GNs) of different shapes (nanospheres, nanorods, nano stars) and sizes exhibit properties. The surface plasmon resonance of GNs can be tuned by changing their shape and size, which affects the binding efficiency of target antigen and antibody interaction. The shape of GNs can also affect the orientation of attached antibodies and antigens, leading to improved specificity in sensing platforms. This study has investigated the morphological and optical properties of GNs, evaluated the impact of different sizes and shapes on ELISA surfaces, and optimized the conditions to enhance the sensitivity. The morphology and optical properties of GNs was studied using a 3D nanop profiler, UV-Visible spectrophotometer. Gold nanospheres (GNPs) with 10, 15 and 30 nm, nanorods with 500,700 and 980 nm, gold nanostars with 60 nm were employed. Smaller GNPs may have higher binding capacities due to their increased surface area to volume ratio. The height and roughness of anti-spike protein antibody morphology increased when 10 nm GNPs were added, demonstrating attachment between spike-antibody molecules and GNPs. The attained limit of detection (LOD) is 1 pM, where the limit of quantification (LOQ) is 10 pM. Gold nanospheres and nanostars behave better than nanorod and provided good LOD and LOQ.

ICONMAR 55: Sensors for Polystyrene Nanoplastics Detection in Water Samples

Nurul Iman Ramzan; Mohamad Faris Mohamad Fathil

Polystyrene nanoplastics (PS-NPs) are increasingly discovered in aquatic ecosystems, posing ecological and human health problems. Identifying PS-NPs in complex environmental matrices remains difficult due to their small dimension, chemical passiveness, and existence of background interferences. Recent improvements in sensor and biosensor technologies have shown promise for improving the sensitivity, selectivity and portability of PS-NPs detection systems. However, maintaining high detection accuracy while minimizing false signals and matrix interferences remains a significant challenge. Limited selectivity, sensor fouling, and a lack of standardization across detection platforms add to the complexity of analysis. To improve recognition performance, several ways have been investigated, including surface functionalization, nanomaterial immobilization and substrate modification. These strategies seek to overcome limitations in sensitivity, repeatability, and environmental applicability. As a result, more advanced sensor platforms capable of detecting low concentrations in real time are urgently needed. This study highlights recent research on sensor and biosensor technologies used to detect PS-NPs, with a focus on the integration of nanomaterials and molecular recognition elements. Literature from Science Direct and IEEE Xplore indexed journals until June 2025 was reviewed. The findings indicate that hybrid sensor systems, particularly those employing plasmonic nanoparticles and functionalized nanostructures, are at the forefront of PS-NPs detection research. To find novel sensing methodologies, this review examines current technologies and compares their merits using recent case studies and performance analysis.

ICONMAR 57: Impact of Nb Addition on Oxide Growth Characteristics of HR120 Alloy in the Fe-40Ni-24Cr System Under Isothermal Oxidation Conditions

Noraziana Parimin

The isothermal oxidation tests were conducted on HR120 alloy in the Fe-40Ni-24Cr system to investigate oxide growth characteristics in terms of oxidation kinetics, oxide phases, and oxide scale morphology. The alloy underwent heat treatment at 1050 °C and 1150 °C for 3 hours, followed by rapid water quenching. The samples were categorized based on grain size as having either low grain diameter (from 1050 °C treatment) or high grain diameter (from 1150 °C treatment). The average grain diameter was measured using the line intercept method in accordance with ASTM E112. The heat-treated samples were subjected to isothermal oxidation at 500 °C for 500 hours in laboratory air. Post-oxidation, the samples were characterized for oxidation kinetics via weight change measurements, oxide phase identification using X-ray diffraction (XRD), and oxide scale morphology using scanning electron microscopy (SEM) and field emission SEM (FESEM). The results showed that both samples followed a parabolic oxidation rate law. The sample with low grain diameter exhibited a lower parabolic rate constant, indicating a slower oxidation rate. XRD analysis revealed the formation of several oxide phases on the alloy surface. Morphological analysis showed the presence of protruding Nb-rich oxide particles. The high grain diameter sample exhibited an overgrown, non-adherent oxide scale prone to exfoliation. These findings suggest a diffusion-controlled oxidation mechanism influenced by grain size, particularly affecting the development and distribution of Nb-rich oxide structures.

ICONMAR 62: Bamboo Charcoal as a Dual Inhibitor of OxLDL Uptake and Foam Cell Formation

Mutaman Hussein Abdullah; Ahmad Naqib Shuid; Muhammad Mahyiddin Ramli; Rafeezul Mohamed

Atherosclerosis continues to be a primary contributor to cardiovascular disease, mostly caused by the internalisation of oxidised low-density lipoprotein (oxLDL) and the ensuing development of foam cells. This work introduces bamboo charcoal (BC) as a biocarbon that mitigates atherogenesis through a dual-action mechanism: the physicochemical adsorption of oxLDL components and the competitive suppression of receptor-mediated uptake in macrophages. We assessed BC's molecular interactions and biological outcomes using a combination of *in silico* and *in vitro* techniques. Molecular docking and dynamics simulations revealed robust and persistent binding affinities between BC and oxLDL components (oxidised cholesterol and ApoB100), along with critical macrophage receptors such as LOX-1, SR-A1, SR-B1, and TLR-4. Quantum chemical calculations using Density Functional Theory (DFT) indicated the high reactivity of BC, with a narrow HOMO–LUMO gap and an obvious dipole moment. Further analysis revealed thermodynamically favourable binding to oxidised cholesterol. Experimental validation utilising RAW 264.7 macrophages demonstrated that BC markedly decreased total cholesterol accumulation and lipid droplet formation in cells treated with oxLDL. ELISA experiments demonstrated a significant reduction of TNF- α and IFN- γ secretion in supernatant of oxLDL-treated cells co-treated with BC. These findings demonstrate that BC effectively attenuates foam cell formation and inflammatory responses in macrophages by adsorbing oxLDL components and inhibiting receptor-mediated uptake. This dual mechanism highlights BC's potential as a novel therapeutic or nutraceutical strategy for mitigating atherosclerosis progression.

ICONMAR 68: Fabrication and Characterization of Eco-Friendly Screen Printed Electrode Using Activated Rice Husk Carbon Ink for Electrochemical Detection of SAR-CoV-2.

Athirah Amir; Shahidah Arina Shamsuddin; Adilah Ayoib

Rice husk in Malaysia has been treated as agricultural waste for the whole this time. To disposed them, they were usually burnt and this act have caused air pollution to the environment. Few researchers have tried to save the environment by transforming the rice husk into something usefull for example like implementing rice husk into composite panels for furniture. Similar to other organic substance, rice husk can be treated to become activated carbon through control carbonization and activation process. Activated rice husk carbon have been reported to be developed for multiple usage such as in battery storage or fertilizer applications due to its high porosity properties and their flexibility to be surface modified with various functionalities groups. This study is focusing in developing activated rice husk carbon (ARHC) conductive ink that will be used to fabricate in house screen printed electrode (SPE) for detecting SARS-COV-2 viruses (COVID19). To synthesis the ARHC, rice husk was carbonized at 500°C for 2 hours and further treated with activation process at 850°C for 2 hours in NaOH soaking. To prepare the conductive ink, the synthesized ARHC were mix with Polyvinylidene fluoride (PVDF) powder binder and N-Methyl-2-Pyrrolidone (NMP) solvent.

To fabricate the SPE, ARHC conductive ink will be printed as the working electrode (WE) on polyethylene (PE) substrate using screen printing technique. Meanwhile, counter and reference electrode were printed with conventional carbon and Ag/AgCl inks, respectively. The synthesized ARHC was material characterized through surface morphology (FESEM), surface area (BET), surface functionality (FTIR and EDX), and crystallinity (XRD). For COVID19 detection test, ARHC WE was first functionalized with (3-Aminopropyl)triethoxysilane (APTES) and further immobilized with spike protein (SP) antibodies. These surface modification step allowing for the selective detection of SARS-COV-2 viruses through the detection of spike protein (SP) target. This project will evaluate the signal transduction mechanism between SP target and the ARHC surfaces using electrochemical impedance spectroscopy (EIS). For sensitivity and limit of detection (LOD) analysis, current-voltage (I-V) test and EIS analysis were carried out across various concentrations of SP target, ranging from micromolar to picomolar. All this results will be compared with the conventional carbon SPE to see whether the performance of SPE as COVID19 biosensor can be enhanced by implementing ARHC into the SPE system. From the project findings, the hydroxyl (OH) groups formed on the ARHC surface after synthesis enable strong interactions with target biomolecules such as APTES, antibodies, and target viruses at various concentrations. The presence of these OH groups enhance the sensitivity and selectivity of ARHC toward specific biomolecules, making it a promising candidate for the development of low-cost and eco-friendly biosensors. This ARHC-SPE offers a real-time, label-free platform for detecting COVID19. In addition, it aligns with sustainable practices by utilizing agricultural waste and providing an efficient early virus detection tool, thereby helping to prevent the spread of infectious diseases.

ICONMAR 69: The Performance of Natural Enhancement Mixtures as Grounding Enhancement Materials

Nur Iwanina Zafirah Binti Khairul Ridzuan; Chin Leong Wooi

Effective grounding is necessary to ensure safe performance of high-voltage electrical systems. However, achieving low grounding resistance in high grounding resistance conditions is a significant challenge. This study identifies the most effective grounding rod material, determines the optimal Natural Enhancement Mixture (NEM), and evaluates the influence of rainwater on grounding performance. Three rod types (copper, aluminium, and stainless steel) and three NEM (bentonite, vermicast, and coco peat) were tested. Data was collected twice a week over four months under different environmental conditions. Combination of copper rod and coco peat have the best performance. Future work should consider long-term performance and additional organic materials.

ICONMAR 70: Development of a Portable Gold Nanoparticle-Based Sensor for Rapid Malathion Detection

Marlia Morsin, Nur Anis Aqilah Abdul Halim; Suratun Nafisah; Nur Liyana Razali; Zarina Tukiran

The widespread use of pesticides such as malathion in agriculture poses significant risks to human health, ecosystems, and food safety due to contamination of water, soil, and crops. Conventional methods for detecting pesticide residues are highly accurate but impractical for on-site monitoring due to their high cost, complexity, and time-consuming procedures. This study introduces a portable, cost-effective sensor system for real-time malathion detection, integrating gold nanobipyramids as sensing materials, a SparkFun Triad Spectroscopy Sensor, and an Arduino UNO microcontroller. The gold nanobipyramids, with a surface density of approximately 69.623% and an average aspect ratio of 1.65 ± 0.06 , exhibit two resonance peaks: one around 556 nm, associated with transverse plasmon resonance (t-SPR), and another at 716 nm, corresponding to longitudinal plasmon resonance (l-SPR). Sensor responses were recorded through spectral shifts upon exposure to malathion. The spectroscopy sensor was calibrated to detect these shifts and integrated with the Arduino UNO for data processing and display. A custom 3D-printed casing made from biodegradable PLA material housed the system, ensuring portability and user-friendliness. Experimental results validated the sensor's capability to detect malathion with high precision, at concentrations as low as 0.5 mg/mL, offering a rapid and reliable alternative to conventional laboratory techniques. This portable device presents high potential for agricultural workers as an efficient tool for monitoring pesticide residues, supporting sustainable agricultural practices, reducing environmental pollution, and enhancing food safety.

ICONMAR 73: Insertion loss reduction in SAW device through ZnO nanoparticle coating toward cell migration applications

Mazlee Mazalan

Surface acoustic waves (SAW) have been widely utilized for particle manipulation and cell migration due to their high efficiency and non-invasive nature. However, the presence of cell media and PDMS-based confined area can lead to significant insertion loss, which limits their effectiveness in biological applications. In this study, we explored the use of a ZnO nanoparticles to enhance the performance of SAW devices by reducing insertion loss for cell migration applications. Prior to fabrication, simulations were conducted to analyze the effect of the ZnO nanoparticles on the interdigital transducer (IDT). The simulation results indicated an improvement in the reflection coefficient and a significant increase in maximum surface displacement, suggesting enhanced device performance. Following the simulations, the SAW device was fabricated using standard microfabrication techniques, with ZnO nanoparticles coating achieved via spin coating. The presence of the ZnO nanoparticles was confirmed using UV-Vis spectrometry before ZnO nanoparticles coating, while the surface morphology was characterized through scanning electron microscopy (SEM). Electrical testing of the fabricated device using a vector network analyzer (VNA) revealed a substantial reduction in insertion loss compared to the SAW device without the ZnO nanoparticles. This reduction in insertion loss suggests that the ZnO nanoparticles improves the device's ability to generate acoustic waves with higher efficiency. This improvement enables the device to induce higher mechanical stress on cells, highlighting its potential for applications in cell migration and other biomedical fields.

ICONMAR 74: Impact of Source Material Selection on Dielectric-Modulated Tunnel Field-Effect Transistor Biosensor Performance

Mohamad Faris Mohamad Fathil

A biosensor is a device that generates signals proportional to the concentration of an analyte, enabling the measurement of biological or chemical reactions. The dielectric-modulated tunnel field-effect transistor (DM-TFET)-based biosensor has gained significant attention in recent years due to its low subthreshold swing (SS), rapid detection capability, and low power consumption. It integrates the drain, channel, source, and sensing region into a single device. By modulating the tunneling barrier, the biosensor operates based on variations in biomolecule properties within the nanogap. Limitations in other devices, particularly in sensitivity and selectivity, have motivated the adoption of the DM-TFET, as it can detect both charged and neutral biomolecules more effectively than conventional FET biosensors. In contrast, MOSFET-based biosensors suffer from higher leakage currents, larger subthreshold swing, and low I_{on}/I_{off} ratios. This study investigates the impact of different source materials on the performance of DM-TFET-based biosensors for biomolecule detection using semiconductor device technology computer-aided design (TCAD). Device structures employing silicon, indium arsenide, and indium antimonide as source materials were modeled in the SILVACO ATLAS simulator. Simulations were performed with nanogap dielectric constants of 1, 4, 6.3, 8, 10, and 12, representing different biomolecules. Variations in drain current were interpreted as biomolecule detection events, and device sensitivity was evaluated. Data analysis revealed that InSb, with the lowest energy bandgap, achieved the highest drain current among the tested materials. InSb also exhibited the highest sensitivity value of 8.337 μA , indicating its superior potential for achieving enhanced biosensor performance.

ICONMAR 75: Optimization of Weave Patterns in Banana Fiber Bomb Blanket Composites for Blast Resistance

Siti Aisyah Azman; Asna Rasyidah Abdul Hamid; Ahmad Humaizi Hilmi; Abdul Rashid Othman

This study focuses on enhancing blast resistance in sustainable protective materials by evaluating the performance of banana fiber bomb blanket composites with different weave patterns—plain, twill, and satin. Banana fibers were mechanically extracted, chemically treated with a 5% alkali solution, and woven into five-layer composite blankets. Tensile properties were measured using ASTM D638 Type IV, while impact resistance was tested through a guided 5 kg drop-weight system. A field blast test was conducted using 100 g of black powder (black oxide) explosive placed 1ft above the samples to simulate realistic blast conditions. Among the three configurations, twill weave demonstrated the most balanced performance by combining structural integrity, energy absorption, and flexibility. Plain weave yielded higher stiffness but limited deformation capability, while satin weave provided greater flexibility at the expense of blast resilience. These findings confirm that weave architecture plays a vital role in optimizing energy dissipation and mechanical response in natural fiber bomb blankets. Twill weave is identified as the most suitable configuration for eco-friendly protective solutions in civil and defense applications.

ICONMAR 76: Investigation of significant parameter and interaction of Plastic Transfer Moulding Parameters for 3D Dual In-Line IC Package Encapsulation

***Uzair Rosli; Masniezam Ahmad; Mohd Fathullah Ghazli; Chu Yee Khor;
Muhammad Syamil Zakaria***

Precise control of plastic transfer moulding parameters is essential for achieving high yield and reliability in advanced semiconductor packaging. This study investigates the significant parameters and interactions influencing air trap formation and shear stress during 3D Dual In-Line Package (DIP) encapsulation. Mold-flow® simulations were conducted to evaluate the effects of mold temperature, melt temperature, curing time, injection pressure, and material composition (un-filled and 80% silica-filled epoxy molding compound, EMC). Perturbation, interaction, and 3D response surface analyses were employed to determine parameter influence and synergistic effects. Results show that silica filler content is the primary determinant of process sensitivity. Unfilled EMC exhibited stable performance with minimal defect variation across all parameters, while highly filled EMC demonstrated strong sensitivity due to elevated viscosity. Melt temperature was the most influential factor for reducing both air traps and shear stress, with mold temperature providing a secondary but synergistic effect. Injection pressure significantly reduced air traps but has a limited impact on shear stress. An optimized process window with high melt and mold temperatures with sufficient injection pressure was identified for high-filler EMCs. These findings advance understanding of material–process–defect interactions and provide a dual-defect mitigation strategy to enhance yield, reduce rework, and improve reliability in high-density electronic packaging.

ICONMAR 78: Gold Nanoparticle-Functionalized Silicon Nanowire Biosensor for Ganoderma boninense DNA Detection

Adilah Ayoib

Ganoderma boninense, the causal agent of basal stem rot in oil palm, poses a severe threat to Malaysia's palm industry. We demonstrate a label-free electrochemical biosensor based on p-type silicon nanowires (SiNWs) functionalized with gold nanoparticles (AuNPs) for DNA detection of **G. boninense**. The device, comprising 95-nm-wide SiNWs with Ni/Au contact pads, was characterized by current-voltage (I–V) measurements. Following AuNP deposition and thiolated probe DNA immobilization, hybridization with complementary target DNA from **G. boninense** produced a substantial increase in conductance. For example, a single-wire sensor's current at 1 V rose from 8.23×10^{-9} A (bare SiNW) to 4.44×10^{-8} A (after hybridization), demonstrating high sensitivity. High-power optical microscopy confirmed the patterned Au contacts. These results indicate that AuNP-enhanced SiNWs can effectively detect **G. boninense** DNA at low concentrations. The proposed sensor combines SiNW electrical amplification with Au–thiol chemistry for biomolecule attachment, offering a promising platform for early disease diagnosis. Future work will focus on reducing SiNW dimensions to further enhance sensitivity.

ICONMAR 80: Effect of Curing Method on Mechanical Properties of Ground Spent Garnet Powder Cement Based Mortar

Khairunisa Muthusamy; Sofia Adibah Jasni; Sharifah Maszura Syed Mohsin; Aishah Abu Bakar; Gasem Hayder

Environmental degradation due to industrial activities is possible to wisely managed through adoption of circular economy. Growing cement industry which cater the need of construction sector causes higher consumption of non-renewable resource from the environment. Disposal of spent garnet waste disposal after being used at shipping maintenance yard which increase the risk of pollution also need to be resolved. The approach of recycling the spent garnet waste to be used as cement replacement in cement-based construction material would be a more sustainable approach. The effect of curing method on mechanical properties of spent garnet cement-based mortar were investigated in this research. A mortar mix formed of 100% cement were used as control specimen. Five blended cement based mortar mixes were prepared by integrating ground spent garnet powder that is 10%, 20%, 30%, 40%, and 50% as partial cement replacement. Two types of curing were employed that is air curing and water curing. Compressive strength test, splitting tensile strength test and flexural strength test were carried out at 28 days of curing age. The result obtained shows that water cured spent garnet cement-based mortar exhibit higher strength in contrast to air cured one. Continuous presence of moisture has enabled better hydration and pozzolanic reaction lead to production of large amount of calcium silicate hydrate gel resulting in compact microstructure with highest strength. Water cured mortar produced by integrating 10% spent garnet powder exhibit the highest compressive strength, splitting tensile strength and flexural strength amongst all mixes. Conclusively, channeling spent garnet waste to be transformed as cement replacement for production of cement-based construction material would reduce quantity of this industrial waste disposed and save the use of landfill.

ICONMAR 82: Influence of MgO nanoparticles for High Voltage Direct Current (HVDC) cable insulation.

Zhi Kai Hong; Noor Fadzilah Mohamed Sharif; Nor Laili Ismail; Norshafarina Ismail; Nazatul Shiema Moh Nazar; Matthew Ding Jie Wee

This paper presents an enhancement of insulating materials for High Voltage Direct Current (HVDC) cable applications by introducing a nano-magnesia (MgO) particles into Low-Density Polyethylene (LDPE). The main emphasis of this work is to investigate the DC breakdown voltage performance of LDPE/MgO nanocomposites as a function of filler content. Increase in DC breakdown strength is very important for long-term reliability and safety of HVDC cable insulation. Besides electrical performance, morphological study and Raman scanning were made to support the study. The nanocomposites were engineered using the melt-blending method, where 40 grams of LDPE was mixed with 1.0g, and 2.0g of nano-magnesia at 170 °C and 50 rpm using a Haake internal mixer. The resulting materials were hot-pressed into 1 mm thin films at 160 °C and 50 bar pressure. DC breakdown voltage tests were conducted on the samples to determine their breakdown voltage. Results indicated that nano-magnesia incorporation improved the DC breakdown voltage of LDPE, with the optimum value at 1.0g of MgO. At this loading, the material showed the strongest dielectric strength. Thus, this study has proven that LDPE reinforced with 1.0g of nano-magnesia is a viable and efficient insulation material for HVDC cable applications at average of 40.1 kV compared to pure LDPE at 32.41 kV.

ICONMAR 83: Unintended Catalysis and Defect Formation in Electroless Metallization of Semiconductor Wafers

Zhi En Er; Phey Yee Foong; Theng Theng Tan; Nurhanani Zakaria

Additive metallization using electroless plating has emerged as a promising alternative to traditional subtractive approaches in semiconductor fabrication, offering advantages such as reduced material waste, lower process complexity, and improved environmental sustainability. However, reliability challenges—including the formation of unintended metallic nodules—continue to hinder its widespread adoption. In this study, a detailed physical failure analysis (PFA) was conducted to investigate the formation mechanism of metallic nodules observed near metal pads on electroless-plated wafers. A multi-technique analytical approach, including optical microscopy, field-emission scanning electron microscopy (FESEM), focused ion beam (FIB) cross-sectioning, and energy-dispersive X-ray spectroscopy (EDX), revealed that the nodules consist of Ni and Pd, loosely adhered to the passivation layer. Post-delayering analysis and elemental mapping identified metal oxide residues as potential catalytic sites for unintended metal deposition. A defect formation mechanism is proposed, involving incomplete residue removal during PVD and etching steps, oxidation of residual metal residue, and subsequent autocatalytic deposition during electroless plating. Ultrasonication was demonstrated to be effective in dislodging the nodules, suggesting a potential mitigation strategy. These findings offer valuable insights into defect prevention and process optimization in electroless metallization for advanced semiconductor applications.

ICONMAR 85: TiO₂–CNT Hybrid Nanomaterials: A Synergistic Platform for Next-Generation Biosensors

Foo Loong; Soo Jin Tan; Wei Wen Liu; cheng yong heah; Yun Ming Liew; Muhammad Kashif

Carbon nanotubes (CNTs) and titanium dioxide (TiO₂) are two of the most widely studied nanomaterials in biosensing due to their complementary properties. CNTs offer superior conductivity, a large surface area, and quick electron transfer, while TiO₂ offers chemical stability, photocatalytic activity, and biocompatibility. When combined, TiO₂–CNT nanohybrids have synergistic effects that improve photoelectrochemical (PEC), optical, and electrochemical biosensors' sensitivity, stability, and selectivity. This review presents a comprehensive discussion of TiO₂ and CNT fundamentals, synthesis and functionalization strategies, and their role in various biosensing mechanisms. Recent developments between 2022 and 2025 are highlighted, along with advancements in aptamer-based, enzyme-based, and non-enzymatic sensing platforms. Important issues like scalability, selectivity in complex media, long-term stability, and reproducibility are evaluated critically. Lastly, future directions are described, emphasizing the potential of AI-assisted biosensing, integration with new nanomaterials, and sophisticated fabrication techniques. Collectively, TiO₂–CNT nanohybrids show great promise for biomedical, environmental, and clinical diagnostics of the future.

ICONMAR 86: Effect on carbonization temperature on activated carbon utilizing palm kernel shell

Nurul Aishah Binti Mohd Amran; Norizah Abd Karim; Muhammad Mahyiddin Ramli; Ismariza Ismail; Shazlina Johari; Anis Syafiqa Binti Rosman

This study investigates the effect of carbonization temperature on the structural and defect characteristics of activated carbon derived from palm kernel shell (PKS). Carbonization was carried out at 400, 500, and 600 °C with varying heating rates, and the resulting samples were analyzed using X-ray diffraction (XRD) and Raman spectroscopy. XRD patterns revealed broad (002) peaks around 22–24°, indicating the formation of turbostratic carbon structures, with interlayer spacing decreasing as temperature increased. The 500 °C samples, particularly at 10°C/min heating rates, displayed a favourable balance of broadened peaks and sufficient intensity, signifying well-developed amorphous carbon with high porosity and structural stability. Raman spectra showed distinct D and G bands, where the ID/IG ratio confirmed the presence of abundant structural defects that are beneficial for adsorption. The 500 °C samples exhibited an optimal compromise between defect and graphitic ordering compared to the under-carbonized 400 °C and the more ordered 600 °C carbons. These results demonstrate that a carbonization temperature of 500 °C with 10°C/min provides the most suitable conditions for producing high-quality activated carbon from PKS, offering both stability and enhanced potential for adsorption applications.

ICONMAR 87: Microstructure Enhancement of Protonic Ceramic Fuel Cell Cathode Using Sugarcane Bagasse as The Pore-Forming Agent

Ismariza Ismail; Norizah Abd Karim; Shazlina Johari; Nur Nasuha Najwa Rahimudin; Muhammad Mahyiddin Ramli

The development of high-performance protonic ceramic fuel cell (PCFC) cathodes requires controlled porosity to facilitate gas diffusion and electrochemical activity. In this work, sugarcane bagasse was investigated as a natural pore-forming agent for $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Fe}_{0.8}\text{O}_{3-\delta}$ (LSCF) – $\text{BaCe}_{0.5}\text{Zr}_{0.36}\text{Y}_{0.1}\text{O}_{2.95}$ (BCZY) composite cathodes. LSCF and BCZY powders were prepared via a sol–gel route, with bagasse incorporated at 0 – 40 wt% prior to pelletization and sintering at 1000 °C for 5 h. Characterization by X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) confirmed stable phase formation, decomposition of organic constituents, and the development of porous microstructures. Quantitative porosity analysis revealed an increase from 7.17% (10 wt%) to 26.14% (40 wt%), while bulk density decreased from 5.858 to 3.131 g/cm³. SEM imaging showed well-distributed pores with increasing bagasse content, indicating effective decomposition of the pore former. These results demonstrate that sugarcane bagasse is an effective, low-cost, and sustainable additive for tailoring PCFC cathode microstructures, providing a viable route to enhance material performance in energy conversion applications.

ICONMAR 88: Effect of Thermal Treatment on the Structural and Physicochemical Properties of Bamboo Charcoal for Biomedical Applications

Norizah Abd Karim; Nurul Aishah Binti Mohd Amran; Che Mohd Ruzaidi Ghazali; Ismariza Ismail; Shazlina Johari; Muhammad Mahyiddin Ramli

Bamboo charcoal, with its unique structural and physicochemical properties, has attracted significant interest for biomedical applications. This study investigates the activation of bamboo charcoal under various heat treatment parameters to optimize its functional characteristics. Two sets of samples were prepared: the first subjected to heat treatments at 400 °C, 700 °C, and 900 °C with a heating rate of 10 °C/min and a soaking time of 3 h, while the second was treated at 800 °C under the same conditions. Post-treatment characterization was conducted using Scanning Electron Microscopy (SEM) for surface morphology, X-ray Diffraction (XRD) for crystalline structure, and Brunauer–Emmett–Teller (BET) analysis for surface area and porosity. The results revealed that thermal treatment significantly modified the microstructure, crystallinity, and specific surface area of bamboo charcoal. High-temperature treatments promoted the development of microporous structures, thereby enhancing surface characteristics relevant to biomedical applications. The study identifies optimum heating parameters that yield desirable material properties, offering insights into the design of bamboo charcoal as a versatile and sustainable material for biomedical use.

ICONMAR 89: IoT-Based System Using Red-Laser Time-of-Flight LiDAR for Water Turbidity Assessment

Nur Aina Athirah Mohd Nizar; Juliza Jamaludin; Fatinah Mohd Rahalim; Marinah Othman

This study presents the development of a portable turbidity monitoring system integrating a red-laser Time-of-Flight (ToF) LiDAR sensor with an Internet of Things (IoT) platform for real-time water quality assessment. The system was designed with a compact lid-and-chamber configuration to ensure measurement stability and ease of deployment. The lid housed three essential components: a power bank for portable energy supply, a TFMMini-S LiDAR sensor for distance and signal strength detection, and an ESP32 microcontroller serving as the IoT node for data processing and wireless transmission. A square tube chamber with a height of 30 cm was selected as the measurement path, as this dimension minimized light scattering, reduced external interference, and provided a controlled beam distance for improved signal consistency. Powered entirely by the integrated power bank, the system operated independently of external power sources, making it suitable for field applications. Real-time data from the LiDAR were transmitted via Wi-Fi to the Favoriot IoT platform, enabling remote access and continuous monitoring. The collected data were subsequently analyzed using Minitab, where interval plot of distance were employed to evaluate sensor responses and determine the most efficient prototype configuration. The results demonstrate that the proposed system provides stable, repeatable measurements and holds strong potential as a low-cost, portable solution for online turbidity monitoring and broader water quality applications.

ICONMAR 90: Water-based Immobilization of Xylanase on Magnetized Multiwall Carbon Nanotubes (m-MWCNTs)

Kunasundari Balakrishnan

There has been growing interest in enzyme immobilization on magnetic nanoparticles (MNPs), owing to the ease and speed of recovering the bioconjugates from the reaction medium. However, the conventional synthesis of MNPs typically involves the use of large quantities of chemicals and remains a time-consuming process. In the present study, the newly developed water-based system was employed to immobilize xylanase onto magnetized multiwall carbon nanotubes (m-MWCNTs). The successful adsorption of xylanase onto the carrier surface was confirmed by FTIR peaks in the range of 1050–1350 cm^{-1} . A concentration of 5 mg/mL xylanase was found to be optimal for immobilization with binding efficiency above 95%. Morphological characterization via SEM provided evidence of xylanase attachment, as indicated by distinct bright spots and the formation of dense agglomerates. Free xylanase exhibited maximum relative activity at 60 °C, whereas immobilized xylanase on m-MWCNTs showed an optimum temperature of 70 °C, indicating enhanced thermostability upon immobilization.

ICONMAR 91: Electrochemical Characterization of AuNP-Modified Carbon Electrodes for 17 α -Ethinylestradiol Sensing

Nur Hamidah Abdul Halim; Nur Syakimah Ismail; Nurul Iman binti Ramzan

This work investigates the electrochemical detection of 17 α -ethinylestradiol (EE2) using gold nanoparticle (AuNP)-modified carbon sheet electrodes. Cyclic voltammetry (CV) was employed to study the electrochemical behavior of EE2 with and without ferricyanide (FeCN) as a redox mediator, while differential pulse voltammetry (DPV) was used to evaluate sensitivity after aptamer immobilization on AuNP-modified electrodes. CV results revealed that the electrochemical reaction of EE2 is irreversible, involving only oxidation. The peak current response increased with higher AuNP loading, confirming its role in enhancing electron transfer. FeCN facilitated electron transfer and improved redox peak resolution, as observed in both CV and DPV analyses; however, the highest sensitivity was achieved in EE2 solutions without FeCN, as indicated by steeper calibration slopes and higher correlation coefficients (R^2). These findings demonstrate that AuNP-modified carbon electrodes offer a promising platform for sensitive electrochemical detection of EE2, with or without the use of mediators.

ICONMAR 92: Effect of Recovered Carbon Black on Polypropylene for Conductive Polymers Composites

Bee Ying Lim, Nurun Nabilah Kamaruddin; Pei Leng Teh; Chun Hong Voon

This study examines the influence of recovered carbon black (rCB) on the properties of polypropylene (PP) as conductive polymer composites. The rapid growth of ground transportation has significantly increased the generation of end-of-life tires (ELTs) worldwide. Converting waste tires into rCB offers a sustainable route to reduce non-biodegradable waste and promote the circular economy. In this work, rCB obtained from waste tires was incorporated into a PP matrix at varying loadings, ranging from 5 wt% to 20 wt%, both with and without a plasticizer, to assess changes in mechanical, morphological, and electrical properties. Composite samples were fabricated using a twin-screw co-rotating extruder. Polyethylene (PE) wax was employed as a plasticizer to enhance processability without compromising electrical conductivity. Results showed that tensile strength decreased 30.9% as rCB content increased from 5 wt% to 20 wt%, likely due to particle agglomeration. However, adding a 2 wt% plasticizer improved elongation at break and ductility, with a corresponding increase in tensile strength compared to un-plasticized composites. Electrical resistivity declined with higher rCB loading, while the presence of plasticizer did not significantly alter conductivity. These findings highlight the potential of rCB-filled PP composites in sustainable conductive material applications.

ICONMAR 93: Mechanical and Microstructure Behaviour of Recycled Copper Matrix Composites for Brake Pads Application

Muhammad Faheem Mohd Tahir; Shahidah Arina Shamsuddin; Syafiadi Rizki Abdila; Warid Wazien Ahmad Zailani; Meor Ahmad Faris Meor Ahmad Tajudin; Syafwandi Syafwandi

Ceramic brake pads have been a high marketing demand in the automotive industry as brake pads require a proper change to replace the usage of asbestos in brake pads that are causing particle emissions to the air which can severely impact the environment and healthcare of individuals. The application of Recycled Copper Matrix Composite is an alternative to take over the usage of asbestos in addition with improved mechanical properties along with improvements of the microstructure and physical properties of the material. This analysis is subjected to the source of aluminosilicate reinforced with recycled copper matrix particulates with 0, 5, 10 and 15 wt% fabricated via powder metallurgy. The study will be highly focused on the manipulated variables such as physical, mechanical and morphological properties by the differences of copper content percentage mixed in Fly ash. The samples of fly-ash copper composites are mixed conventionally with specific amounts of copper percentage and followed with the pressing action of the powders. The samples were then homogenized by the process of sintering (heating below melting point) which increases the green density of the samples. It was then followed by measuring its volume and weight to study its density, the analysis shown that the increment of copper content within the fly ash composite increases the density of the samples. The study then proceeded with the morphological study which resulted in the characterization of the composites exposed persuasively uniform distribution of recycled copper reinforcement with minimum porosity. A hardness test was conducted to differentiate the hardness strength of the samples which produced significant results as the increment of copper content proportionally increases the hardness strength as well. It is concluded that the addition of recycled copper matrix improves the mechanical properties and decreases the defects in the morphological studies, and 15 wt% of reinforced recycled copper has the optimum properties of density, hardness and microstructure which is deemed suitable for the application of brake pads.

ICONMAR 94: Advances in Microbial Biosensors for Oil Spill Bioremediation Monitoring

Adilah Ayoib

Oil spills release toxic mixtures, including BTEX and PAHs, that threaten ecosystems and human health, necessitating rapid detection and effective remediation. Microbial biosensors – engineered living cells that transduce pollutant sensing into quantifiable signals – offer a sensitive and cost-effective alternative to conventional monitoring methods, such as chromatography. This review summarizes the principles of microbial bio-sensing and highlights recent advances in biosensor platforms for detecting oil contaminants. We examine key target analytes, including hydrocarbons and metabolic indicators, and discuss various biorecognition elements such as enzyme reporters and whole-cell systems. The review contrasts established techniques, such as electrochemical and optical methods, with emerging approaches, including synthetic gene circuits and graphene field-effect transistors. We also assess the performance of these biosensors in field trials, such as correlating biosensor readings with GC-MS results for PAHs in oysters. In addition, we summarize recent progress in sensor de-sign, focusing on synthetic gene circuits and nanomaterial-based platforms, while comparing them to conventional strategies. We address current challenges, including the stability of biosensors under varying environmental conditions and their selectivity in complex samples. Innovations that integrate the Internet of Things (IoT) and omics-guided design are discussed as avenues for developing more sophisticated biosensing technologies. Lastly, we consider sustainability aspects, such as the life-cycle impact and the use of biodegradable materials, underscoring the need for affordable and scalable designs. The insights provided serve as a comprehensive framework to guide future research into microbial biosensors for oil spill response.

ICONMAR 95: Chemical Modification and Carbon Quantum Dots of Rice Straw as Oil Adsorbent

Nor Azizah Parmin; Subash C. B. Gopinath; Chun Hong Voon

The increasing prevalence of oil spills and industrial oil waste necessitates the development of efficient and sustainable oil adsorbent materials. This study explores the chemical modification of rice straw to enhance its oil adsorption capacity and the synthesis of carbon quantum dots (CQDs) from the modified rice straw. The rice straw was chemically treated with sulfuric acid and sodium dodecyl sulfate (SDS) to improve its hydrophobic properties. Subsequently, CQDs were synthesized through a microwave process using the modified rice straw as a carbon source. The synthesis of carbon quantum dots (CQDs) using microwave technology is a quick and efficient method. The structural and morphological characteristics of the modified rice straw and CQDs were analyzed using techniques such as Ultraviolet-Visible Spectroscopy (UV-Vis) and Scanning Electron Microscopy (SEM). The oil adsorption capacity of the modified rice straw and CQDs was evaluated through batch adsorption experiments. The results showed a significant increase in oil adsorption efficiency, with the modified rice straw and CQDs demonstrating better performance compared to untreated rice straw. This study highlights the potential of using agricultural waste materials for the development of high-performance oil adsorbents, and the synthesis of carbon quantum dots (CQDs) from rice straw contributes to environmental sustainability and waste valorization.

ICONMAR 96: Performance Evaluation of Fly Ash-Based Geopolymer Binders Modified with Recycled Metal Additives

***Muhammad Faheem Mohd Tahir; Shahidah Arina Shamsuddin; Syafiadi Rizki Abdila;
Warid Wazien Ahmad Zailani; Meor Ahmad Faris Meor Ahmad Tajudin;
Syafwandi Syafwandi***

Geopolymer concrete presents a promising alternative to ordinary Portland cement, offering significant potential for reducing carbon dioxide emissions in the construction industry. This study investigates the effects of incorporating recycled metal as a filler in fly ash-based geopolymer binders, focusing on the resulting physical, mechanical, and morphological properties. Geopolymer concrete samples were prepared using fly ash as the aluminosilicate source, activated with an alkaline solution, and reinforced with varying proportions of recycled metal at 0%, 5%, 10%, and 15% by volume. All samples were cured at ambient room temperature. Physical properties, including density and water absorption, were evaluated alongside compressive strength performance. The results indicate that increasing the recycled metal content led to higher density and water absorption values. Notably, the sample with 15% recycled metal exhibited the highest compressive strength, suggesting improved mechanical performance at higher metal content. Morphological analysis further revealed distinct structural differences corresponding to the varying levels of recycled metal incorporation. These findings support the potential of recycled metal as a sustainable additive to enhance the performance of geopolymer concrete.

ICONMAR 97: Nano-Engineered Hydrated Lime for Hydrogen Sulfide (H₂S) Emission Control in Landfills

Tijjani Adam

Hydrogen sulfide (H₂S), a toxic and malodorous gas released during the anaerobic decomposition of organic solid waste, poses a critical environmental and health hazard in landfills. Current treatment technologies for landfill gas are limited in efficiency and cost-effectiveness. This study investigates the application of nano-engineered hydrated lime [Ca(OH)₂] as a high-performance adsorbent for H₂S removal. Limestone (CaCO₃) was calcined to quicklime (CaO) and subsequently hydrated to produce Ca(OH)₂, with nanoscale powders obtained through controlled processing. A Design of Experiment (DOE) was employed to examine the influence of calcination temperature (900–1200 °C), particle size (75–300 μm), and residence time (2–6 h) on CaO quality and yield. The optimal condition was identified at 1100 °C, yielding CaO with 97.58 wt.% purity. Characterization via X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR) confirmed the presence of calcite and quartz in the raw material, while nano-hydrated lime exhibited an average crystallite size of 40–80 nm, specific surface area exceeding 120 m²/g, and enhanced pore volume. Performance evaluation against simulated landfill gas demonstrated a 98% H₂S removal efficiency, attributed to increased surface reactivity and formation of stable CaS/CaSO₄ phases. The findings establish a scalable and low-cost route for synthesizing nano-hydrated lime from limestone, offering a sustainable solution for H₂S mitigation in landfill gas management.

ICONMAR 98: Planar Barrier Diode-Based OR Logic Gate Exhibiting High-Rectification Property for High-Frequency Signal Processing Applications

Zarimawaty Zailan, Mohammad Nuzaihan Md Nor

This paper reports on the use of nano-based rectifying devices in logic gate operations. These devices have attracted significant attention in nanotechnology due to their small size, energy efficiency, and superior rectification performance. They play a vital role in converting alternating current (AC) to direct current (DC) and regulating current flow, making them essential components in radio frequency, microwave, digital, and computing circuits. Conventional rectifying diodes, however, face limitations such as slow switching speeds, high reverse leakage, temperature dependence, and complex triggering mechanisms. Nanochannel-based Planar Barrier Diodes (PBDs) overcome these challenges by reducing forward voltage drop, improving switching speed, and enhancing thermal stability. Designed with precise nanochannel structures within silicon substrates, PBDs offer high-speed operation, low capacitance, and low forward voltage drop. When configured in parallel, PBDs can implement OR logic gates, enabling faster switching and improved system performance, features that are crucial for advanced electronic applications. This study presents the design, operating principles, and performance analysis of nano-based rectifying devices in basic logic gate configurations, including AND, OR, and NOT. Simulation results demonstrate their potential as key building blocks in logic circuits, exhibiting desirable characteristics and high reliability. The highest current achieved was $9.7 \mu\text{A}$ at an 85° channel angle with a 40 nm channel width, while rectification performance yielded a peak curvature coefficient (γ) of 20.62 V^{-1} at zero bias. These findings highlight the promise of nano-based rectifying devices in enabling the next generation of compact, efficient, and high-performance logic circuits.

ICONMAR 99: Carbon Nanotube-Enhanced ELISA for the Early Detection of Cardiac Troponin I

Foo Loong; Emily M.Y. Chow; Soo Jin Tan; Subash C. B. Gopinath; Yun Ming Liew; Cheng Yong Heah; Muhammad Kashif

Enzyme-linked immunosorbent assay (ELISA) is a simple and widely used method for detecting cardiac troponin I (cTnI), a critical biomarker for heart attacks. However, the conventional ELISA method has its limitations, with a detection limit only at 100 pM. To enhance sensitivity and accuracy for early detection, improvements were made by incorporating carbon nanotubes (CNT) as signal enhancers for cTnI detection. The use of CNT took advantage of their large surface area and existing functional groups, which contributed to the enhancement of signaling in the detection process. As a result, the detection limit was significantly reduced to 10 pM, a remarkable improvement over the conventional ELISA method. Furthermore, the detection rate increased substantially, rising from 31.90% to an impressive 153.92%. This four-fold increase in sensitivity demonstrates the significant advancement achieved through the use of CNT in the modified ELISA method.

ICONMAR 100: Advanced Nanoparticle-Engineered Biosensor Frameworks for Pre-Symptomatic Detection of Neurodegenerative Disorders

Tijjani Adam

Neurodegenerative diseases such as Alzheimer's, Parkinson's, and Huntington's remain difficult to diagnose at pre-symptomatic stages due to the limited sensitivity and invasiveness of conventional methods such as PET imaging and cerebrospinal fluid assays. To overcome these limitations, this study presents the design and performance evaluation of nanoparticle-engineered biosensor frameworks that integrate gold, silver, and quantum dot nanostructures functionalized with aptamers and antibodies for selective detection of amyloid- β , tau protein, and α -synuclein. The biosensors were fabricated using controlled surface modification and characterized through electrochemical impedance spectroscopy (EIS) and localized surface plasmon resonance (LSPR). Experimental results demonstrated detection limits of 1.2 pg/mL for amyloid- β , 2.8 pg/mL for tau, and 3.1 pg/mL for α -synuclein, achieving nearly two orders of magnitude improvement compared to ELISA (~100 pg/mL). Additionally, nanoparticle-induced field enhancement improved signal-to-noise ratios by 65–78%, while optimized device architecture enabled response times of <120 seconds, supporting near-real-time diagnostics. Reproducibility analysis across 50 replicates confirmed a coefficient of variation below 4.7%, indicating robust performance. The integration of nanoscale sensitivity, rapid detection, and scalable fabrication highlights the potential of this platform as a cost-effective and portable solution for early diagnosis of neurodegenerative disorders, bridging nanotechnology and clinical neurology.

ICONMAR 101: Enhancing Gamma-Ray Shielding Properties of Concrete Using Palm Oil Fuel Ash and PET

Siti Amira Othman; Nurain Najwa Ramli

This study investigates the incorporation of Palm Oil Fuel Ash (POFA) and Polyethylene Terephthalate (PET) into concrete mixtures for enhanced gamma-ray shielding performance. POFA, with its high silica content, serves as a potential radiation attenuator, while PET contributes mechanical reinforcement. Spectroscopic analysis revealed that POFA exhibits strong absorption peaks at 800–500 cm^{-1} , attributed to Si–O–Si and Si–O bond vibrations, confirming its suitability for energy dissipation. In contrast, sand displayed weaker absorption due to its crystalline silica structure. X-ray diffraction analysis of POFA–PET concrete demonstrated a sharp peak at $2\theta \approx 28^\circ$, indicating a high degree of crystallinity associated with improved structural integrity and shielding capacity. However, scanning electron microscopy revealed microstructural weaknesses, including voids and poor bonding, in samples with insufficient POFA and PET content, leading to reduced density and shielding efficiency. Overall, the findings highlight the importance of optimizing POFA and PET ratios to balance mechanical strength, water absorption, and radiation attenuation, offering a cost-effective and sustainable approach to gamma-ray shielding applications.

**ICONMAR CONFERENCE SECRETARIAT
INSTITUT KEJURUTERAAN NANO ELEKTRONIK
UNIVERSITI MALAYSIA PERLIS
Lot 106, 108 & 110, Tingkat 1, Blok A,
Taman Pertiwi Indah, Jalan Kangar – Alor Setar, Seriab
01000 Kangar, Perlis, Malaysia**



iconmar@unimap.edu.my



<https://iconmar.unimap.edu.my/>