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In Collaboration with

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Day 1 (Room 1)

Plenary Session

Materials Space-Tectonics: Toward the 2nd Generation of Mesoporous Materials (Online)

Yusuke Yamauchi*

The University of Queensland, Australia

Nano-Plasmonic Assay Platforms for the Expeditious and High-Fidelity Diagnosis of Infectious Diseases

Jaebum Choo*

Chung-Ang University, South Korea

Abstract

The COVID-19 pandemic has caused severe social and economic problems worldwide. RT-PCR has been widely acknowledged as the benchmark method for identifying specific viral genetic markers. However, RT-PCR entails a comprehensive diagnostic process, encompassing sample preparation, gene amplification, and detection, resulting in a timeframe of around 3-4 hours. Consequently, there exists a pressing need to streamline the diagnostic duration to facilitate swift on-site diagnoses. Numerous rapid immuno-diagnostic kits leveraging antigen-antibody reactions have emerged as alternatives to expedite diagnostic timelines. Nonetheless, their adoption as the standard diagnostic protocol has been hindered by suboptimal sensitivity and accuracy. Notably, the prevalent "false-negative" predicament associated with commercial diagnostic kits poses a significant challenge, exacerbating the transmission of COVID-19. The advent of ultrasensitive sensing technologies integrating nanotechnology presents novel avenues for diagnosing respiratory infectious ailments like COVID-19, especially crucial in environments necessitating rapid dissemination. To mitigate these challenges, we have pioneered innovative nano-plasmonic assay platforms featuring a portable optical reader for precise COVID-19 diagnostics in real-world settings. This presentation will showcase high-sensitivity immunodiagnostic and molecular diagnostic platforms utilizing a nano-plasmonic framework comprising functional nanoparticles and nanostructure substrates. Anticipated applications include accurate point-of-care diagnoses for potential forthcoming infectious diseases.

Biography:

Jaebum Choo is a Distinguished Professor at Chung-Ang University in South Korea. He earned his Ph.D. from Texas A&M University in 1994. In 2016, he was the President of the Korea Biochip Society. He has published more than 320 research papers in peer-reviewed journals, with over 23,000 citations. He is a Fellow of the Royal Society of Chemistry and is an Associate Editor of “Analyst” and serves on the

Advisory Boards of "ACS Sensors" and "Analytical Chemistry." Currently, he is the Director of the "Center for Nanophotonics-based Biomedical Diagnostics Research Center (ERC)," supported by the National Research Foundation of Korea.

Unveiling the Potential of Bicontinuous Concentric Lamellar Nanostructures for Advanced Applications

Veinardi Suendo[1,2]*, Nadiatus Silmi[1,3], Rafiq Arsyad[1], Didi Prasetyo Benu[1,3,4], Fairuz Gianirfan Nugroho[2,5], Fry Voni Steky[1,3], Muhamad Nur Siddik[1], Fajar Rakhman Wibowo[6], Muhammad Iqbal[7], Brian Yuliarto[2,7], Rino Rakhmata Mukti[1,2,8]

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[4]Department of Chemistry, Universitas Timor, Indonesia;
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[7]Advanced Functional Materials (AFM) Laboratory, Department of Engineering Physics, Institut Teknologi Bandung, Indonesia;
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Abstract

KCC-1 nanostructured particles possess a fascinating bicontinuous concentric lamellar (bcl) morphology, distinct from conventional mesoporous silica. This unique structure grants KCC-1, also known as bcl silica, exceptional properties, making it a highly attractive material for diverse applications. In catalysis, bcl silica's interconnected pore network facilitates efficient mass transport of reactants and products, acting as a superior support for catalysts. Its high surface area allows for maximized catalyst loading, enhancing reaction efficiency. As an adsorbent, bcl silica demonstrates a remarkable ability to capture and remove unwanted molecules from liquids and gases, making it valuable for purification processes. The bcl structure also positions bcl silica as a promising candidate for drug delivery. Its pores can be precisely tailored to encapsulate and release drugs in a controlled manner. Furthermore, bcl silica's biocompatibility makes it a safe choice for biomedical applications. Beyond these areas, bcl silica's unique properties hold promise in photocatalysis, CO2 capture, and even micro-reflectors in solar cells. The ability to fine-tune the pore size and surface chemistry of bcl silica opens doors for further optimization and exploration in various technological fields. Moreover, due to its morphological uniqueness and excellent physical properties, the mechanism of bcl morphology formation has been applied to different mesoporous materials, such as alumina, titania, zinc oxide, and aluminosilicate. Our recent developments on syntheses, quantification, and applications of nanostructured materials with bcl morphology are presented and discussed.

Biography:

Veinardi Suendo was born in Jakarta on November 7, 1975. He received his Bachelor of Science in Chemistry from ITB in 1998, his Master of Engineering from Tokyo Institute of Technology in 2001, and his PhD from École Polytechnique, France, in 2005. Veinardi became a lecturer at ITB's Department of Chemistry in 2008. His research focuses on molecular spectroscopy, photophysics, and advanced materials, particularly dye-sensitized solar cells and metal oxides like silica, alumina, titania, and zinc.

High-Energy Ni-Rich Cathodes for Electric Vehicles

Yang Kook Sun*

Hanyang University, South Korea

Protector-Free Metal and Metal Oxide Quantum Clusters: Preparation by Femtosecond Pulse Laser Irradiation and Characterization

Toyoko Imae*

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Abstract

Metal clusters have received plenty of attention in nanotechnology due to exert the quantum confinement effect and lead to the size-dependent fluorescence property. Different from theoretical estimation of cluster characters, the experimental confirmation of clusters is relatively scarce even now because of their instability in medium. Here we report the novel synthesis procedure of metal clusters using high-intensity femtosecond pulse laser irradiation technique, which is a simple and efficient bottom-up physical procedure without adding any reducing/oxidizing and stabilizing agents, because this water radiolysis method self-produces the reducer/oxidizer and the reaction can finalize within a few minutes to produce clusters in a metal precursor solution.

Gold clusters with average sizes of 0.6-1.6 nm generate after femtosecond pulse laser irradiation for 1-3 min, where hydrated electron e-aq reacts as a reducer [Imae, et al. ACS Applied Nano Mater. 2022, 5, 16842-16852]. At longer irradiation, plasmonic nanoparticles with larger sizes are produced. Both clusters and plasmonic nanoparticles exhibited fluorescence, indicating a quantum property, although the fluorescent property is not expected from conventional plasmonic gold nanoparticles. Meanwhile, silver clusters also display fluorescence but does not occur plasmonic bands [Imae et al. Nanoscale Horizons, 2024, in press], different from conventional silver nanoparticles, and platinum clusters do not reveal fluorescence. Zinc and copper precursor ions were oxidized by OH● and produced metal oxides. Thus, the femtosecond pulse laser irradiation to Zn and Cu ions produced ZnO and CuO clusters, respectively, with larger bandgaps than conventional counterparts [Nguyen, et al. ACS Appl. Mater. Interfaces, 2024, 16, 22532-22546].

Biography:

Toyoko Imae is Honorary Chair Professor of National Taiwan university of Science and Technology, Taiwan, since 2009 and Visiting Professor of Nagoya City University, Japan, since 2020. She is Professor Emeritus of Nagoya University, Japan, since 2006 and previous Specific Research Professor of Keio University (2006-2009). Research fields: nanoscience/nanotechnology, polymer/materials science, energy/environmental/biomedical science, photonics/plasmonics, energy production and storage (solar cell/fuel cell/capacitor), pollutant removal/decomposition (greenhouse gas/sick-house gas/pesticide), inspection and therapy (drug delivery system/phototherapy/hyperthermia). Publications: original papers 376, edited monographs 4, book chapters 30, translation 1, reviews 25, newspaper press 2, TV release 1, patent >20, invited talk >150 (See HP: http://imaelab.jpn.org/)

Smart Luminescent Materials Based on Nanoclusters of Nonemissive (Macro)Molecules

Ben Zhong Tang*

Chinese University of Hong Kong, China

Session: NanoBiosensors, BioMEMs and Biochips

Keynote Talks

Organic Transistor-Based Chemical Sensors

Tsuyoshi Minami*

Institute of Industrial Science, The University of Tokyo

Abstract

Organic field-effect transistors (OFETs) are electronic devices showing switching characteristics by applying voltage. Owing to their beneficial device properties, OFETs functionalized with appropriate molecular recognition materials contribute to sensitive detection over conventional electrochemical sensing methods. Biological materials such as enzymes and antibodies have been employed owing to their favorable specificities to analytes based on the lock-and-key recognition principle. However, detectable analyte structures are limited by a library of these biological materials. Therefore, synthetic receptors based on molecular recognition chemistry are promising approaches in the design of recognition sites. In this study, molecularly imprinted polymers (MIPs) were applied to molecular

recognition materials for selective detection. MIPs provide three-dimensional recognition networks against specific analytes because a pre-organized structure made of a template (i.e., analyte) and functional monomers can be optimized by quantum chemical calculation methods. Such optimized MIP structures contribute to selective detection even in the presence of interferents. In contrast, the inherent cross-reactivity of supramolecular receptors can be applied to simultaneous detection by using pattern recognition methods. This presentation will discuss the usability of this approach for the realization of OFET-based chemical sensor devices based on fusion technologies of organic electronics, molecular recognition chemistry, and polymer chemistry.

Biography:

Tsuyoshi Minami obtained his Ph.D. from Tokyo Metropolitan University in 2011. During his Ph.D. research, he worked at University of Bath as a collaborative researcher. Between 2011 and 2013, he served as a Postdoctoral Research Associate at Bowling Green State University and was appointed as a Research Assistant Professor in 2013. In 2014, he worked at Yamagata University as an Assistant Professor. Subsequently, he was appointed as a Lecturer at the University of Tokyo in 2016 and has held the position of Associate Professor since 2019. His research interests include supramolecular analytical chemistry for bio/chemical sensing applications.

Microfluidic Strategy for Exosome-Based Diagnostics 13:30 - 13:55 and Therapeutics

Hyo-Il Jung*

School of Mechanical Engineering, Yonsei University, South Korea

Abstract

Since exosomal cargoes are an important key to the cellular communication an essential step for the analysis of functional exosomes is to purify them from the body fluids. Conventional isolation methods of exosomes, such as ultracentrifugation (UC), differential ultracentrifugation (dUC), and membrane filtration, suffer from time-consuming processes, low isolation efficiency, and no selectivity to tumor-associate exosomes. Microfluidics has recently been exploited to overcome the above limitations, but the improvements in terms of throughput and selectivity are still struggling to become practical. Here, we introduce a novel microfluidic chip capable of selectively separating various types of exosomes with high efficiency in a short time, depending on the expression of their surface protein. Our microfluidic device offers size-based continuous stratification of various sized micro-beads with high-throughput, on whose surface the functional exosomes are immoblized. Subsequently, these different sizes of microbeads enable the exosomes to hydrodynamically separate depending on their phenotypes in the channel. It only used small volume of biological samples for the downstream analysis. Our device is expected to pave the new way for exosome-based early diagnosis of disease as well as its fine production.

Biography:

Hyo-Il Jung is a Professor in the School of Mechanical Engineering, Yonsei University, South Korea. He received his PhD (Physical Biochemistry) degree from University of Cambridge, United Kingdom. His research includes the development of bio-analytical systems for human healthcare, in particular microfluidic strategy for isolation and enrichment of circulating biomarkers including circulating tumor cells and extracellular vesicles. Recently he has contributed to the founding of start-up companies. He also serves as a technical advisor to several in vitro diagnostics companies. He is author of over 120 journals' articles and owns over 70 patents. He also serves as the president of Korean Society of Extracellular Vesicles (KSEV) and a vice president of Korean Biochip Society (KBS).

Revolutionizing Cancer Research with 3D Microfluidic Devices: Simulating Drug Resistance and Immune Dynamics

Sungsu Park*

School of Mechanical Engineering, Sungkyunkwan University (SKKU), Korea

Abstract

In this presentation, we introduce two innovative microfluidic devices designed to enhance our understanding of cancer by simulating key aspects of tumor behavior and drug resistance. The first device is a 3D microfluidic cell culture platform that replicates the dynamic tumor microenvironment (TME) observed in chemotherapy patients. This platform features microfabricated habitats and concentration gradients that mimic the complex interactions within the TME, providing a realistic setting for studying cancer cell behaviors under chemotherapeutic stress. The second device, a multi-inlet spheroid generator (MSG), introduces a novel method for integrating drug solutions or cells into spheroids with minimal mechanical stress. This is achieved through a unique side inlet that preserves the structural integrity of the spheroids, making it particularly useful for precise drug testing and cellular interaction studies. These devices allow for the direct assessment of drug efficacy using patient-derived cancer (PDC) cells and facilitate the adjustment of stromal cell ratios within TME-analogous spheroids. By closely replicating the in vivo conditions, these microfluidic platforms enhance the relevance of high-throughput screening (HTS) methods, enabling more accurate predictions of anticancer drug effectiveness.
The clinical implications of these technologies are profound, offering a more faithful representation of the TME and potentially leading to significant advancements in cancer therapy and research. Our findings demonstrate the critical role these devices can play in advancing our understanding of tumor dynamics and improving therapeutic outcomes.

Biography:

Professor Sungsu Park earned his Ph.D. from Cornell University in 1999 and held postdoctoral positions at Tokyo Institute of Technology, Cornell University, and Princeton University. He joined Ewha Womans University in 2004, became a full professor in 2011, and moved to Sungkyunkwan University in 2014. His research focuses on organ-on-a-chip, tumor-on-a-chip, and 3D printed devices for diagnostics. He has published 181 SCI-indexed papers with 9,600 citations and holds an H-index of 52.

Boron-Doped Diamond Nanoparticle for Electrochemical Sensor Application

Prastika Krisma Jiwanti*

Nanotechnology Engineering, Faculty of Advanced Technology and Multidiscipline, Universitas Airlangga, Surabaya 60115, Indonesia

Abstract

Boron-doped diamond (BDD) material has been known to its excellent electrochemical properties, such as wide potential window, low background current, high chemical and physical properties. This material has been used as electrode in electrochemical analysis and electrocatalytic application. The nanoparticle form of BDD, called boron-doped diamond nanoparticle (BDDNP) has its own special properties, in which, it is easier to be modified or fabricated as composite material, thus improve the flexibility for designated application. BDDNP can be fabricated as screen-printed electrode and be applied for electrochemical detection. Several sensor applications, such as fluoroquinolone and artificial sweetener sensor will be introduced. Fluoroquinolone, one of quinolone type antibiotic, such as enoxacin (ENX), norfloxacin (NOR), ciprofloxacin (CIP), ofloxacin (OFL), and levofloxacin (LEV) has the ability to treat gram-positive bacteria. Despite their effectiveness in treating infectious diseases, antibiotics are known to be used in food animals as growth promoters. This could promote antibiotic resistance and antibiotic residues in meat, milk, and eggs intended for human consumption. Therefore, fast and sensitive sensor device is important. Therefore, BDDNP will be used as an electrode material that can improve the sensitivity of the sensor, in comparison to the use of commercial screen-printed carbon electrode. For example, screen-printed BDDNP electrode improves the sensitivity of levofloxacin detection from 1.594 µA/µM to 2,036 µA/µM.

Biography:

Dr. Prastika K. Jiwanti was born in 1991. She received her B.S. (2014) in Universitas Indonesia, M.S. (2016) and Ph.D (2019) in Keio University, Japan. Currently, she is an assistant professor at department of Nanotechnology Engineering, Faculty of Advanced Technology and Multidiscipline, Universitas Airlangga. Her current research focus is in Electrochemistry of boron-doped diamond material and other carbon-based material, sensor and biosensor applications, CO2 electrochemical reduction, and nanomaterial and metal nanoparticle modification.

The SERS Measurement and Advanced Micro- and Nano- Manufacturing on Microfluidic Sensor

Rongke Gao*

College of Control Science and Engineering, China University of Petroleum (East China), Changjiang West Road 66#, Qingdao 266580, China

Abstract

Microfluidics is the science and technology of systems that manipulate very small amounts of fluids in microchannels with multiple research fields. This talk is going to introduce the background of microfluidic technologies and the recent research process that the SERS measurement and advanced micro- and nano- manufacturing integrated with microfluidics, and the applications on the early

diagnostic of cancer and cardiac diseases, heavy metal ions detection in seawater, crude oil separation from seawater etc. Accordingly, microfluidic sensors are expected to be useful as a potential clinical tool for personalized diagnosis and marine environment protection.

Biography:

Rongke Gao received Ph.D. degree from Department of Bionano Engineering, Hanyang University in 2015. From 2015–2021, He worked as associate professor at Hefei University of Technology. He moved to China University of Petroleum (East China) as full professor in 2021 and involved in the "Taishan Scholars" program of Shandong Province. He has published more than 30 research papers (e.g. Lab Chip, ACS Appl. Mater. Interfaces, Chem. Mater., Biosens. Bioelectron. etc.). He also serves on the Editorial Board of the journal Computers in Biology and Medicine (Elsevier), vice president of Anhui society of Biomedical Engineering, and committee member of Branch of Biomedical Sensors in Chinese Society of Biomedical Engineering. His research interest is mainly centered on the development of highly sensitive SERS detection technology, and its applications of biomedical sensor, nano science, and microfluidics.

Multimodulity Sensing Method for Point-of-Care Detection of Pathogens

Jingbin Zeng*

China University of Petroleum, China

Isolation and Label-Free Detection of Circulating Tumour Cells by Fluidic Diffraction Chips with a Reflective Laser Beam System

Jem-Kun Chen* and Feng-Ping Lin

Department of Materials and Science Engineering, National Taiwan University of Science and Technology, Taiwan, ROC

Abstract

A photonic crystal (PC) based line array of poly(methacrylic acid) (PMAA) brushes was grafted from a photoresist template using a trench array. The array was functionalised with anti-epithelial cell adhesion molecule antibodies (EpY). A laser beam was employed to analyse the two-dimensional (2D) and three-dimensional (3D) reflective signals of PCs at an incidence angle of 45◦. The EpY-tailed PMAA PC possessed an optical feature with a characteristic diffraction effect along two laser input configurations including the SII configuration, in which the projection of the laser beam on the plane of the SPM chip was parallel to the strips, and the ST configuration, in which they were perpendicular. A fluidic diffraction chip based on the EpY-tailed PMAA PC with 1-μm resolution was fabricated to examine the ability to detect circulating tumour cells (CTCs) along the ST configuration. The CTCs attached on the EpY-tailed PMAA PC, resulting in the change in the diffraction intensity. Dependence of change degree of the diffraction intensity exhibited a linear range of concentration of CTC from 0 to

64 cells and a limit of detection of 5 cells in 3 mL. CTC detection using both fluidic diffraction chips and a commercial IsoFlux system was carried out in clinical trials, including three healthy donors and 12 patients at various stages of colorectal cancer for comparison. Our platform provides a simple label-free method with high accuracy for rapid CTC counting, which has great potential in clinical treatment applications.

Biography:

Jem-Kun Chen received his BS (1996) and MS (1998) in Chemical Engineering from National Tsing Hua University (Taiwan) and his Ph.D. (2003) in Applied Chemistry from National Chiao Tung University (Taiwan). Since 2006 he has been an professor of Materials Science and Engineering at National Taiwan University of Science and Technology until now. His current research emphasizes the device processing, characterization, modeling, and optimization for optical and biological sensors. He has published more than 200 research articles in SCI journals (2005–2024).

Invited Talks

Interface Chemical Environment Control and Sensing Technology

Wei-Ssu Liao*

Department of Chemistry, National Taiwan University, Taiwan

Abstract

The interface chemical environment control plays an important role in nanofabrication and corelated sensor designs. In this talk, both substrate and colloid based approaches will be presented to discuss how interface chemical controls affect nanomaterial properties and sensing capabilities. The significance of interface environment managements from nanofabrication, sensor designs, toward innovative device developments will be highlighted. Delicate controls over the interface environment should be considered for the capability improvement of sensors and can open avenues for next-generation sensor integration. Challenges and potential solutions, with prospective opportunities in this research area will also be included.

Biography:

Wei-Ssu Liao received his BS from National Cheng Kung University and his MS from National Taiwan University. He received his PhD from Texas A&M University, thereafter, he worked as a postdoctoral scholar at UCLA. In 2013, he joined Department of Chemistry, National Taiwan University as a faculty member. His research experience and interests lie in bioanalytical chemistry, surface science, functional nanomaterials, and analytical devices.

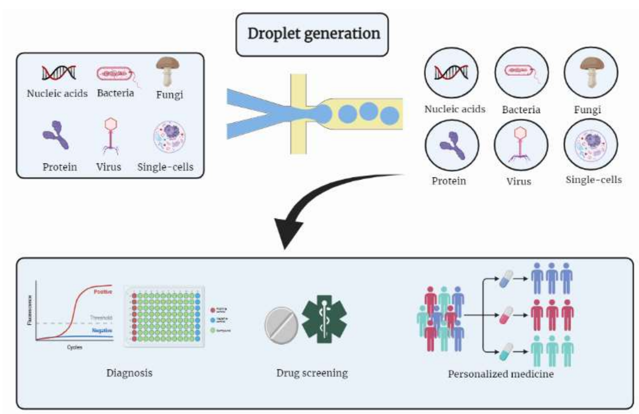
Droplet Microfluidics for Single-Molecule and Single-Cell Analysis for the Multiplexed Diagnostics

Dong-Ku Kanga*

Department of Chemistry, Incheon National University, Incheon 22012, Republic of Korea; Research Center for Sustainable Plastics, Incheon National University, Incheon 22012, Republic of Korea; Research Institute of Basic Sciences, Incheon National University, Incheon 22012, Republic of Korea

Abstract

Over the last decade, rapid and precise diagnostics have become increasingly important, especially during the SARS-CoV-2 pandemic. Advances in droplet-based microfluidics (DMF), which divides samples into hundreds of thousands of microdroplets, have been widely used to analyze disease-related biological molecules such as nucleic acids at the single-molecule level. Since each microdroplet can be severed as an individual picolitre reactor, the target-initiated signal can be continuously amplified inside confined droplets, which allows single-molecule sensitivity. However, microscopic systems are commonly used for imaging and analyzing droplets using high-magnification objective lenses, which are complex and expensive. Another concern is the time gap between droplets that are analyzed inside a microfluidic channel or imaging chamber, which can cause discrepancies in reaction time between droplets. Here, I would like to discuss the strategies for multiplexed droplet analysis and absolute quantification of disease-related biological molecules such as pathogens and nucleic acids.



Metal-Oxide Graphene Nanocomposite as Gas Sensor Element for Detecting Carbon Monoxide (Online)

Estananto Estananto[1,2,3], Ni Luh Septiani[1,4], Muhammad Fadlan Raihan[1], Suyatman Suyatman[1], Ahmad Nuruddin[1], Brian Yuliarto[1,5]

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[4]Research Center for Advanced Materials, National Research and Innovation Agency (BRIN), KST BJ Habibie, South Tangerang 15314, Indonesia.
[5]Research Center of Nanosciences and Nanotechnology, Institut Teknologi Bandung, Bandung 40132, Indonesia

Abstract

This collection of research investigates the development and enhancement of carbon monoxide (CO) gas sensors utilizing various nanocomposites and fabrication techniques. The studies present innovative approaches in integrating metal-oxide semiconductors with graphene to achieve efficient CO detection at different temperature ranges. The first research examines a nanocomposite of graphene and WO3 nanowires, revealing that the inclusion of graphene enhances the sensor's sensitivity and response/recovery times, particularly at 300°C, and demonstrates promising results for low-temperature CO detection. The second study explores the effects of using 2-Methoxyethanol as a capping agent in WO3-based CO sensors, demonstrating that the structural properties and gas sensing performance significantly depend on the solvent ratio and temperature, achieving optimal sensitivity at 250°C. The third study details the synthesis and application of a WO3-graphene nanocomposite sensor, which exhibits high selectivity and optimal response characteristics at 200°C, offering significant potential for environmental monitoring, industrial safety, and indoor air quality assessment. Finally, the fourth study focuses on a flexible sensor combining TiO2 anatase with graphene-coated cotton fabric, highlighting its capability for room-temperature CO detection despite minimal conductance changes across different concentrations. Collectively, these studies advance the understanding of CO sensing mechanisms and propose viable solutions for flexible and efficient gas sensor technologies.

Biography:

Estananto obtained his Sarjana Teknik (B.Eng) in Engineering Physics from Institut Teknologi Bandung, Indonesia, his M.Sc in Sensor System Technology from Hochschule Karlsruhe, Germany, and his PhD from Institut Teknologi Bandung, respectively. Since 2014 he is lecturer and researcher at Electronical Engineering Study Program, Telkom University, Bandung, Indonesia. His main research topics are synthesis of metal oxide semiconductor, variative working environment of semiconductor gas sensor, and sensor implementation in the IoT systems.

Poster Presentations

Improving the Sensitivity of Ferrous Particle Sensors with Permanent Magnet in a Lubrication System

Sung-Ho Hong*

Dongguk University – WISE, South Korea

Abstract

This research focused on enhancing the sensitivity of ferrous particle sensors combined with permanent magnets, used in various mechanical systems such as gearboxes, to identify anomalies by measuring the quantity of ferrous wear particles produced by metal-to-metal contact. The current

sensor's capacity to detect abnormalities is restricted because it only measures the ferrous particles accumulated on the sensor's surface. To overcome this limitation, this study assessed the sensitivity of the existing sensor through a multi-physics analysis method and enhanced it by modifying the core shape within the sensor. The improved sensor's detection ability was analytically demonstrated to surpass that of the existing sensor. Additionally, a new numerical method for determining the optimal placement of the sensor was introduced to further increase the measurement sensitivity of ferrous wear debris sensors with permanent magnets. A flow guide wall was also proposed to focus the flow around the sensors, enhancing their sensitivity. Numerical analysis techniques capable of performing multi-physics analysis were utilized to develop a ferrous particle sensor and to provide a method for analytically comparing sensor sensitivity. This research will contribute to the creation of more effective ferrous particle sensors, potentially boosting the performance and reliability of mechanical systems.

Biography:

He received the M.S. and Ph.D. degrees in the Department of Mechanical Engineering from the Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea. He had worked on tribology at the Engine and Machinery Division in Hyundai Heavy Industries for five years. He is currently working on tribology at Dongguk University-WISE. His current research areas include bearings, purification of used oil, development of oil sensors, and machine condition monitoring based on lubricant analysis.

SERS-Based Microdroplet Sensor for the Rapid Classification of SARSCoV-2 and Influenza A Infections

Xiangdong Yu*, Jaebum Choo

Chung-Ang University, South Korea

Abstract

We developed a dual-mode surface-enhanced Raman scattering (SERS)-based microfluidic device capable of simultaneously diagnosing and distinguishing severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and influenza A. In this device, separate SARS-CoV-2 and Influenza A assays were performed in alternate droplets. Additionally, an internal standard was employed in the chip to improve the accuracy of the measurement process [1]. As a result, considering the variation of internal standards for quantitative analysis of SARS-CoV-2 and influenza A assays, the correlation coefficient increased from 0.9766 and 0.9441 to 0.9932 and 0.9842. These increases indicate that internal standard values significantly enhanced the accuracy of the assay. The limits of detection were estimated to be 9.43 PFU/mL and 20.4 HAU/mL for SARS-CoV-2 and influenza A/H1N1, respectively. The entire analysis process, from droplet generation to SERS detection, took less than 10 min because all experimental conditions were controlled within the exquisitely designed microfluidic channel. We anticipate that this SERS-based immunosensing platform will serve as a new point-of-care diagnostic tool for detecting SARS-CoV-2 and Influenza A infections.

Electrochemical Surface-Enhanced Raman Spectroscopy Analysis of Malachite Green on Gold Substrates

Wiyogo P. Wicaksono[1,2]*, Hajun Dang[1], Sungwoon Lee[1], Jaebum Choo[1]

[1]Chung-Ang University, South Korea; [2]Universitas Islam Indonesia, Indonesia

Abstract

The pH-sensitivity and electroactivity of malachite green (MG), a cationic dye, can potentially affect the surface-enhanced Raman spectroscopy (SERS) profile during electrochemical SERS (EC-SERS) analysis. An EC-SERS investigation was performed by acquiring dynamic SERS profiles of MG on Au SERS substrates at various applied potentials to elucidate the electrochemistry of MG at the molecular level. The appropriate EC-SERS potential window of MG, mass and electron transfer modes, and the number of electrons and protons in the redox process were determined by cyclic voltammetry. The EC-SERS parameters (pH and type of supporting electrolyte) were optimized. The highest SERS signal was achieved by chronoamperometry SERS (CA-SERS) and CV-SERS at an applied potential of 0.6 V (vs. Ag/AgCl) using 0.1 M phosphate buffer at pH 4 as the supporting electrolyte. Plausible mechanisms for electrooxidation and SERS signal enhancement were proposed. The oxidized form of MG, conformational changes, and evolution of the adsorption orientation were successfully elucidated using CV-SERS. This study provides molecular-level insight into the adsorption orientation of MG and its oxidized form, which involves aromatic rings with a tilted upright orientation at positive applied potentials. The mechanism of SERS signal enhancement is expounded, which is valuable for developing EC-SERS-based MG sensing.

Effect of the Chemical Structure of a Self-Assembled Monolayer on the Gas-Sensing Behavior of SnO Nanowires

Hyoungwon Park[1] and Jae-Hun Kim[2], *

[1] Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Äußere Nürnberger Str. 62, Forchheim 91301, Germany

[2] Materials Science and Engineering, Inha University, Incheon 22212, Republic of Korea

Abstract

In this study, detailed investigations of the selective sensing capability of semiconducting metal oxide (SMO)-based gas sensors with self-assembled monolayer (SAM) functionalization were conducted. The selective gas-sensing behavior was improved by employing a simple and straightforward post-modification technique using functional SAM molecules. The chemical structure of the SAM molecules promoted interaction between the gas and SAM molecules, providing a gas selective sensing of SnO2 nanowires (NWs). In addition, a bundle of SnO2 NWs provided a large surface area that could act as a sensing site. SAM functionalization was confirmed by infrared spectroscopy and thermogravimetric analysis, and the selective gas-sensing behaviors were investigated under different sensing conditions. With variations in the chemical structures of the SAM molecules, the selective gas-sensing behaviors also changed as the corresponding intermolecular interaction forces were different. This integration of selective gas sensing and passivation of a sensing surface provides a straightforward approach for the

preferred gas sensing of SnO2 NWs. Furthermore, owing to the universal binding characteristics of the metal oxide surface, this approach can be expanded to other SMO-based gas-sensing platforms.

Biography:

Jae-Hun Kim received his M.S. and Ph.D. degrees from Inha University in Materials Science and Engineering in 2015 and 2019, respectively. He worked at Inha University as a postdoctoral fellow from 2019 to 2020. He was a visiting researcher at the National Institute for Materials Science (NIMS), Japan for 2 years from 2020 to 2022. Since 2023 he joined the Department of Materials Science and Engineering at Inha University as an assistant professor. He has been working on 1-demensional oxide nanowire and 2-dimensionnal transition metal dichalcogenides gas sensors.

Day 2 (Room 1)

Session: Smart Materials for Energy and Environment

Keynote Talks

New 2D Boron Materials for Hydrogen Creation, Storage, and Usage

Takahiro Kondo*

Institute of Pure and Applied Sciences, University of Tsukuba, Japan

Abstract

As new 2D metal-free materials, we have experimentally synthesized hydrogen boride (HB) sheets [1] and boron monosulfide (BS) sheets [2]. The BS sheets are crystalline semiconductor and its bandgap was found to be tuned to a desired value by controlling the number of stacked 2D BS nanosheet [2]. Moreover, the stacked BS sheets, rhombohedral BS (r-BS), is found to be as a p-type semiconductor [3] and have a great electrocatalytic property for oxygen evolution reaction in alkaline solution [4,5]. HB sheets are composed of boron and hydrogen at a 1:1 stoichiometric ratio, which can be formed by an ion-exchange reaction between protons and magnesium cations in magnesium diboride with exfoliation [2]. In the HB sheets, boron atoms form a hexagonal 2D network, in which hydrogen atoms are bound to boron by three-center-two-electron bonds (B–H–B) and two-center-two-electron bonds (B–H) [6]. Experimental studies have clarified that HB sheets exhibit solid acid catalytic activity [7], metal ion reducibility [8, 9], semimetal electronic properties [10], gas-sensor applicability [5], stability against water [11], CO2 adsorption/conversion property including C-C coupling [12], and a light-responsive hydrogen release function [13,14]. In the presentation, recent progress of BS and HB sheets will be introduced by focusing hydrogen creation, storage and usage.

Biography:

Dr. Takahiro Kondo is Professor at Department of Materials Science, Institute of Pure and Applied Sciences and Director of R&D Center for Zero CO2 Emission with Functional Materials, University of Tsukuba from 2022. He also holds Specially-appointed Professor position at the Advanced Institute for Materials Research at Tohoku University. He is also Fellow of the Japan Society of Vacuum and Surface Science from 2022. He received Doctor of Philosophy in Engineering from University of Tsukuba at 2003. He spent 4 years at Institute of Physical and Chemical Research (RIKEN) as Postdoctoral researcher. He then moved to University of Tsukuba from 2007.

Tuning Photons into Chemical Reaction: Plasmonic Au Nanocatalysts

Youngsoo Kim[1]*, Juhee Ha[1]

[1]*Department of Chemistry, Yeungnam University, Republic of Korea*

Abstract

Plasmonic noble metal nanoparticles, especially Au, have recently received increased attention as visible-light-driven photocatalysts because of their strong absorption cross-section in the visible light region and their great catalytic activities in the nanoscale regime. Furthermore, diverse research has shown that important chemical reactions like water splitting and CO2 reduction can be driven using Au photocatalysts. In this talk, we will delve into the physical behavior of the photochemical reaction and the changes in activation energy contributed by light in Au-catalyzed photochemical reactions in detail. We will also discuss how the activation energy of Au nanoparticle-catalyzed electron transfer reactions is significantly reduced under visible light excitation due to light-induced cathodic polarization of nanoparticle catalysts. Finally, I will share some recent progress on intermolecular bond formation and bond cleavage with plasmonic Au nanocatalysts.

Biography:

Youngsoo Kim is an associate professor in the Department of Chemistry at Yeungnam University, South Korea. He received his Ph.D. degree in 2009 from Korea University, South Korea, and then joined Samsung Electronics as a principal investigator. He worked at the Department of Chemistry at the University of Illinois at Urbana-Champaign as a postdoctoral researcher. His research encompasses both synthesis and applied aspects of nanomaterials. Currently, his research interests mainly focus on photocatalysis, chiral nanomaterials, 2D-layered TMDCs, and light-emitting materials.

Recent Research Progress on Insertion Materials for Li-ion Battery Applications

Naoaki Yabuuchi*

Yokohama National University, Japan

Customized Electrolyte Design for Different High Voltage Lithium Battery Systems

Jianwen Liu*

Hubei University, China

Solar Cell Application of Semiconductor Nanostructures

Yoshitaka Okada*

Research Center for Advanced Science and Technology (RCAST), University of Tokyo, Japan

Abstract

A detailed balance calculation evidences high energy conversion efficiencies exceeding 60% for intermediate-band solar cells (IBSCs) when operated under maximum sunlight concentration. In order to achieve high efficiencies, the key is to be able to realize an efficient sequential two-photon absorption (STPA) process, which requires a sufficiently long radiative recombination lifetime for the carriers in the IB. In this work, we report on one type of so called "ratchet-IBSC", utilizing the well confirmed long lifetimes, up to the order of a millisecond, of rare-earth ion luminescence centers in Erbium-doped GaAs compound solar cells [1]. Four Er-doped GaAs solar cells were fabricated by molecular beam epitaxy (MBE) with varying Er concentrations in the i-layer of p-i-n junction structure. The temperature dependent differential external quantum efficiency (EQE) measurements revealed a clear STPA contribution originating from the Er3+ luminescence centers at a wavelength of 1540 nm. All the experimental results were then modeled and interpreted by integrating the ratchet effect and up-conversion steps along with DFT simulation of electronic states in Er-doped GaAs. Our work demonstrates that the well-known long lifetime energy-transfer mechanism in Er3+ centers contribute directly to the formation of ratchet-type IB in GaAs material, which can therefore be integrated to achieve high efficiency IBSC device. [1] T. Sogabe et al, Communications Physics 4, 38 (2021).

Biography

Yoshitaka Okada is Professor at the Research Center for Advanced Science and Technology (RCAST) of the University of Tokyo. He received his BSc in electronic and electrical engineering from King's College London in 1984, and MEng and PhD degrees in electronic engineering from the University of Tokyo in 1987 and 1990. He was appointed as Visiting Assistant Professor at Stanford University in 1995-96, Visiting Fellow at Imperial College London in 2006, and Visiting Fellow of Cavendish Laboratory at the University of Cambridge in 2015. His research interests include thin-film growth of low-dimensional quantum nanostructures for advanced concepts in high-efficiency photovoltaics such as multijunction and intermediate-band solar cells.

Invited Talks

Attaching Luminous Downshifting Vanadium-Doped ZnO Nanoparticles and Antireflection Coating Layers to Enhance the Efficiency of Silicon Solar Cells

Parameswar Hari*[1a,b] Ganga R. Neupane[2a], David N. McIlroy[3c], Elena Echeverria[4c], Prasanna Sankaran[5d]

[a]*Physics and Engineering Physics, University of Tulsa, Tulsa, Oklahoma 74104, USA*
[b]*The Oklahoma Photovoltaic Research Institute, University of Tulsa, Tulsa, Oklahoma 74104, USA*
[c]*Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078, USA*
[d]*Center for Surface Science, Department of Physics, PSG College of Technology, Coimbatore 641004, India*

Abstract

In this study, we report on the role of vanadium doped (0%, 2%, 4%, and 6%) ZnO (V-ZnO) nanoparticles to improve the efficiency of silicon solar cells by facilitating the luminous down-shifting (LDS) and anti-reflection (AR) process. The structure and morphology of V-ZnO nanoparticles have been analyzed through transmission electron microscopy (TEM) and X-ray diffraction spectroscopy (XRD). The chemical composition of V-ZnO was analyzed through X-ray photoelectron spectroscopy (XPS). The size of the V-ZnO particles increased as vanadium concentration increased. Reitveld analysis of XRD data confirms the presence of the secondary phase in all doped V-ZnO samples. Optical properties were analyzed through photoluminescence (PL) and absorption using UV-vis spectroscopy. Green emission was observed in all doped samples and the intensity of the green emission was found to increase with increasing concentration of vanadium. The bandgap of V-ZnO nanoparticles was found to decrease with increasing vanadium concentrations up to 6% from 3.11 eV to 2.37 eV. Current-Voltage measurement confirms the enhancement in power conversion efficiency by 34.52% with a 6% V-ZnO nanoparticles layer. Enhancement in external quantum efficiency (EQE) due to downshifting and antireflection coating layer was also observed. The optimum thickness of approximately 183 nm was found for the observed maximum enhancement in power conversion efficiency in silicon solar cells.

Biography:

Dr. Parameswar Hari is a Professor in the Physics and Engineering Physics at the University of Tulsa. Dr. Hari is also the director of the Oklahoma photovoltaic research institute at the University of Tulsa. Dr. Hari conducts research on nanomaterials, especially on materials used in third generation photovoltaics. Dr. Hari obtained Ph.D. in condensed matter physics from the University of Utah. Prior to joining the University of Tulsa, Dr. Hari obtained post- doctoral training at The National High Field Lab, Texas A&M University and Vanderbilt University. Dr. Hari is the author of over 97 publications in condensed matter physics.

Advanced Wavelength-Selective Technologies in Transparent Dye-Sensitized Solar Cells

Jongin Hong*, Mutia Anissa Marsya, Dini Hayati, and Kantapa Yolthida

Chung-Ang University, Republic of Korea

Abstract

Technologies transparent to human eye have recently garnered significant attention by utilizing photoactive materials that selectively absorb UV and/pr NIR photons. Among the emerging solar cells, dye-sensitized solar cells (DSSCs) stand out due to their ability to finely tune photosensitizers for wavelength-selective absorption. Metal-free organic dyes featuring a donor-π bridge-acceptor (D-π-A) configuration offer numerous advantages, including high molar extinction coefficient, bespoke structural modification through straightforward synthetic protocols, and low-cost mass production. Our research has introduced novel fluorene-based dyes that selectively harvest UVA (315-400 nm), resulting in UV-selective and visibly transparent DSSCs with a power conversion efficiency (PCE) of 3$ and visible light transmittance (VLT) of 60%. To enhance both PCE and VLT, we have developed co-sensitization of UV and NIR dyes, transparent liquid electrolytes composed of tetramethylthiourea/tetramethyl formaminium disulfide (TMTU/TMFDS2+) and transparent counter electrodes using Pt-based nanocatalysts produced through combustion-assisted chemical reduction. Furthermore, we are exploring the color perception and rendering properties of light transmitted through these DSSCs, demonstrating their potential for widespread adoption. These advancements mark a significant step toward the development of efficient, aesthetically pleasing solar cells for practical applications.

Biography:

Jongin Hong is a professor in the Departments of Chemistry & Smart Cities and Director at the Energy and Environment Institute at Chung-Ang University (CAU). He received his B.S., M.S., and Ph.D. in the Department of Materials Science and Engineering from KAIST. He completed postdoctoral training at KIST, the University of Pennsylvania, and Imperial College London. Prof. Hong has published over 120 research papers. His research focuses on developing next-generation solar cells and smart windows for energy-efficient buildings and cities.

Advanced Electrocatalyst for Direct Seawater Splitting

Nasir Mahmood*

RMIT University, Australia

Versatile Hybrid Nanostructured Materials Platform for Nanobio Sensors

Seunghyun Lee*

Department of Chemical & Molecular Engineering, Hanyang University ERICA

Abstract

The hybrid nanostructured materials platform for nano convergence research is a pioneering initiative that spearheads groundbreaking research at the intersection of nanoscience and bioscience fields. This platform represents a dynamic collaboration between experts in nanotechnology, biology, and materials science, with the goal of developing innovative hybrid nanostructured materials that revolutionize biomedical applications.

In nanobio research, plasmonic metal nanoparticles have attracted significant interest due to their optical properties known as localized surface plasmon resonances (LSPR), which is a phenomenon in which the free electrons on the surface of gold particles interact with light. Furthermore, when plasmonic nanoparticles are arranged in a regular array or pattern on a metal substrate, they form nanogaps that generate multiple hotspots capable of amplifying Raman signals. This unique optical property makes anisotropic gold nanoparticles and their arrays particularly useful in surface-enhanced Raman scattering (SERS). Our research has focused on developing highly sensitive SERS-active substrates by utilizing these optical properties and employing experimental methods. Furthermore, we will discuss not only SERS-active substrates that incorporate plasmonic-carbon hybrid nanostructures for molecular detection but also the integration of metal nanoparticles within nanostructured substrates.

Degradation of High Nickel Li-ion Cathode Materials Induced by Exposure to Fully-Charged State and its Mitigation

H. Hohyun Sun*

The University of Alabama, USA

Structures, Morphology, and Size of Tin Phosphate Powders via Modified Hummers Method for Potential Application in Battery and Fuel Cell

Adhitya Trenggono[1,2,7]*, Joseph Bona Nandito[1,2], Erin Ovenia Samosir[1,2], Riyangga Purnawansya Ardhi[1,2], Mudzakkir Dioktyanto[3,4], Yus Rama Denny[5,6], Erlina Yustanti[1,7,8]

[1]Department of Metallurgy Engineering-Sultan Ageng Tirtayasa University, Indonesia
[2]Material Functional Laboratory-Sultan Ageng Tirtayasa University, Indonesia
[3]Nano Centre Indonesia, Indonesia

[4]Department of Mechanical and Industrial Engineering-Norwegian University of Science and Technology, Norway
[5]Department of Physic Education-Sultan Ageng Tirtayasa University, Indonesia
[6]Photovoltaic, Functional Device and Artificial Intelligence Laboratory-Sultan Ageng Tirtayasa University, Indonesia
[7]Centre for Research Collaboration in Tin Metal-Sultan Ageng Tirtayasa University, Indonesia
[8]Center of Excellence Faculty of Engineering, Nanomaterial and Process Technology Laboratory-Sultan Ageng Tirtayasa University, Indonesia

Abstract

The Indonesian government has implemented a downstream policy for the utilization the metal resources such as nickel, copper, tin, alumina, and others critical metals. These metals are used for electric vehicle battery application. Among those metals, tin have been marketed as solder, and Poly Vinyl Chloride (PVC) stabilizer and the heat stabilizer. In addition to the aforementioned products, tin phosphate powders have been developing for a membrane in proton-exchange membrane fuel cell (PEMFC), electrodes, and electrolytes additive in lithium and sodium batteries. In this work, tin phosphates/graphene oxides composites were synthesized by modified Hummers method to produce graphene oxide (GO) layers as the template for tin phosphate structures growth during the reaction. The tin phosphate powders are produced by calcination process to remove GO out of the composites. The powder structures, morphology, and size were characterized by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Particle Size Analyzer (PSA), respectively. The graphite precursor size, Hummers reaction time, tin and graphite weight ratio, and the dispersion solvents (e.g distilled water and dimethyl formaldehide) have affected structures, morphology, and size of the tin phosphate powders. The structures are potassium ditin phosphate, tin phosphate, and potassium ferrate mostly. The acicular, angular, and spherical shapes are resulted after the calcination step. For the size distribution, there are 2 (two) distribution region such as between 1-20 µm and 200 nm-1 µm. In conclusion, this tin phosphate powders has potential to be developed for membrane PEMFC, electrodes, and electrolytes additive in the batterries.

Biography:

Adhitya Trenggono is a senior lecturer at Department of Metallurgy Engineering-Sultan Ageng Tirtayasa University in Cilegon, Indonesia. He received a bachelor’s degree in Material Engineering from Bandung Institute of Technology in Bandung, Indonesia and a master’s degree in Materials Science from Universidade de Aveiro in Aveiro, Portugal. He was a scholarship grantee from Erasmus Mundus and Marie Curie Scholarship. Some papers, books, patents, and research funds have been produced during his tenure time. He is interested in Functional Materials, Energy Materials and Nano Composites for Energy and Environment. Joseph Bona Nandito is an alumnus of the metallurgical engineering department at Sultan Ageng Tirtayasa University. He once worked at the first HPAL factory in Indonesia, PT Halmahera Persada Lygend. Furthermore, He is now an LPDP Awardee at Northeastern University China majoring in Metallurgical Engineering. He is interested in Energy Materials. Erin Ovenia Samosir received a bachelor degree in Metallurgical Engineering from Sultan Ageng Tirtayasa University. During her study, she served as the member of the Metallurgical Engineering Student Association (HIMAMET) at the Faculty of Engineering, Sultan Ageng Tirtayasa University. She is very interested in nanomaterials, particularly the synthesis of SnO2@GO. Riyangga Purnawansya Ardhi is a graduate of Metallurgical Engineering from Sultan Ageng Tirtayasa University. He received his bachelor's degree in 2022. During his study, he served as the head of the Metallurgical Engineering Student Association (HIMAMET) at the Faculty of Engineering, Sultan Ageng Tirtayasa University, and participated in the Student Creativity Program for Exact Research (PKM-RE). He is very interested in nanomaterials, particularly the synthesis of SnO2@GO. Mudzakkir Dioktyanto is a researcher at the

Department of Mechanical and Industrial Engineering and Nano Center Indonesia. He has a bachelor's degree in Materials and Metallurgical Engineering from Sepuluh Nopember Institute of Technology (Indonesia) and a master's degree in Metallurgy and Materials Engineering from University of Indonesia (Indonesia). He is interested in materials processing and synthesis, extractive metallurgy, mechanical alloying, and recycling of materials. Yus Rama Denny received a bachelor degree in Material Physic from Universitas IndonesiaIndonesia in 2006, a master degree in Material Physic from Universitas Padjajaran-Indonesia in 2009, and a doctoral degree in Materials Science from Chungbuk National University-South Korea in 2014. He is a senior lecturer at Department of Physic Educational-Sultan Ageng Tirtayasa in Indonesia. He is member of Korean Vacuum Society and American Vacuum Society. Some papers, books, patents, and research funds have been produced during his tenure time. He is interested in Transparent Conducting Oxide, and Surface and Interface analysis for absorber, antenna, microwave, bio sensor, and solar cell. Erlina Yustanti is a professor and senior lecturer in the Department of Metallurgy Engineering at Sultan Ageng Tirtayasa University, Cilegon, Indonesia. She obtained a bachelor's degree in chemistry from the Bandung Institute of Technology in Bandung, Indonesia. She completed her master's and doctoral degrees in materials science from Universitas Indonesia. The Ministry of Research, Education, Culture, Research, and Technology of the Republic of Indonesia, in partnership with internal funds from Sultan Ageng Tirtayasa University, provided funding for the development of publications and books. She is interested in radar absorber materials, nanocomposites, and advanced materials.

Cellulose Nanocrystal-Directed Hierarchical ZSM-5 for the Catalytic Cracking of Palm Oil into Green Gasoline

Ainul Maghfirah[1]*, Deaul Aulia[2], Grandprix T. M. Kadja[1,3,4]

[1]*Center for Catalysis and Reaction Engineering, Institut Teknologi Bandung, Indonesia;*
[2]*Department of Nanotechnology, Graduate School, Institut Teknologi Bandung, Indonesia;*
[3]*Division of Inorganic and Physical Chemistry, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Indonesia;*
[4]*Research Center for Nanosciences and Nanotechnology, Institut Teknologi Bandung, Indonesia*

Abstract

The global energy crisis and environmental problems have raised attention to utilizing renewable materials as raw materials for biofuels. Palm oil, thanks to its abundance and high oil production, is among the most prospective raw materials for biofuel. The transformation of palm oil into biofuel requires a catalyst to accelerate the reaction and to tailor the selectivity. The hierarchical ZSM-5 zeolite has recently shown excellent catalytic cracking of palm oil into gasoline. Hierarchical zeolite has one or two additional porosities (meso/macro pores) in addition to the zeolite`s intrinsic micropores. However, the preparation of this type of zeolite generally entangles expensive and hazardous pore-directing agents (mesoporogens). As the research continues, benign materials are more desirable. Herein, we utilized a renewable cellulose nanocrystal (CNC) as a green mesoporogen to assist the formation of hierarchical ZSM-5. This mesoporogen created a mesopore size of 3-4 nm in the prepared zeolite. The amount of CNC influenced the porosity properties of the prepared catalyst. TEM analysis results suggest higher CNC amounts created more mesoporosity in the zeolite framework. As the CNC increased from 1 to 4 g, the hierarchy factor rose from 0.148 to 0.165. These characteristics resulted in an excellent conversion of palm oil with gasoline production of up to 33%. The Gas Chromatography-

Mass Spectrometry analysis results suggest that the prepared catalyst was highly selective toward aromatic-group gasoline (92%). This work aligns with the sustainability campaign by synthesizing a catalyst in a greener way for biofuel production.

Biography:

Dr. Ainul Maghfirah is a postdoctoral researcher at Institut Teknologi Bandung, Indonesia. She is working on porous materials such as zeolite as catalysts.

Nanomaterial and Coating for Solar Energy Applications and Perovskite Solar Cells

Pisist Kumnorkaew*

National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency. 111 Thailand Science Park, Phahonyothin Road, Khlong Nueng, Khlong Luang, Pathum Thani 12120, THAILAND

Abstract

The innovative nanocoating research team at NANOTEC Thailand is pioneering the development of solution-based nano coatings tailored for industrial applications, with a particular emphasis on solar energy. Their advancements encompass a range of solar applications, including solar thermal systems, commercial solar cells, and the latest solar cell devices.

In solar thermal applications, NANOTEC has engineered a cost-effective solar absorber coating using graphene/nano silica. This advanced coating significantly improves the conversion of solar radiation into heat, facilitating the generation of superheated steam at 450°C and 30 bar pressure. It has been effectively implemented in parabolic trough and linear Fresnel solar concentrators across various industrial sites.

For commercial solar cells, the team has developed a transparent, anti-dust nanocoating composed of surface-modified nano silica. This innovative coating helps maintain electricity production and reduce maintenance costs in solar farms and rooftop installations. Notably, this solution is designed for easy, on-site application.

In the realm of emerging solar cells, NANOTEC has developed semiconductor nanomaterials such as tin oxide, titanium dioxide, and zinc cadmium sulfide to serve as electron-transporting materials. These materials enhance the performance and stability of perovskite solar cells, anticipated to be the next generation of solar technology. The team has achieved a power conversion efficiency exceeding 21.4% and a stability of over 2400 hours without encapsulation. Additionally, they have fabricated perovskite modules with open circuit voltages of 7V and 12V on 5x5 cm and 10x10 cm substrates, respectively.

The work of NANOTEC stands at the forefront of nanocoating research, pushing the boundaries of what is possible in solar energy technology.

Application of Nanotechnology in Wood Science: Quality Improvement of Fast-Growing Wood through Impregnation and Surface Modification

Istie Sekartining Rahayu*

IPB University, Indonesia

Abstract

Fast-growing wood is known to have inferior quality, including its physical-mechanical properties and durability. Several modification methods including with nanoparticles are needed to improve the wood quality. Nanoparticle materials are known to have a high surface area and nano size so that it can penetrate the wood intercellular or coat the surface perfectly. This allows wood to have new functions and expands its use, thereby increasing its economic value. Herein, there are two different methods to enhance wood quality, namely vacuum-pressure impregnation and coating. Vacuum-pressure impregnation is carried out by immersing the wood with a solution containing dispersed nanoparticles under a vacuum of -0.5 bar for 60 minutes and continues with a pressure of 1 bar for 120 minutes. On the other hand, the coating method is done by applying the nanocoating solution on the wood surfaces and evaluating the wood with wettability analysis. These research processes have used three kinds of nanoparticles namely silica (SiO2), magnetite (Fe3O4), and titanium dioxide (TiO2). The synthesis of nano-SiO2 can be achieved via base extraction and ultrasonic methods, nano-Fe3O4 is formed through the co-precipitation method using weak or base precursors, whereas nano-TiO2 can be synthesized by the hydrothermal method with low-temperature. The physical-mechanical properties and surface characteristics of the treated wood are examined systematically. Furthermore, the material characterization is also carried out with several parameters, including the use of XRD to analyze its crystallinity and material phase, observation of the changes in wood morphology and chemical surface content through SEM-EDX, functional groups identification with FTIR, measurement of magnetic characteristics via VSM, and analysis on the wood behavior towards electromagnetic waves using VNA. In addition, chemical parameters were analyzed by the activity of nano-TiO2 photocatalysts that had formed nanocomposite polymers and coated the wood through nano-coating.

Where Nanomaterials Meet Applications: The Case of Chemoresistive Gas Sensors (Online)

Elena Spagnoli*[,1], Barbara Fabbri[1], Arianna Rossi[1], Emanuela Tavaglione[1], Matteo Valt[2], Vincenzo Guidi[1]

[1]*Department of Physics and Earth Sciences, University of Ferrara, Ferrara, Italy*
[2]*MNF, Micro Nano Facility Sensors and Devices Center, Bruno Kessler Foundation, Trento, Italy*

Abstract

Electrical gas sensors based on semiconducting materials are currently widely employed in a variety of applications and supplied by many companies. They attracted the interest of many consumers and scientists because to their inexpensive cost, flexibility of production, ease of use, long-term stability,

and huge number of detected gases. The growing need for gas sensors in a variety of applications has highlighted both their advantages and limitations. Although common semiconductors, like metal-oxides, are catalytically active, new approaches are needed to improve their selectivity and sensitivity. The aim of this presentation is to provide an overview of recent trends in this field with a focus on the functional material characteristics and the understanding of gas sensing mechanism. It is indeed critical to meticulously tailor the morphological, chemical, and structural material features to satisfy the requirements of chemoresistive gas sensors applications. In addition, some results from the extensive experience of the Sensors group at the University of Ferrara will be provided as practical cases. Nonetheless, methods for characterizing sensors from an electrical and catalytic standpoint will be discussed. Among these techniques will be described an innovative operando system based on Diffuse Reflectance Infrared Fourier Transform (DRIFT)-spectroscopy, which is one of the most effective and advanced methods for examining the composition of rough-surfaced solid samples such as nanostructured semiconducting films. Thanks to customized accessories, the system is capable to combine the electrical characterization of sensors, in conditions for real applications, together with DRIFT spectroscopy for the investigation of gas-surface reactions.

Biography:

Elena Spagnoli obtained her M.Sc. degree in Chemistry (Magna cum Laude) at the University of Ferrara, in 2019. She received her Ph.D degree in Physics at the University of Ferrara in 2022, working on the synthesis of nanostructured semiconductors for the development of chemiresistive gas sensors. She is currently conducting her research activity in the Sensors group of University of Ferrara, broadening her horizons to include light activated chemoresistive gas sensors and innovative techniques for the investigation of sensor gas-surface reactions.

Noncovalent Two-Dimensional Molecular Crystals for Solid State Luminescence

Somobrata Acharya*

School of Applied & Interdisciplinary Sciences, Indian Association for the Cultivation of Science, Jadavpur, Kolkata 700032, India

Abstract

Two-dimensional (2D) molecular crystals represent an important class of materials for advanced optoelectronic applications. Owing to the monolayer or few-layered thickness, unique properties can be realized from the 2D molecular crystals which are different from the bulk organic counterparts. We introduce a promising pressure-triggered strategy to fabricate noncovalent free–standing 2D molecular crystals (1, 2). The molecular thick, micron long, yet stable 2D molecular crystals are formed in a controllable and efficient way on the flat-water surface having small roughness. Formation of 2D molecular crystals at different stages is monitored using in-situ synchrotron grazing incidence X-ray diffraction measurements and atomic force microscopy. The crystal structures are probed using in-situ synchrotron grazing incidence X-ray diffraction measurements and selected area electron diffraction pattern using transmission electron microscopy. Resultant 2D molecular crystals show a marked enhancement of luminescence in the solid state. The critical conformation of molecules within the 2D crystals concomitantly leads to the reduced singlet-triplet energy gap and strong spin–orbit coupling

for effective mixing of the singlet and triplet states, which explains the room temperature phosphorescence origin of the luminescence and luminescence enhancement.

Biography:

Prof. Somobrata Acharya received his PhD degree from Indian Association for the Cultivation of Science in 2003. He carried out post-doctoral research at Ben Gurion University in Israel. He was a fellow of International Centre for Young Scientists (ICYS) and World Premier International (WPI) Research Centre for Materials Nanoarchitectonics (MANA) at National Institute of Materials Science (NIMS) in Japan. He is currently appointed as Senior Professor at the School of Applied and Interdisciplinary Sciences at Indian Association for the Cultivation of Science, India.

Oral Talks

Resistance of Wood Plastic Composites with Silica Filler to SubterraneanTermite

Aujchariya Chotikhun[1], Wa Ode Muliastuty Arsyad[2], Emilia-Adela Salca[3], Yusuf Sudo Hadi[4,5]*, Salim Hiziroglu[6]

[1]Songkla University, Thailand;
[2]Center for Standardization of Sustainable Forest Management Instruments, Indonesia;
[3]Transilvania University of Brasov, Romania;
[4]Bogor Agricultural University, Indonesia;
[5]The PNG University of Technology, Papua New Guinea;
[6]Oklahoma State University, U.S.A.

Abstract

Rubberwood (Hevea brasiliensis) is one of the most widely used species in South East Asia with excellent physical and mechanical properties. However, it has very poor resistance to subterranean termite attack due to its chemical structure. This study evaluated termite resistance of experimental wood plastic composite (WPC) panels manufactured from rubberwood flour, polyethylene terephthalate, and silica. The panels were exposed to Coptotermes curvignathus, subterranean termites in a no-choice test in laboratory conditions based on the Indonesian standard. Solid rubberwood samples presented poor resistance to subterranean termite attack as indicated by low termite mortality and high wood weight loss, while the WPCs samples exhibited extreme resistance. High termite mortality and low board mass loss indicated a high protection level of boards in regard to the Indonesian standard.

Biography:

Yusuf Sudo Hadi has retired from Bogor Agricultural University and now join with The Papua New Guinea University of Technology. Research interest on wood composites, wood plastic composites, nano wood composites, chemically wood modification, wood products resistance to biodegradation, and wood drying.

Emerging Development of MXene Nanosheets for Effective Hydrogen Evolution and Ultrafast Membrane Filtration

Grandprix T. M. Kadja[1,2,3]*

[1]Division of Inorganic and Physical Chemistry;
[2]Center for Catalysis and Reaction Engineering;
[3]Research Center for Nanosciences and Nanotechnology, Institut Teknologi Bandung, Indonesia

Abstract

MXene is a novel class of two-dimensional nanomaterials composed of transition metal carbide, nitride, or carbonitride. It has several physicochemical characteristics, e.g., notable electroconductivity, high surface area, and hydrophilic surface termination, which are beneficial as electrocatalysts, especially in the hydrogen evolution reaction. Moreover, the stacking of nanosheets creates tunable nanoscale interlayer galleries, providing selective layers for membrane applications. Herein, I would like to share our current, emerging synthesis, functionalization, and hybridization of several MXene nanosheets, including (but not limited to) Ti3C2, Ti2C, and V2C, for hydrogen evolution electrocatalysts, and ultrafast membrane filtration. Our results show that MXene and its hybrids are up-and-coming, high-performance materials for energy and environmental applications.

Biography:

Grandprix T. M. Kadja serves as an Assistant Professor within the Division of Inorganic and Physical Chemistry, Institut Teknologi Bandung. His research primarily focuses on the design, synthesis, and characterization of nanoporous and nanolayered materials, with a special emphasis on Two Dimensional (2D) MXene compounds, and their applications in the emerging fields of catalysis, renewable energy, separation processes. His contributions to the scientific community are underscored by an extensive publication track record, comprising around 140 articles published in reputable international journals.

Two-Dimensional, Nanosheet Ti3C2 Membrane for Fast and Efficient Azo Dye Removal: Effect of Chloride Salt Modification

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[3]Research Center for Nanosciences and Nanotechnology, Institut Teknologi Bandung, Jl. Ganesha No.10, Bandung, 40132, Indonesia.

Abstract

Methylene blue (cationic dye) and Congo red (anionic dye) are azo dyes that are widely used in the textile industry, which leads to an increase in dye waste. Untreated dyes wastewater will pollute the

environment because these dyes have an aromatic structure, which makes them difficult to degrade. Therefore, membrane technology is applied to overcome this issue due to its ease of operation and low consumption of energy. However, some membranes have a trade-off between their selectivity and permeability. Ti3C2 is a 2D nanomaterial with layered structures and terminal functional groups of -O, -OH, -F. This material is suitable for membrane application due to its hydrophilic properties. In this research, there are four major stages, starting with the synthesis of Ti3C2 from the Ti3AlC2 phase using HF for etching Al structure, preparation and modification of Ti3C2-based membrane (MM) using chloride salt (NaCl, KCl, and MgCl2), characterization of, and membrane filtration test using vacuum-assisted filtration. The result of XRD and SEM-EDX confirmed the insertion of ions from chloride salt into the adjacent nanosheets of MXene. This structure elevated the membrane performance. In methylene blue filtration, an excellent result was achieved by MM-KCl with flux and rejection of 141 L m-2 h-1 and ~100%, respectively. Meanwhile, in Congo red filtration, MM-MgCl2 has higher performance with a flux of 117 L m-2 h-1 and a rejection of ~100%. These results suggest the chloride salt-modified Ti3C2 is a promising membrane for dye removal.

Biography:

Fuja Sagita, M.Si, is a PhD student in Chemistry at Bandung Institute of Technology. She received a Bachelor's and Master's degree in Chemistry (fast-track program) from Bandung Institute of Technology in 2021 and 2022. She focused on the nanomaterial field, especially MXene. She has published 11 international papers until 2024.

Session: NanoBiosensors, BioMEMs and Biochips

Keynote Talks

Detection of CpG Methylation Level using Fluorescent Modified Methylated Probe DNA with Methyl-CpG Binding Domain Fused Luciferase

Wataru Yoshida*

Tokyo University of Technology, School of Bioscience and Biotechnology, Graduate School of Bionics, Japan

Abstract

Global CpG hypomethylation and promoter CpG hypermethylation at tumor suppressor genes are the hallmarks of cancer. We previously reported a global DNA methylation level measurement system based on bioluminescence resonance energy transfer (BRET) between methyl-CpG binding domain (MBD)-fused luciferase and DNA-intercalating dye. Therefore, the aim of this study was to develop a method to measure CpG methylation levels at tumor suppressor genes based on BRET between MBD-Nanoluc (Nluc) and fluorescent modified methylated probe DNA. When target DNA is methylated, the probe DNA hybridizes to the target DNA to form fully methylated dsDNA. The MBD-Nluc specifically binds to the fully methylated dsDNA and excites the fluorescent dye; therefore, the CpG methylation levels of the target DNA could be measured by measuring the BRET signal. Probe DNA modified with TAMRA at the 5' end and methylated at 1, 2, 3, 4, 5, 6, 7, 9, 11 or 17th cytosines were synthesized. The

corresponding methylated target DNA was hybridized to the probe DNA. The dsDNA was mixed with MBD-Nluc and the emission spectra were measured. The highest BRET signal was observed when a probe DNA methylated at the 5th cytosine was used, indicating that the optimal distance between 5'TAMRA and methylcytosine was 5 bases on the probe DNA. In addition, the BRET signal increased with increasing of the CpG methylation level of the target DNA. These results demonstrated that the CpG methylation level of target DNA was quantified by the BRET assay.

Biography:

Wataru Yoshida is a professor at the School of Bioscience and Biotechnology, Tokyo University of Technology (TUT). He received his Ph.D. in Engineering from Tokyo University of Agriculture and Technology (TUAT) in 2008. In 2008, he was accepted as JSPS Research Fellowships for Young Scientists (PD). In 2011, he became an assistant professor at TUAT and moved to TUT in 2013. In 2024, he became a full professor at TUT. His research group is interested in biomolecular engineering to develop biosensing technologies for epigenetic modifications. He is the author or co-author of more than 60 papers in international peer-reviewed journals.

Oral Talks

Low-Interference Norepinephrine Signal on Dopamine Detection Using Nafion-Coated Boron Doped Diamond Electrodes

Irkham[1]*, Kazuki Nasa,[2] Yasuaki Einaga[2]

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padjadjaran University, Jl. Raya Bandung-Sumedang Km 21, Jatinangor, Sumedang, West Java, 45363 Indonesia
[2] Department of Chemistry, Keio University, 3−14−1 Hiyoshi, Yokohama 223−8522, Japan

Abstract

The detection of dopamine in the presence of norepinephrine using nafion-coated boron doped diamond (Nafion-BDD) electrodes was presented. An increase current signal for dopamine could be observed at around 0.75 V using Nafion-BDD, while a change in the current signal of norepinephrine that appears at similar potential was not observed. This might be due to electronegativity of the norepinephrine that is not positive enough to be attracted towards the nafion membrane, albeit neutral enough to pass through the membrane and undergo electrochemical oxidation. An optimization process including accumulation time of dopamine inside the nafion layer, solution of the pH, and nafion thickness was conducted to exploit the difference electrochemical behavior between those two catecholamines at the Nafion-BDD. Using an accumulation time of 300 s, solution pH of 7, and nafion thickness of 1.1 µm, dopamine's LOD was found to be 0.966 µM. Low-interference signal of norepinephrine to the dopamine could be observed with an excellent %recovery of dopamine in 5% range when the concentration of norepinephrine was 10 times lower compared to dopamine concentration.

Biography:

Irkham is currently a Lecturer in Analytical Chemistry and Separation, Department of Chemistry, Universitas Padjadjaran. He gets his PhD degree in Department of Chemistry, Keio University, Japan, under supervision of Professor Yasuaki Einaga in 2020. Before joining Universitas Padjadjaran, he works at Einaga's group as a post-doctoral researcher. His current research mainly focusses on electrochemical sensor and biosensor to detect various analytes including disease biomarker and some halal related compounds using carbon-based electrodes. He also utilizes the use of Boron-doped diamond electrode in sensor application, including the development of novel electrochemiluminescence methods.

Green Synthesis of Ceria Nanoparticles from Cassava Tubers for Electrochemical Aptasensor Detection of SARS-CoV-2 on Screen-Printed Carbon Electrode

Salma Nur Zakiyyah[1], Irkham[1], Yeni Wahyuni Hartati[1]*

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padjadjaran University, Jl. Raya Bandung-Sumedang Km 21, Jatinangor, Sumedang, West Java, 45363 Indonesia

Abstract

Green synthesis approach for making a nanosized ceria using starch from cassava as template molecules to control the particle size are reported. The results of the green synthesis ceria with an optimum calcination temperature of 800oC shows a size distribution of each particle less than 30 nm with average size 9.68 nm, while the ratio of Ce3+ state to Ce4+ was 25.6%. The green synthesized nanoceria are applied to increase sensitivity and attach biomolecules to the electrode surface of the electrochemical aptasensor system for coronavirus disease (COVID-19). The response of the aptasensor to the receptor binding domain of the virus was determined with the potassium ferricyanide redox system. The screen-printed carbon electrode that has been modified with green synthesized nanoceria shows 1.43 times higher conductivity than the bare electrode, while those modified with commercial ceria only increase 1.18 times. Using an optimized parameter for preparing the aptasensors, the detection and quantification limits were 1.94 and 5.87 ng.mL-1, and the accuracy and precision values were 98.5 and 89.1%. These results shows that green synthesized ceria could be a promising approach for fabricating an electrochemical aptasensors.

Biography:

Salma Nur Zakiyyah currently is a PhD Candidates in Professor Hartati's research group, Department of Chemistry, Universitas Padjadjaran. She finishes her Bachelor and Master study in the same group in 2021 and 2023, respectively. Her research mainly focusses on develop various type of electrochemical biosensor to detect some daily disease such as hypertension biormarker and infectious disease such as SARS-CoV-2 and Chikungunya Virus utilizing nanoparticle modified carbon electrode. Currently her PhD research works on designing a novel CRISPR-based electrochemical biosensor for diagnostic purpose.

Highly Sensitive Three-Stage Amplified Detection System for Cardiac roponin Ibased on Pressure Sensing

Gengchen Guo[1]*, Jingbin Zeng[1]

[1]*College of Chemistry and Chemical Engineering and State Key Laboratory of heavy oil processing, China University of Petroleum (East China), Qingdao 266580, China*

Abstract

Annually, approximately 12 million individuals succumb to myocardial infarction (MI), underscoring the significance of timely MI diagnosis for optimal treatment and prognosis. Cardiac troponin (cTn) detection represents the gold standard for rapid MI diagnosis, yet there persists a gap in the availability of low-cost, high-sensitivity cTn rapid tests for home and community settings. In this work, we propose a three-stage amplified pressure sensing bioassay system. The magnetic bead-troponin-Pt nanocluster immunosandwich complex was formed by immunoconjugation of antigen and antibody. The magnetic beads in the complex were magnetically separated and magnetically enriched in order to reduce the background interference and increase the concentration of the complex, thus achieving the primary amplification. The Pt in the complex catalyzed the decomposition of large amounts of H2O2 to generate barometric signals, which were recognized by a barometric sensor to achieve secondary amplification. Furthermore, we synthesized Pt nanoclusters crosslinked with biotin and amphiphilic pigments to achieve tertiary catalytic amplification of the system. This cross-linking enables the unit troponin to be associated with being recognized by more Pt nanoparticles, thereby catalyzing more H2O2 decomposition and generating significant barometric pressure changes that can be quantitatively detected by a differential pressure meter. The optimized conditions yielded a detection limit of 3.8 pg/mL, which was two orders of magnitude more sensitive than the original secondary amplification detection system. Furthermore, the results of the clinical samples tested were in accordance with those detected by actual samples tested and compared to commercial kit results and demonstrated promising potential.

Biography:

Gengchen Guo received the B.S. degree in Chemical Engineering from China University of Petroleum, Qingdao, China. He is currently working toward the M.S. degree in Chemistry with the school of China University of Petroleum, Qingdao, China. His research interests include designing and synthesizing nanomaterial labels for application in biosensing and detection. His recent research project in low-cost rapid myocardial infarction screening enhancing detection sensitivity by triple amplification approach through the cross-linking nanoparticles.

Exploring Nanogap Sensitivity: Bridging Single-Particle Insights to Practical Applications

Sungwoon Lee* and Jaebum Choo

Nanophotonics-based Biomedical Diagnostics Research Center, Chung-Ang University, Korea

Abstract

Plasmonic nanoparticles, particularly gold nanoparticles (AuNPs), are known for their unique optical properties. These properties, such as surface plasmon resonance (SPR), lead to the absorption or scattering of visible light, generation of localized electric fields around the nanoparticles, and heating of medium surrounding the nanoparticles This talk will cover the major motivation behind our study to date, experimental realization, and future direction. The goal of our study is to understand optical properties based on the effect of the morphologies of gold nanoparticles at the nanogap. Then large-area fabrication with homogenous nanogaps toward reducing inhomogeneity for practical applications. For this, we utilized plasmon-enhanced spectroscopy to observe the effect of morphology between nanoparticles of dimers at the single-particle level correlated with electric field enhancement. Considering the optical properties in morphology and gap distance at the nanogap, we have been producing large-scale homogeneous nanogaps using patterned gold nanoparticle assemblies with light. Furthermore, gold nanoparticles were integrated into gold nanodimpled substrate. For practical applications, our research aims to create surface-enhanced Raman spectroscopy platform for trace analysis using nanogap engineering with various morphologies to achieve highly sensitive detection.

Biography:

Sungwoon Lee earned his Ph.D. in Chemistry from Chung-Ang University in 2021. He is currently working as a post-doctoral researcher associate at the same university. His ongoing research revolves around advancing a highly sensitive plasmonic-based platform for bio-diagnosis. He is keenly interested in crafting manageable plasmonic substrates without the need for machining processes and fine-tuning Raman spectroscopy to optimize spectroscopic capabilities.

Next Generation Biomarker in Oncology; Innovation and Application

Ayesha Zafar*

RMIT University, Australia

Day 2 (Room 2)

Session: Advances in Materials Research for Sustainable Development (AMRSD)

Plenary Talk

TBA

Widodo Wahyu Purwanto*

Universitas Indonesia, Indonesia

Keynote Talks

Green Synthesis of TiO2 Nanoparticle in Mangosteen Pericarps Extract for DSSC Sensitized Using Malabar Spinach Fruits Natural Dye

Nofrijon Sofyan[1,2],*, Robertus R. B. Rumapea[2], Akhmad H. Yuwono[1, 2], Donanta Dhaneswara[1, 2], Aga Ridhova[3]

[1]*Department of Metallurgical and Materials Engineering, Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia.*
[2]*Advanced Materials Research Center, Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia.*
[3]*Research Center for Metallurgy, National Research and Innovation Agency, Tangerang Selatan, Banten 15314, Indonesia.*

Abstract

This work aims to explore the characteristics of TiO_2 nanoparticles green synthesized via environmentally friendly method using mangosteen (Garcinia mangostana L.) pericarps extract as a capping agent. The green synthesis was performed via sol-gel method by utilizing precursor of titanium tetra isopropoxide (TTIP) in mangosteen pericarps extract under different acid conditions of 0%, 10%, 40%, and 60%. The formed gel was filtered and dried at 90 °C before being calcined at 450 °C for 30 minutes. The characterizations were performed using field emission scanning electron microscope (FESEM) for the surface morphology, X-ray diffraction (XRD) for the crystal structure, ultraviolet spectroscopy (UV-DRS) for the absorbance, and infrared spectroscopy (FTIR) for the functional groups. The obtained TiO_2 nanoparticles was further used as a semiconductor in dye-sensitized solar cells (DSSC) device sensitized using natural dye extracted from Malabar spinach (Basella rubra L.) fruits. The DSSCs performance were analyzed for their efficiency using a source meter interfaced with a solar simulator. The highest efficiency of 0.95% was obtained from TiO_2 synthesized under acidic condition of 40%, higher than that of commercial TiO_2 (0.74%). For the same materials sensitized using commercial dye N719, the efficiency is 1.05% and 1.35% for TiO_2 synthesized under acidic condition of

40% and commercial TiO_2, respectively. These results are promising for the green synthesis of TiO_2 nanoparticles and the use of natural dye extracted from Malabar spinach fruits as a sensitizer.

Biography

Nofrijon Sofyan is an Associate Professor at the Department of Metallurgical and Materials Engineering, Faculty of Engineering, Universitas Indonesia.

Eco-Friendly Synthesis of Ag/Tio2 Nanocomposite for Enhanced Photocatalytic Applications

Akhmad Herman Yuwonoa,[b], Fairuz Septiningruma, Nofrijon Sofyana,[b], Donanta Dhaneswaraa,[b]

[a]*Department of Metallurgical and Materials Engineering, Universitas Indonesia,*
[b]*Advanced Materials Research Center (AMRC), Universitas Indonesia*

Abstract

In recent years, the pursuit of sustainable and eco-friendly methods for material synthesis has gained considerable traction. Green synthesis of nanoparticles presents a promising alternative to conventional methods that typically require hazardous chemicals and high energy. Among various nanoparticles, silver (Ag) and titanium dioxide (TiO2) have garnered substantial interest due to their unique properties and diverse applications, particularly in the field of photocatalysis. Photocatalysis is a process where light energy is used to accelerate photoreaction, and it has extensive applications in environmental remediation, including the degradation of pollutants and the purification of water. The integration of Ag and TiO2 nanoparticles can significantly enhance photocatalytic efficiency due to the synergistic interactions between the two materials, resulting in improved light absorption and more effective charge separation. The use of natural extracts in the synthesis of these nanoparticles aligns with the principles of green chemistry, emphasizing the reduction of toxic substances and the use of renewable resources. Mangosteen (Garcinia mangostana L.) pericarp extract, rich in bioactive compounds like xanthones, tannins, and flavonoids, has emerged as a potential reducing and stabilizing agent in nanoparticle synthesis. This biogenic approach not only mitigates the environmental impact but also imparts additional functionality to the synthesized nanoparticles due to the inherent properties of the phytochemicals involved. Our study explores the green synthesis of Ag/TiO2 nanocomposite using mangosteen pericarp extract and investigates their photocatalytic performance. The aim is to develop an efficient and sustainable method for synthesizing high-performance photocatalysts, contributing to the advancement of green technology and environmental sustainability.

Biography:

Akhmad Herman Yuwono is Professor of Metallurgical and Materials Engineering and Associate Chair at Energy Systems Engineering, Faculty of Engineering, Universitas Indonesia.

Development of Li-Ion Battery Materials for Electric Vehicle Toward Net Zero Emission

Anne Zulfia*

Laboratorium Battery, Department Metallurgy and Materials, Faculty of Engineering Universitas Indonesia, Kampus Baru UI, Depok 16424, Indonesia Tropical Renewable Energy Centre, Faculty of Engineering Universitas Indonesia, Kampus Baru UI, Depok 16424, Indonesia

Abstract

The world is currently confronted with greenhouse gas emission from burning of fossil energy, which contributed by transportation sector. The consumption of fossil energy also increase from year to year and this effected to diminishing reserves of fossil fuels. The excessive consumption of these fuels not only causes a depletion of resources but also contributes significantly to the escalation of greenhouse gas emissions, which are responsible for global warming and climate change, therefore electric vehicles is a one of solution to support net zero emission. Electric vehicles need large-scale power source with high energy density and good cycle capabilities must be achieved. In this research the anode material based on LTO and nickel based cathode or NMC have been studied. LTO has synthesized by hydrothermal process and mixed with various of Si that is 1, 5, 10wt-% to improve their capacities. The LTO/Si anode was characterized for both chemical and battery performance. The results showed that the LTO/ Si doped with 10wt% has specific capacity of 262.54 mAh/g which is higher than LTO (175mAh/g). While NMC cathodes has synthesized by co-precipitated. Hhigh nickel content leads to capacity decay, poor rate capability, thermal and structural instability. In this work, to eliminate the drawbacks by optimizing the process and doped with activated carbon derived from biomass. The NMC doped has improved their performance from 171 mAh/g to 210 mAh/g. Overall, the development of lithium-ion battery materials for electric vehicles and continually improving their battery performance are still under studied.

Biography:

Anne Zulfia is a first woman Professor at the Department of Metallurgy and Materials Engineering since January 2008. She earned her Ph.D. in Composites Materials from Department of Engineering Materials, University of Sheffield, UK in 2000. She developed her knowledge in energy materials in 2006 since she had a join research of Fuel Cell project with P3TKEBT-ESDM for 3 years and 2012 she extend to developed energy materials for battery especially in LTO Composites. In 2012 she joined with MOLINA Project-Universitas Indonesia under Higher Education (DIKTI) Fund and in 2014 she received a RISPRO Project under LPDP funding for developing LTO anode materials. In 2018 she got a research funding from USA under USAID-SHERA Grant, and in 2021 she got PRN funding to develop Li-ion battery materials for both LTO anode and LFP as well as NMC cathode materials.

Realization from Materials to a Medical Device Products: A Case Study in Biomaterial

S. Supriadi[1,2]*, Y. Whulanza[1,2], J. Istiyanto1, A. S. Saragih[1], B. Suharno[3], B.Munir[3], M. Chalid[3,] P. N. Kreshanti[4,5], A. J. Rahyusalim[5,6], I. H. Dilogo[5,6], A. F. Kamal[5,6], Y. Prabowo[5,6], M. K. Purwanegara[7], B. Irawan[8], R. S. Dewi[9], M. F. L. Soetanto[9]

[1]Dept. of Mechanical Engineering, Faculty of Engineering, Universitas Indonesia;
[2]Research Center on Biomedical Engineering, Faculty of Engineering,Universitas Indonesia;
[3]Dept. of Metallurgy and Material Engineering, Faculty of Engineering, Universitas;
[4]Plastic Reconstructive and Aesthetic Surgery Division, Department of Surgery, Cipto Mangunkusumo Hospital,
[5]Faculty of Medicine, Universitas Indonesia, Depok 16424, Indonesia;
[6]Dept. of Orthopaedic and Traumatology, Universitas Indonesia, Jakarta 10430, DKI Jakarta, Indonesia;
[7]Dept. of Orthodontics, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia;
[8]Dept. of Dental Materials, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia;
[9]Dept. of Prosthodontics, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia

Abstract

This recently-done research on materials, processes, and product development has spread into an individual work on synthesis, processing technology, design analysis, and testing. Even if this research is a small area and deeply-explored, it should help the comprehensive evaluation and verification process become a standard product. Therefore, such extended work should be conducted to verify and validate the result to comply with the standard of the product. Every single step from the material, process, and testing standards should be taken and recorded properly. In the case of a medical device with such a tight regulation, every development process should follow the standards and regulations, and it include procedure and facility. After medical device development is completed, the industrial partners that will realize and bring it into the market will be able to use the data and results for the product registration and marketing purposes. In this study, we present the biomaterial development, design, manufacturing, and testing cases to realize a medical part. Various biomaterials such as Titanium, Magnesium, Stainless steel, and bioceramic have been implemented. Those materials have been applied to various fields such as plastic reconstruction surgery, orthopedic surgery, and dental restoration. The processing encompasses Machining, Metal Injection molding, Investment Casting, and Additive manufacturing. A post-processing is required to obtain some desired properties, surface texturing, and identification of the part. This biomaterial product testing includes Mechanical testing, Metallurgical Testing, and Biocompatibility using Invitro and Invivo Methods. Some modifications might be necessarily made to comply with a standard performance. Therefore, this paper will guide the product development to be aligned through various material development and manufacturing techniques.

Biography:

Sugeng Supriadi is a lecturer in Department of Mechanical Engineering, Faculty of Engineering, Universitas Indonesia. Finish Bachelor with background of material processing technology graduated from Department of Metallurgy and Material Engineering Universitas Indonesia, Departemen of Material Science and Engineering Yeungnam University, and Department of Mechanical Engineering Tokyo Metropolitan University. 2015 join Research Center on Biomedical Engineering (RCBE). Since 2019 mengelola Teaching Industry of Biomaterial in Universitas Indonesia (TiBio UI). The scope of development is design, manufacturing, and testing of medical device made by biomaterial especially Titanium, magnesium and stainless steel for dental, orthopedic application, medical apparatus with industrial standarization. Currenct research topics are Material forming technology from bulk material and Particulate material.

Development of Carbon-Based Microfluidic Device as a Neurotransmitter Modulator in Case of Brain Toxicity

Yudan Whulanza*, Jos Istiyanto, Yunus B. Arafat, Samuel Kassegne

Department of Mechanical Engineering, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia
Research Center for Biomedical Engineering, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia
Department of Mechanical Engineering, College of Engineering, San Diego State University, San Diego, CA 92182, USA

Abstract

This study explores advancements in carbon-based electrochemical sensors and microfluidic systems, focusing on enhancing biosensors for neurotransmitter detection and management. A novel screen-printing technique is introduced for texturing carbon electrodes to increase their active surface area, which is crucial for improving biosensor sensitivity and selectivity. Electrodes with a 3D bee hive structure demonstrate increased surface roughness, facilitating more effective analyte capture and enabling precise illness detection at lower concentrations. The research integrates a user-friendly dopamine sensing system that combines electrochemical detection with a finger priming pump on a chip, reducing the need for complex laboratory equipment. This system underscores the practical application of microfluidic biosensors in real-world settings, highlighting reduced consumable costs and equipment size. Another study within this framework utilizes a carbon-based platform in a microfluidic system to regulate glutamate levels, offering a promising alternative to conventional treatments for neurotoxicity. This platform uses electro-adsorption for precise glutamate manipulation, proving non-toxic and compatible with neural implants, enhancing its therapeutic potential. These innovations in carbon-based materials could transform neurochemical monitoring, making it more accessible, effective, and precise, potentially revolutionizing the diagnosis and treatment of neurological disorders and paving the way for significant impacts on healthcare and personalized medicine in neurology.

Biography:

Yudan Whulanza holds a Bachelor Degree in Chemical Engineering in 2000. He continued his master study at Forschungszentrum Juelich in 2005. He then participated in a European Union project to establish Biomedical Engineering program in Universitas Indonesia together with his completion of doctoral degree in Bioengineering at the Piaggio Research Center University of Pisa. In 2012 he returned to Universitas Indonesia to initiate multi-disciplinary research projects and collaborate closely with the Bioengineering NanoFab San Diego State University and Institute of Digital Health, University of Warwick.

Valorisation of Tengkawang Butter from Shorea Stenoptera, an Endemic Plant of Kalimantan

Misri Gozan[1,2*]

[1]*Research Centre for Biomass Valorization (RCBV), Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, 16424, Indonesia*
[2]*Bioprocess Engineering Program, Department of Chemical Engineering, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, 16424, Indonesia*

Abstract

Tengkawang (Shorea stenoptera) is a potential endemic plant of Kalimantan, which is traditionally processed and consumed as low-grade butter by the tribe. Tengkawang butter has the potential to be a cocoa butter equivalent (CBE) because it has a fatty acid composition and melting point close to cocoa butter (CB). This study identified the quality, physicochemical properties, and oxidation stability of tengkawang butter (TB) from indigenous plants in various areas of Kalimantan, Indonesia. The fatty acid profile of the tengkawang butter is dominated by palmitic acid, stearic acid, and oleic acid. The melting point of tengkawang butter is at the human mouth (body) temperature of 35–37 ∘C. Physical and chemical processing of tengkawang is carried out to increase the quality of tengkawang butter according to the standard butter material. This work also emphasizes the economic feasibility of using tengkawang butter as a substitute for cocoa butter, a strategy that has drawn attention as a means to achieve cost-effective food material production and conservation of endemic plants in Kalimantan.

Biography:

Misri Gozan is a professor of Bioprocess Engineering at Universitas Indonesia and has written several Engineering books, including those published by Wiley and Springer. He was the former Vice President of the Asian Federation of Biotechnology AFOB. He graduated from the Department of Chemical Engineering, Universitas Indonesia, in 1993. He earned a Master of Technology in Process and Environmental Engineering from Massey University, Palmerston North, New Zealand, in 1998. 2004, he finished his Doctor of Engineering at the Faculty of Geology, Forestry and Hydrology, TU Dresden, Germany. His research focuses on bioprocess engineering, especially in the valorisation of biomasses.

Invited Talks

Effect of Laser Irradiation Time on Reduced Graphene Oxide Synthesized from Palm Shell Waste

Alfian Ferdiansyah Madsuha*

Universitas Indonesia, Indonesia

Abstract

Graphene has been extensively researched over the last few decades because of its excellent optical, electrical, and mechanical properties. However, graphene cannot be found directly in nature; it must undergo a complex synthesis process. One alternative way that has been found is to make Reduced Graphene Oxide (rGO), which has similar properties to graphene. In this study, the synthesized rGO will come from coconut shell waste carbon, which will be oxidized to produce graphene oxide (GO) using the modified Hummers method and reduced to get rGO. The chemical reduction method is the most commonly used because it is efficient, but on the other hand, it is not environmentally friendly. Therefore, this study focuses on the effectiveness of other more environmentally friendly reductions on the characteristics of rGO. The type of reduction used is laser reduction, using a variable reduction time for 1, 2, 3, and 4 hours. Types of characterization that will be used are UV-visible, FTIR, XRD, and SEM. Based on the UV-Vis results, the peak of the reduction time of 1 hour was at 236 nm, 2 hours at 240 nm, and 3 hours at 255 nm, while at 4 hours, there was no peak. This shows that 3 hours is the optimal reduction time. If the reduction time is more than 3 hours, it will damage the structure of rGO, as demonstrated by the SEM images. Not only the XRD peak of 26,5□, but The FTIR results of rGO with a reduction time of 3 hours also indicated the loss of oxygen bonds. It can be concluded that laser reduction has considerable potential to be developed as the simple path for graphene-based material fabrication.

Ferronickel Slag as Low-Cost Sustainable Building Materials

Sotya Astutiningsih*

Universitas Indonesia, Indonesia

Effects of Binder Type and Sintering Temperature on the Electrochemical Performance of $LiNi_{0.6}Mn_{0.2}Co_{0.2}O_2$ (NMC 622) as a Lithium-Ion Battery Cathode

Bambang Priyono[1,2]*, Anne Zulfia Syahrial[1], Areita Ghassani Labibah[1], Chandra Pratama Wiyaga[1], Achmad Subhan[3], Rizki Ismoyojati[1], Rahmat Rizqi Susanto[1]

[1]Department of Metallurgical and Materials Engineering, Faculty of Engineering, University of Indonesia, Indonesia;
[2]Tropical Renewable Energy Center (TREC), Faculty of Engineering, University of Indonesia, Indonesia;
[3]National Research and Innovation Agency, Indonesia

Abstract

The development of electric batteries as the main energy source for electric vehicles (EVs) is a major focus in the current automotive industry, driven by the need to address climate problems caused by fossil fuels. Lithium-ion (Li-ion) batteries, particularly those using the LiNi0.6Mn0.2Co0.2O2 (NMC 622) cathode, are at the forefront due to their balance of energy density, power capability, cost efficiency, and improved thermal stability compared to LiCoO2 (LCO). Enhancing the performance of NMC cathodes, especially in terms of specific capacity, involves optimizing binder materials. While Poly(vinylidene difluoride) (PVDF) is commonly used, it has drawbacks, prompting research into water-based alternatives like Carboxy Methyl Cellulose (CMC) and Sodium Alginate (SA). This study synthesizes NMC 622 cathodes using the solution combustion (SCS) method with sintering temperatures of 700°C, 800°C, and 900°C, aiming to identify the best synthesis conditions. Characterization through SEM-EDS and XRD confirmed good particle distribution and a hexagonal structure. Electrochemical performance was evaluated using EIS, CV, and CD techniques. Results showed that NMC 622 sintered at 800°C achieved the highest capacity of 137.25 mAh/g, while those at 700°C and 900°C had capacities of 101.57 mAh/g and 66.61 mAh/g, respectively. Binders PVDF, CMC-SBR, and SA yielded specific capacities of 137.25 mAh/g, 40.75 mAh/g, and 12.38 mAh/g, respectively. Although water-based binders offer some advantages, they cannot yet replace PVDF in NMC 622 cathodes, highlighting the need for continued research in this area.

Biography:

Dr. Bambang Priyono received his Doctoral Degree in 2017 in the field of Lithium-ion batteries, focusing on the synthesis of high-surface Lithium Titanate anode material under Prof. Anne Zulfia at Universitas Indonesia. He researches doping elements on LTO and microstructural control, and analyzes LFP and NCM cathode performance. Additionally, he works on converting BBM motorcycles into electric motors with NCM batteries. He earned his bachelor's degree from Universitas Indonesia in 1989 and a master's degree in 1995, researching material catalysts at Carnegie Mellon University. Currently, he is developing flash-graphene materials for high-performance Lithium-ion batteries.

The Investigation of Graphene Oxide Synthesized from Palm Shell Waste as a Friction Modifier Additive on Poly-Alpha Olefin Tribology Properties

Alfian Ferdiansyah Madsuha*

Universitas Indonesia, Indonesia

Oral Talks

Facile Fabrication of TiO2 Nanoparticles with Different Methods Using Extracted Kalimantan Ilmenite Solution for Photocatalytic Applications

Fakhri Akbar Maulana[1]*, Akhmad Herman Yuwono[1,2], Nofrijon Sofyan[2], and Donanta Dhaneswara[2]

[1]*Department of Metallurgical and Materials Engineering, Faculty of Engineering, Universitas Indonesia, Depok, 16424, Indonesia*
[2]*Advanced Materials Research Center (AMRC), Faculty of Engineering, Universitas Indonesia, Depok, 16424, Indonesia*

Abstract

Titanium dioxide (TiO2) has a wide range of applications in engineering because of its exceptional material properties. Among these, its photocatalytic properties have been extensively researched for energy harvesting and environmental applications. In this study, we explore a novel approach to synthesizing TiO2 nanoparticles using different methods, employing natural ilmenite minerals from Kalimantan region as a precursor. The fabrication process entails a series of meticulously controlled steps to convert ilmenite into TiO2 nanoparticles, harnessing the inherent properties of the mineral. Advanced analytical techniques such as X-ray Diffraction (XRD), scanning electron microscopy-Energy Dispersive Spectroscopy (SEM-EDS), and nitrogen adsorption are employed to characterize the resulting nanoparticle structures, confirming their morphology, crystalline structure, and surface properties. Ultraviolet-visible diffuse reflectance (UV-VIS DRS) and photoluminescence (PL) spectroscopy are utilized to comprehensively assess the optical properties of the nanoparticles. Furthermore, the synthesized TiO2 nanoparticles are subjected to a photodegradation process of methylene blue under simulated sunlight conditions to evaluate their photocatalytic properties. The study includes a thorough investigation of photodegradation kinetics and the influence of key experimental parameters on process efficiency.

Biography

Fakhri Akbar Maulana is a Ph.D. student in Universitas Indonesia specializing in nanomaterials sourced from natural resources for photocatalytic applications. Currently, he serves as a research member of Advanced Materials Laboratory under the guidance of Prof. Dr. Ir. Akhmad Herman Yuwono, M.Phil.Eng. His expertise lies in leveraging the unique properties of these materials for photocatalysis, particularly in environmental remediation and energy harvesting.

Synthesis and Characterization of Complex Compounds [Fe(NH2trz)3]SO4 as Alchohal Sensors

Cepi Kurniawan[1,a],*, Putut Marwoto[2,a], Ngurah Made Darma[2,a], Agus Yulianto[2,a], M. Alauhdin[1], Feri Mukhayani[3], Naily Nidhofatin[1], Hadariah Bahron[4]

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[3]Chemistry Department, Faculty of Mathematics and Natural Sciences, Universitas Gajah Mada, Yogyakarta, Indonesia
[4]Coordination Chemistry Group, Faculty of Applied Science, Universiti Teknologi MARA, Malaysia
[a]Research centre of functional material, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia

Abstract

The transition metal Fe(II) holds distinctive allure due to its d6 outer electron configuration, allowing for the formation of intricate complex compounds, the magnetic attributes of which pivot on the ligand field's intensity. This magnetic diversity, arising from spin transitions, is coined the Spin Crossover phenomenon, presenting potential as a multi-parameter sensor. Conversely, the pervasive issue of alcoholic beverages has burgeoned globally, afflicting health, economy, and society. This research aims to delineate the architecture and magnetic traits of [Fe(NH2trz)3]SO4 compounds, synthesized through the solution diffusion route, with a dual purpose of investigating their selectivity and sensitivity as alcohol sensors. The synthesis of [Fe(NH2trz)3]SO4 compound was effectuated via a 3-hour solution diffusion approach, while the fabrication of the alcohol stick sensor was accomplished utilizing the sol-gel method. Comprehensive characterization, including magnetic susceptibility balance (MSB), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD), illuminated the diamagnetic nature of the complex compounds, spectral disparities in the synthesized compound, and the polycrystalline orthorhombic structure of [Fe(NH2trz)3]SO4, respectively. Surface area analysis (SAA) revealed augmented surface area through the sol-gel process. Thermochromic experimentation unveiled [Fe(NH2trz)3]SO4's Spin Crossover propensity, manifesting at a transition temperature of 81°C. Subsequent selectivity and sensitivity evaluations resonated with excellence, spotlighting the [Fe(NH2trz)3]SO4 sensors' remarkable responsiveness to diverse alcohol types and alcoholic beverage samples. This exploration augments our understanding of complex compounds' magnetic dynamics, and underscores the potential of [Fe(NH2trz)3]SO4 as a versatile sensor platform for alcohol detection.

Biography:

Cepi Kurniawan, born in Bandung in April 1981, is a distinguished academic and researcher in the field of chemistry. In 2016, Dr. Cepi earned his doctoral degree after conducting extensive research at the Graduate School of Chemical Science and Engineering, Hokkaido University, Japan. His primary focus was on hydrogen production using molecular catalysts. His notable research contributions are in the field of inorganic materials and electrochemistry. Driven by a passion for advancing knowledge and technologies in this field, He continues to make significant strides in the pursuit of functional material for sensing and electrocatalyst.

Locally Resourced Tin Doped Mesoporous Titanium Dioxide Synthesized Using Hydrothermal Template-Free Sol-Gel Semiconductors Application

Maurice Efroza[1]*, Akhmad Herman Yuwono[1,2], Nofrijon Sofyan[2], and Donanta Dhaneswara[2]

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[2]Advanced Materials Research Center (AMRC), Faculty of Engineering, Universitas Indonesia, Depok, 16424, Indonesia

Abstract

Titanium dioxide (TiO2) has a very distinct physical and chemical properties. Among them, it includes good optical and electronic properties as well as highly available in nature. This attracts a lot of research that has been carried out because of its very significant potential, one of the areas of research carried out is in areas relating to energy and advance materials. Indonesia having a various stream of Tim extractions opens up the further possibilities of having a superior semiconductor that is fully synthesized from Indonesian local resources. The prepared Sn sample are extracted from PT. Timah Industri's SnCl4 from Bangka Island and the Sn-doped titania are characterised using X-Ray Diffraction (XRD) which shows the existence of the Sn-doped TiO2 anatase, Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS) to validate the existence of the mesoporus and Ultraviolet-Visible Diffuse Reflectance Spectroscopy (UV-Vis DRS) to determine the absorbance as locally-resourced semiconductor materials.

Biography:

Maurice Efroza is an incoming Ph.D student at the Washington University in St. Louis for the Fall 2024 period. Currently working as a research member at the Metallurgical and Materials Engineering Department of the Universitas Indonesia under the provision of Prof. Dr. Ir. Akhmad Herman Yuwono, M.Phil.Eng., on a topic of locally resourced semiconductor using Tin and Titanium extracted from Indonesia's natural resources. Maurice is also part of the INSPIRASI research that collaborates with the Nanyang Technological University of Singapore to develop a next-generation semiconductor materials.

Development of Biowaste-Derived Mesoporous Silica Adsorbent for the Removal of Methylene Blue Dye from Wastewater

Adrian Constantine[1]*, Qomarudin Helmy[1,3] , Akhmad Herman Yuwono[2,4], Nofrijon Sofyan[2,4], Donantha Dhaneswara[2,4]

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[4]Advanced Materials Research Center, Faculty of Engineering, Universitas Indonesia, Indonesia

Abstract

With the increasing application of mesoporous materials as adsorbents in textile wastewater treatment, this study investigates the potential of using biowaste, specifically rice husk ash (RHA), as an alternative to the typically expensive TEOS for producing mesoporous silica. The study focuses on the characteristics related to dye adsorption capacity. Silica extraction was performed using the thermal refluxing method, involving 200 ml of 8% w/v NaOH solution on 12.5 g of RHA at 100°C for one hour. The resulting Na2SiO3 solution was gradually introduced into 380 ml of 1.6M HCl solution containing p123 surfactant with mass variations of 5, 10, and 15 g. The solution underwent aging at 40°C for 24 hours, followed by drying at 100°C for 24 hours, and calcination at 600°C for five hours, producing white mesoporous silica powder. The formation of mesoporous silica was confirmed through FTIR characterization, which showed peaks corresponding to three siloxane groups and hydrogen bonds; SEM characterization revealed cubical particles with smaller aggregates indicating micelle templating; and BET characterization displayed mesoporous characteristics with high specific surface areas (m^2/g) of 396.653, 414.323, and 422.971, and pore radii (nm) of 3.390, 3.076, and 3.058 respectively for the different p123 surfactant masses. The application results showed effective color removal in a one-hour sorption test, with UV-Vis characterization indicating significant dye adsorption by 10 mg of mesoporous silica.

Biography:

Adrian Constantine is a final-year student at the Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung. He interned at the Advanced Material Research Center, Faculty of Engineering, Universitas Indonesia, under the supervision of Prof. Ir. Edwan Kardena, Ph.D., and field supervisor Prof. Dr. Ir. Donanta Dhaneswara, M.Si, IPM. During his internship, he focused on engineering mesoporous materials from biowaste. His thesis is guided by Dr. Qomarudin Helmy, S.Si., M.T. In addition to his academic pursuits, Adrian is actively involved in various organizational activities to enhance his critical thinking and problem-solving skills.

SnO2 Nanocrystallites Derived from Indonesia Tin Chloride Precursor Synthesized via Co-Precipitation Technique with Variation in Calcination Time

(Eka Nurhidayah[1]*, Akhmad Herman Yuwono[1]*, Fairuz Septiningrum[2], Rizkie Ramadhia Setiawan[1], Fakhri Akbar Maulana[1], Donanta Dhaneswara[1], Nofrijon Sofyan[1], Ria Wardhani Pawan[3], Yahya Winda Ardianto[3], Latifa Hanum Lalasari[4], Lia Andriyah[4], Tri Arini[4])

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[3]PT Timah Industri, Indonesia;
[4]National Research and Innovation Agency, Indonesia

Abstract

Indonesia is a prominent global supplier of tin mineral, providing an abundant source of tin precursors, serves as an advantageous factor for the research and development of SnO2-based nanomaterials that have gained significant scientific attention due to their functional properties. SnO2 can be regarded as an alternative option for the electron transport layer (ETL) in perovskite solar cells (PSCs), which are commonly fabricated using titanium dioxide (TiO2). This study employed a locally sourced tin precursor to synthesize SnO2 nanocrystallites via the co-precipitation technique, followed by calcination

treatment at a temperature of 300 °C, with different durations of 2, 3, and 4 h. The synthesized samples were characterized by x-ray diffraction (XRD), scanning electron microscope (SEM), and UV-visible spectrophotometer (UVVis), while their ETL performance was characterized by a semiconductor parameter analyser. XRD analysis confirms that the synthesized SnO2 nanocrystallites exhibit rutile tetragonal structure. The calcination treatment applied to the samples has resulted in an enhance in the average crystallite size from 2.12 to 3.38 nm, accompanied with the decrease in band gap energy from 3.44 to 2.73 eV. The results of SEM observation reveal that the individual SnO2 nanoparticles have an average size range from 175.53 to 355.99 nm, although they tend to exhibit agglomeration. The sample which received a 3 h calcination process exhibited a higher power conversion efficiency (PCE) of 2.4 x 10-3 % when used as the ETL in PSCs. This suggests that the SnO2 nanocrystallites synthesized from this indigenous precursor show promising potential as viable PSC components.

Biography:

Eka Nurhidayah is a Ph.D. student at Universitas Indonesia in the Department of Metallurgical and Materials Engineering. Her prior research project for the master's degree was focused on photocatalytic effect of SnO2 nanoparticles for degrading organic dye water waste, while her current research is dedicated to investigating the optical and electrical characteristics of SnO2based nanomaterials using a locally sourced tin chloride precursor.

TiO_2 Nanostructure from Ilmenite Leaching Residue via Sulfate Route for Environmental Clean-Up: The Effect of Calcination Time and Temperature

Mufti Ali[1]*, Andy Hakim[2], Akhmad Herman Yuwono[1,2], Donanta Dhaneswara[1,2] and Nofrijon Sofyan[1,2]

[1]*Advanced Materials Research Center, Indonesia;*

[2]*Metallurgical and Materials Engineering, Indonesia*

Abstract

Water pollution due to textile dye wastewater is a crucial issue with significant implications for human life sustainability. Photocatalysis is one of the methods employed to break down pollutants in water by utilizing the interaction of UV and visible light. This process can be carried out using nanostructured TiO2, which can be synthesized from ilmenite minerals through leaching reactions. Residue from this process also contains considerable amount of TiO2. However, the utilization of secondary sources, in this case leaching residue, to extract TiO2 from ilmenite is still relatively low. This necessitates more research in the utilization of ilmenite leaching residue as a TiO2 nanomaterial precursor, especially through the sulfate route (H2SO4 reagent). This research investigates the effect of calcination time and temperature on the TiO2 precursors from leaching residue to its nanostructure characteristics, examining composition, crystallinity, morphology, and band gap energy. Our findings suggest that calcination time and temperature could increase the Ti percentage, enhance the crystallinity phase, form nanowire structures, and create sodium titanate phase. The band gap energy of each sample was related to the crystallite size and the presence of 0.7-1.1% Fe. Photocatalysis test results indicated that the photocatalytic performance of nanostructures tended to be optimal in dark conditions (reaching

70% degradation), while under UV illumination, the photocatalytic performance was suboptimal (with only slight improvement). This could be influenced by the concentration of the photocatalyst used.

Biography:

Mufti Ali Ar Royan is an incoming fall 2024 Ph.D student at the Materials Science and Engineering School, Nanyang Technological University, Singapore. Currently working at University Indonesia's Advanced Materials Research Center laboratory under Prof. Akhmad Herman Yuwono, M. Phil. Eng., on the topic of functional nanomaterials synthesis from locally sourced minerals. While also a part of the INSPIRASI Project team researching semiconductors for next-gen solar cell applications.

Optimization of Graphite From Biomass Waste Using Combination Process Activation and Impregnation $Ni(NO_2)_3$ For Alternative Electrode Battery

Afif Wardana[1,2]*, Bambang Priyono[1,3], Donanta Dhaneswara[1,2], Nofrijon Sofyan[1,2],Akhmad Herman Yuwono[1,2]

[1]Department of Metallurgical and Materials Engineering, Faculty of Engineering, University of Indonesia,
[2]Advanced Materials Research Center, University of Indonesia,
[3]Laboratory of Energy, University of Indonesia.

Abstract

Research into utilizing biomass-derived graphite as an alternative electrode for batteries has surged, aiming to enhance cathodes of battery quality. The study aimed to identify and compare the most effective types of NiO and Non-NiO graphite for cathodes sourced from biomass, specifically Palm Kernel Shell, Candlenut Shell, and Empty Fruit Bunch (EFB). Optimization involved a blend of chemical activation (KOH) with a 5 molar concentration at a 1:5 ratio and physical activation (Ar) via a 0.2 L/min injection at 950°C for 45 minutes. Sample refinement included impregnating Ni(NO2)3 precursor onto graphite, transformed into NiO through 90 minutes of thermal decomposition at 300°C. XRF analysis confirmed NiO presence and minimal alkali and alkaline earth metals in all graphite samples except for K+ and Cl-. XRD analysis revealed predominantly amorphous graphite with a chemical formula of C16.00, detected within the 25-27° interval. EIS results demonstrated NiO Palm Kernel Shell's lowest Polarization Resistance (Rp) value at 79.62, correlating with the highest Specific Capacitance (Cp) of 7.39748 observed in Cyclic Voltametry testing. However, this result inversely related to BET findings, showing Non-NiO Empty Fruit Bunch's largest surface area at 319.30 m2/g. Additionally, FTIR characterization explored the impact of OH, C=C, C-O bonds, and other functional groups on performance. Hence, employing graphite as the cathode and lithium titanate oxide (LTO) as the anode for battery material emerges as the optimal choice with appropriate scan rate parameters (mV/s).

Biography:

Afif Wardana, S.T., began his career as an assistant at the Advanced Material Research Center laboratory under Prof. Dr. Ir. Donanta Dhaneswara, M.Si, IPM. and he also candidate Magister of Materials Engineering at the Department of Metallurgical and Materials Engineering, University of Indonesia. He authored a thesis on biomass waste utilization for supercapacitor batteries. Afif served as vice president of the Nano Research Society, delving into nanotechnology. He frequently wins university and national-level competitions in Technology Application, Constructive Futuristic Ideas, Student Innovation Forum (Environmentally Friendly Metal Waste Extraction), and Sustainability and Development Goals-related technology applications.

Characteristics of Lithium Battery Green Separator Membrane Fabricated via Non-Solvent and Thermal Induced Phase Separation Method with Ethyl Acetate Solvent

Adream Bais Junior[1,2]*, Adam Febriyanto Nugraha[1,3,] Abdul Muzakki[1], Christin Rina Ratri[1,4], Muhammad Hilmy Alfaruqi[5], Mochamad Chalid[1,2]

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[5]Department of Materials Science and Engineering, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju 61186, Republic of Korea

Abstract

The separator acts as a physical barrier to prevent internal short circuits between the electrodes and allows electrolyte ions to move freely. Traditionally, the polymer separator used in commercial lithium-ion batteries has been polypropylene (PP). However, environmentally friendly polymers are being developed for separator manufacturing. Cellulose acetate separators, in particular, have an eco-friendlier production process and are able to degrade naturally. This research focuses on fabricating cellulose-based solid battery separators using the non-solvent and thermal induced phase separation (NTIPS) method with ethyl acetate and water as the non-solvents. The study examines how evaporation time during the printing process affects the membrane's morphology and performance. Characterization conducted includes FTIR, porosity, electrolyte uptake, wettability, tensile strength, dimensional stability, and ionic conductivity using EIS. The results indicate that longer evaporation time during printing process reduce porosity, electrolyte absorption, wettability, and ionic conductivity but increase tensile strength. Evaporation time that yielded the highest porosity, electrolyte absorption and ionic conductivity is 30 minutes; where the value for respective parameters are 28.7%, 40.4%, and 1.5 × 10-5 S/cm. On the other hand, the evaporation time that yielded the highest tensile strength was 50 minutes, which yielded the value of 34.02 MPa.

Biography:

Adream Bais Junior holds a Bachelor of Engineering degree in Chemical Engineering and Master of Engineering in Metallurgical and Material Engineering both graduated with honors, earning cum laude distinction in Universitas Indonesia. Research such as contact glow discharge electrolysis for latex and other polymer fabrication; asphalt bitumen fabrication with HDPE, PP and lignin; and intensive focus on green membrane fabrication were taken during his time in Universitas Indonesia. During their academic tenure at Universitas Indonesia, he collaborated with esteemed professors on diverse projects encompassing energy demand forecasting, supply chain analysis, oil and gas process optimization, sustainability reporting, sustainability awareness systems, and circular economy implementation, among others. This multidisciplinary project involvement, coupled with extensive professional exposure, has finely honed his skill set.

Synthesis of Mesoporous Silica from Empty Palm Oil Fruit Bunches and Palm Kernell Shell with the Addition of Cationic Surfactant as an Adsorbent for Methylene Blue

Syakira Faradiba*

Universitas Indonesia, Indonesia

Day 2 Room 3

Session: Nanomedicine and Healthcare Applications

Keynote Talks

Tumor Transparent Imaging for Drug Penetration Monitoring of Nano Drug Delivery System

Joon Myong Song*

Design of Antibody-Mimetic Peptides Using Machine Learning

Tetsuya Kadonosono*

Tokyo Institute of Technology, Japan

Abstract

Antibody-containing nanomedicines have been extensively developed for cancer therapy. However, due to their large molecular weight and complex structure, antibodies cannot be synthesized chemically, and the options for chemical modifications are limited. To overcome these limitations, one approach is to develop antibody-mimetic peptides that are smaller in molecular weight and can be chemically synthesized.

Recently, we developed an epitope-directed peptide screening system called Monoclonal Antibody-Guided Peptide Identification and Engineering (MAGPIE) screen. In this system, candidate peptides are displayed on the surface of antigen-expressing cells, and those binding to the desired epitope are identified. The epitope is evaluated using a fluorescently labeled guide antibody (gAb) that bind to the desired epitope. Since the epitope of the identified antigen-binding peptides is the same as that of gAb, their amino acid sequence and antigen affinity information can be used as training data for machine learning to predict high-affinity antibody-mimetic peptides.

This presentation describes the development of antibody-mimetic peptides targeted to the human epidermal growth factor receptor 2 (HER2) using a combination of MAGPIE screen and machine learning.

Biography:

Ph.D. in Agriculture (2008, Kyoto University)
Research fellow (2008, National Cerebral and Cardiovascular Center)
Project assistant professor (2009, Kyoto University)
Assistant professor (2010, Tokyo Institute of Technology)
Associate professor (2023, Tokyo Institute of Technology)

Cell-Surface Glycan Targeting Lectin Nanomaterials for the Theragnosis of Cancer

Jonghoon Choi1-2*

1 School of Integrative Engineering, Chung-Ang University, Seoul 06974, Republic of Korea 2 Feynman Institute of Technology, Nanomedicine Corporation, Seoul 06974, Republic of Korea

Abstract:

The unique profile of upregulated glycosylation in metastatic cancer cells may form the basis for the development of new biomarkers for the targeting and diagnosis of specific cancers. This seminar will introduce a pancreatic cancer cell-derived exosome detection and tumor targeting technology, which is based on the specific binding of lectins to distinctive glycan profiles on the surface of exosomes and tumor cells. Lectins with a high and specific affinity for sialic acid or fucose were attached to bifunctional nanoparticles, which facilitated interactions with pancreatic cancer cell-derived exosomes in a microfluidic device. The lectin affinity to surface glycan of tumor cells can also be the strategy to treat tumor cells with lectin-nanoparticles in the immunoand photothermal therapy. This strategy opens the possibility to achieve a new early diagnosis marker and target moiety based on the surface-glycan properties of cancer cells.

Synthesis of Environmentally-Responsive Block Copolymers for Applications in Controlled Drug Release

Trong-Ming Don[1]*, Yu-Wei Lin[1], Yi-Cheng Huang[2], Yang-Jie Zeng[2], Hung-Chih Tai[2]

[1]*Department of Chemical and Materials Engineering, Tamkang University, Taiwan* [2]*Department of Food Science, National Taiwan Ocean University, Taiwan*

Abstract:

Environmentally responsive polymers, which can undergo swelling-deswelling behavior in response to environmental stimuli have attracted great interest. In this research, we synthesized environmentally responsive block copolymers composed of poly(*N*-isopropyl acrylamide) (PNP) and poly(acrylic acid) (PAA) by reversible addition-fragmentation chain transfer (RAFT) living free radical polymerization with controlled molecular weight and architecture. Their chemical structure and physicochemical properties were characterized. Particularly, the cloud point for aggregation (Tc) of the block copolymer was determined and found to depend on the pH value and copolymer composition. When the block copolymer was heated to above its Tc, the block copolymer self-assembled to form gel nanoparticles (NPs) and *in situ* encapsulate a hydrophobic drug of camptothecin (CPT). The NPs could be further consolidated by adding chitosan through the formation of polyelectrolyte complex on the surface. Biocompatibility of NPs was also improved by the added chitosan. The average particle size and zeta potential of the developed NPs were 168 nm and –30.6 mV, respectively. The NPs exhibited good biocompatibility towards NIH 3T3 cells. Moreover, they could protect the CPT at pH 2.0 with a very slow-release rate. At pH 6.0, these NPs could be internalized by Caco-2 cells, followed by intracellular release of the CPT. They became highly swollen at pH 7.4, and the released CPT was able to diffuse into the cells at higher intensity. Among several cancer cell lines, the highest cytotoxicity was observed for H460 cells. These environmental-responsive NPs thus have potential to be applied in oral administration.

Biography:

Dr. Trong-Ming Don is a professor at the Department of Chemical and Materials Engineering at Tamkang University, Taiwan. He received his B.S. degree from the Department of Chemical Engineering in 1985 at National Taiwan University and his Ph.D. in 1996 at the Institute of Materials Science at the University of Connecticut, USA. His research interests include environmentally responsive block copolymers, bio-based polymer blends and composites, and chemical modification and applications of epoxies and chitosan materials. He has published SCI-index papers more than 115 papers with a Google Scholar H-index of 34.

Lipid Based Hyrbid Nanoparticles for Delivery of Bioactive Molecules

Hansoo Park*

School of Integrative Engineering, Chung-Ang University, Seoul, Republic of Korea

Abstract :

Bioengineering strategies to enhance the natural targeting function of nanocarriers would magnify their therapeutic application. Here, we designed functional nanoparticles based on lipids for delivery of bioactive molecules. The reported strategy opens the door for the creation of biocompatible and

custom-tailored biomimetic nanoparticles with varying hybrid functionalities, which may be used to overcome the limitations of current nanoparticle-based therapeutic and imaging platforms.

The topic includes the bioengineered stem cell membranes functionalized nanocarriers (BSMNCs) to increase their retention time and achieve robust targeting for the ischemic tissue and unique hybrid vesicles using macrophage-derived membranes designed to simultaneously co-deliver anti-cancer drugs and polarize tumor-associated macrophages toward attacking cancer, and .

3D Printing and Advanced Fabrication Technologies for Nerve Guide Conduits

Simran, Pooja Bhatia*

Department of Mechanical and Automation Engineering
Indira Gandhi Delhi Technical University for Women, Delhi, India

Abstract:

The peripheral nervous system finds a vital part in coordinating bodily functions and sensations, and can be severely affected by trauma and neurodegenerative diseases. "Nerve guidance conduits called (NGCs) are extensively examined as a treatment modal quality for repairing peripheral nerve damages and its injuries, alongside nerve autografts and allografts. However, the main concerns in establishing their effectiveness for nerve repair and regenerator. The global demand for NGCs is increasing day by day. Various treatments, including surgery and nerve grafting, have addressed these issues from case to case. However, recent advancements in 3D printing techniques have emerged as promising tools in the field of neural engineering. 3D printing enables the fabrication of complex and customized constructs, offering potential applications in tissue engineering, particularly for functional NGCs. This paper aims to introduce several fabrication methods or technologies, like solvent casting methods, phase separation methods, freeze drying techniques, etc. which incorporate cells, bioactive molecules, and drugs. Developing nerve conduits and printing methods requires a comprehensive understanding of neural architecture, neural cells, different types of injuries, suitable materials, and various factors necessary to enhance the mechanical properties of conduits.

Biography:

Dr. Pooja Bhati
Assistant Professor in the Department of Mechanical & Automation Engineering,
Indira Gandhi Delhi Technical University for Women, Delhi.
Dr. Bhati's research is focused on finding novel methods of polymer processing and the development of bioresorbable scaffolds using the latest technology, such as 3D Bioprinting for health improvement. Also, Dr. Bhati is working in the area of soft robotics -the design and development of soft robotics grippers inspired by nature.

Invited Talks

Harnessing Nanotechnology to Overcome Boron Neutron Capture Therapy Challenges in Cancer Treatment

Yi-Lin Chiu, Wan Yun Fu, Wei-Yuan Huang, Shi-Chih Huang, Fang-Tzu Hsu, Tzu-Wei Wang, Pei Yuin Keng*

Department of Material Science and Engineering, National Tsing Hua University, Hsinchu City 300, Taiwan

Abstract:

Boron neutron capture therapy (BNCT), a synergistic cancer treatment modality combining chemotherapy and radiotherapy, capable of delivering highly localized radiation doses at the cellular level. Distinct from conventional chemotherapy and radiotherapy, BNCT generates high linear energy transfer (LET) ionization, causing severe damage to the DNA such as irreversible double-stranded break (DSB) and complex chromosome rearrangement, thus it highly effective in killing targeted cancer cells. However, the effectiveness of BNCT is often limited by the challenge in developing boron drugs capable of delivering a high concentration of 10B (10 9 boron-10 atom/g tumor cells) directly to the tumor cells while maintaining a tumor to blood (T/B) ratio greater than 3. Our research focuses on developing boron-rich nanoparticles to enhance BNCT efficacy. Boron-based nanomaterials are particularly advantageous due to their high boron content, nanoscale properties, multifunctionality, and capability to deliver multiple drugs, making them ideal for BNCT and combination therapies. We will present the synthesis, functionalization, and characterization of poly(ethyleneglycol)-block-(poly(4-vinylphenyl boronate ester)) polymer micelles for combined immuno-neutron capture therapy in melanoma-bearing mice. These micelles demonstrated a 38- fold increase in boron accumulation in metastatic melanoma cancer cells compared to the small molecular boron drugs. Furthermore, we will present findings on the enhanced effectiveness of BNCT when combined with other therapies. In vivo studies showed that melanoma-bearing mice treated with these micelles had an 8-fold increase in boron accumulation in tumor tissues compared to those treated with BPA, resulting in a longer tumor growth delay (5.4 days with micelles versus 3.3 days with small molecular boron drug). Additionally, combining BNCT and anti-PD-L1 immunotherapy extended tumor growth delay to 6.6 days, and increased T-cell infiltration and activation at tumor sites, thereby indicating a boosted immune response. This combination therapy offers promising approach by enhancing cytotoxic T-cell activation and mitigating the immunosuppressive effects of melanoma tumors. In addition to the development of boronrich polymer micelles, our group have also actively developing boron carbon oxynitride nanoparticles. We will present their synthesis, strategies for polymer functionalization, self-assembly, disassembly for boronbased nanoparticles, their ex-vivo stability, the effect tumor targeting ligand. In a triple-negative breast cancer mouse model, we demonstrated that pegylated boron carbon oxynitride (BCNO) nanoparticles achieved a significant tumor growth delay of 9 days compared to a mere 1-day delay observed with treatment using a small molecular boron drug. Furthermore, the incorporation of a folic acid targeting ligand markedly enhanced intracellular uptake and tumoricidal effects upon neutron irradiation in triple-negative breast cancer cell lines. These advancements highlight the potential of boron-rich nanoparticles to significantly enhance the efficacy of BNCT, providing a promising avenue for the treatment of difficult-totreat cancers. Our findings also demonstrate that targeted boron delivery systems, particularly when combined with immunotherapy, can achieve superior tumor specificity and therapeutic outcomes, marking a crucial step forward in the development of more effective cancer treatment modalities.

Inhalable Nano/Microparticles as Pulmonary-Targeted Dosage Forms for Therapeutic and Diagnostic Application (Online)

Kurnia Sari Setio Putri*1, Widya Dwi Aryati1, Miftakul Munir2, Indra Saptiama2, Gatot Suhariyono3, Muhayatun Santoso4, Raditya Iswandana1, Sutriyo1, Silvia Surini1

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3Research Center for Radiation Safety Technology and Metrology, National Research and Innovation Agency, Jakarta, Indonesia, 12440
4Research Center for Radiation Detection and Nuclear Analysis, Nuclear Energy Research Organization, National Research and Innovation Agency, Bandung, Indonesia

Abstract:
Pulmonary administration offers advantages to deliver active substance for local lung-disease (tuberculosis, pulmonary fibrosis, COPD, etc) and systemic drugs with low-bioavailability (peptides, proteins or easily-degraded substances). Unique and specific-characterized pulmonary-targeted dosage forms is required to ensure drug deposition in the lung, adequate drug bioavailability and minimum inflammation reaction of lung immune systems. Currently we developed nano/microparticles to deliver drug (for tuberculosis) and diagnostic substances (99Tc-Carbon for diagnostic of pulmonary embolism). We study on optimization of formula and production parameters to produce nano/microparticles with excellent solubility and aerodynamics properties. The inhalable powder was produced by spray drying method and then characterized for its aerodynamic (using cascade impactor), solubility (using dissolution tester) and cell-toxicity properties (MTT test on A549 cell lines). Our results showed that nano/microparticles powder for inhalation is prospective and safe to deliver therepeutical and diagnostic agents to the lung, for local and systemic effects.

Biography:
Kurnia Sari Setio Putri has bachelor, master and professional degree from Faculty of Pharmacy Universitas Indonesia, and gained her PhD at Department of Pharmaceutical Technology and Biopharmacy, University of Groningen, The Netherlands. She worked at Quality Assurance Department Sanofi Aventis Indonesia, before she joined Faculty of Pharmacy Universitas Indonesia as lecturer. Her main research interest includes modified-release dosage forms, pulmonary-targeting drug delivery systems, markers and target therapy of fibrosis, and polymers modification for pharmaceutical excipients.

Oral Talks

Plasma Activated Nanobubble Water (PANBW) for Medical Applications (Online)

Anto Tri Sugiarto1*, Budi Saksono2, Hilman Syaeful Alam1 and Y. Aris Purwanto3

1Research Centre for Smart Mechatronics, BRIN, Indonesia
2Research Centre for Biomass and Bioproduct, BRIN, Indonesia
3Faculty of Agricultural Technology, IPB University, Indonesia

Abstract:
Nanobubble technology is an emerged solution to address climate change, environmental challenges, cost and energy reduction in industrial processes, optimization of therapeutic and diagnostic techniques and other applications. On the other hand, the plasma activated water (PAW), as a new environmentally nonthermal processing technology, has attracted wide attention for its applications in agriculture, food, and biomedical fields. In this paper we develop a plasma activated nanobubble water (PANBW) generator using a dielectric barrier discharge reactor to activate nanobubble water for microbial inactivation. In the PANBW system, the advantages of PAW are strengthened by the ability of nanobubble (NB) to dissolve reactive gas in water. It was found that using PANBW the concentration of reactive oxygen species (ROS) and reactive nitrogen species (RNS) generated in the water was large and varied. Results show that discharge voltage, gas type and gas flow rate has significant effect to ROS and RNS generation. Increasing discharge voltage was increased the concentration of ROS, RNS, ORP and decreases pH of PANBW. Experiments were also carried out on the process of E.coli inactivation. Results showed that, around 3 to 5 log CFU/g reduction in E. coli population was observed in PANBW 30-45 min treatment. By further increasing PANBW research and development, PANBW can be one of the promising technologies for therapeutic and sterilization processes in medical fields.

Biography:
Anto Tri Sugiarto was born in 1972 in Indonesia. He completed Ph.D in the field of plasma discharge at the Faculty of Industrial Engineering, Gunma University, Japan in 2002. He issenior researcher in Research Centre for Smart Mechatronics, BRIN. He is expertise includes non-thermal plasma and micro-nanobubble technology. He has about 14 Indonesian invention patents and has successfully applied more than 70 installations and products of water and wastewater treatment plant based on plasma and micronanobubble for industrial and domestic sector. His recent research is development of plasma activated micro-nanobubble water for urban aqua-agriculture and medical applications.

2nd International Conference on Sensor Technology (INCOST)

Plenary Talk

Pioneering Molecularly-Level Fe Sites Immobilized on Graphene Quantum Dots as a Key Activity Descriptor in Achieving Highly Efficient Oxygen Evolution Reaction

Mia Rinawati[1], Ling-Yu Chang[1], Chia-Yu Chang[2], Wei-Nien Su[2,3], Brian Yuliarto[4], Min-Hsin Yeh[1,3]*

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Abstract:

The emergence of efficient electrocatalysts to facilitate the thermodynamically demanding and

kinetically challenging oxygen evolution process (OER), which includes the coordinated transfer of four protons and four electrons, remains an issue. The effective transfer of energy encourages molecular-level control over key redox transitions involving small-molecule substrates (O_2, and H_2O), at or near electrode surfaces. While many molecular catalysts have been shown highly active for OER, immobilizing those onto the heterogenous solid matrices is challenging. Herein, graphene quantum dots (GQDs), a carbonaceous sub-class, was used as the solid matrices to conjugate the molecular catalyst onto its surface owing to its high surface area and electronic conductivity. Through the coordinated environment of the conjugated material, the molecular Fe sites on the GQDs surface exhibited outstanding OER features, achieving an ultra-low overpotential of 223 mV and 241 mV at a current density of 50 and 100 and mA/cm^2, respectively, and excellent stability over 24 h. Our results marked a pioneering step in that through conjugation, these molecular sites were well dispersed at the GQDs matrices and were intrinsically active for OER.

Biography:

Prof. Min-Hsin Yeh's research interests are focused in the area of the nanomaterials and their applications in electrochemistry, photoelectrochemistry, energy harvesting systems, energy storage devices, and self-powered systems. He published over 110 papers (Average IF=10.6, h-index=46; Citations ~8,200) in high impact journals, such as Sci. Adv., Adv. Mater., Adv. Energy Mater., Adv. Fun. Mater., ACS Nano, Nano Energy, etc.

Keynote Talks

Sustainable Biosensing Platforms Based on Nanostructured Geothermal Silica for Antibiotic Resistant Bacteria Detection

Nining Oktafina Sifana1,2, Melyna3, Ni Luh Wulan Septiani4,5, Abdi Wira Septama6, Robeth Viktoria Manurung5,7, Brian Yuliarto1,2,5 and S. N. Aisyiyah Jenie5,8*

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2 Advanced Functional Material Research Group, Faculty of Industrial Technology, Institut Teknologi Bandung, Indonesia
3 Master Program of Analytical Chemistry, Institut Teknologi Bandung, Indonesia
4 Research Center for Advanced Materials, National Research and Innovation Agency (BRIN), Indonesia.
5 BRIN and ITB Collaboration Research Center for Biosensor and Biodevices, Indonesia
6 Research Centre for Pharmaceutical Ingredients and Traditional Medicine, National Research and Innovation Agency (BRIN), Indonesia.
7 Research Centre for Electronics, National Research and Innovation Agency (BRIN), Indonesia
8 Research Centre for Chemistry, National Research and Innovation Agency (BRIN), Indonesia

Abstract:
Methicillin-Resistant *Staphylococcus Aureus* (MRSA) is a worldwide major pathogenic bacteria that has emerged over the past three decades as the leading cause of nosocomial and community-acquired infections. Biosensors can provide rapid, sensitive, and selective detection of the presence and number of bacteria in various environments. Herein, a novel fluorescence nanoprobe was designed as a biosensor for MRSA detection using dye-incorporated silica nanoparticles (FSiNP). Based on the results of specific surface area analysis using the Brauner Emmett-Teller (BET) method, the surface area of the nanoparticles was obtained at 377.127 m^2/g, and the X-ray diffraction (XRD) analysis confirmed that it

was in the amorphous phase. Vancomycin, as the bioreceptor, was immobilized on the silica surface through a hydrosilylation reaction, generating the biosensing platform FSiNP-Van. Each modification step was corroborated by the Fourier Transform Infra-Red (FTIR) spectroscopy. The sensing principle was based on the fluorescence-quenching mechanism of FSiNP-Van at 515 nm obtaining a rapid response time of 20 minutes. The FSiNP-Van nanoprobe provided a wide linear concentration range of $10 – 10^6$ CFU/mL with a limit of MRSA detection calculated at 1 CFU/mL. The fluorescent nanoprobe demonstrated here is expected to find applications in point-of-care (POC) diagnostics to detect the presence of MRSA bacteria.

Biography:

Dr. Jenie is presently a senior researcher in the Research Centre for Chemistry, National Research and Innovation Agency (BRIN) Indonesia in the field of chemistry, materials science and nanotechnology. She finished her Ph.D in Materials and Minerals Science in 2016. In 2017, Dr. Jenie was awarded with the L'Oreal-UNESCO FWIS National Fellowship (Indonesia) in the field of Materials Science. Since 2020, she lead the Nanoparticle-based point of care detection of antibiotic-resistant bacteria (NAPARBA) Project, funded by Southeast Asia – Europe Joint Funding Scheme for Research and Innovation. She has also been proactive in leading biosensor related research for COVID-19.

The Evolution of Biosensors: Cutting-Edge Developments and Applications

Veinardi Suendo1,2*, Nadiatus Silmi1,3, Rafiq Arsyad1, Didi Prasetyo Benu1,3,4, Fairuz Gianirfan Nugroho2,5, Fry Voni Steky1,3, Muhamad Nur Siddik1, Fajar Rakhman Wibowo6, Muhammad Iqbal7, Brian Yuliarto2,7, Rino Rakhmata Mukti1,2,8

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Abstract:

KCC-1 nanostructured particles possess a fascinating bicontinuous concentric lamellar (bcl) morphology, distinct from conventional mesoporous silica. This unique structure grants KCC-1, also known as bcl silica, exceptional properties, making it a highly attractive material for diverse applications. In catalysis, bcl silica's interconnected pore network facilitates efficient mass transport of reactants and products, acting as a superior support for catalysts. Its high surface area allows for maximized catalyst loading, enhancing reaction efficiency. As an adsorbent, bcl silica demonstrates a remarkable ability to capture and remove unwanted molecules from liquids and gases, making it valuable for purification processes. The bcl structure also positions bcl silica as a promising candidate for drug delivery. Its pores can be precisely tailored to encapsulate and release drugs in a controlled manner. Furthermore, bcl silica's biocompatibility makes it a safe choice for biomedical applications. Beyond these areas, bcl silica's unique properties hold promise in photocatalysis, CO2 capture, and even micro-reflectors in solar cells. The ability to fine-tune the pore size and surface chemistry of bcl silica opens doors for further optimization and exploration in various technological fields. Moreover, due to its morphological uniqueness and excellent physical properties, the mechanism of bcl

morphology formation has been applied to different mesoporous materials, such as alumina, titania, zinc oxide, and aluminosilicate. Our recent developments on syntheses, quantification, and applications of nanostructured materials with bcl morphology are presented and discussed.

Biography:

Veinardi Suendo was born in Jakarta on November 7, 1975. He received his Bachelor of Science in Chemistry from ITB in 1998, his Master of Engineering from Tokyo Institute of Technology in 2001, and his PhD from École Polytechnique, France, in 2005. Veinardi became a lecturer at ITB's Department of Chemistry in 2008. His research focuses on molecular spectroscopy, photophysics, and advanced materials, particularly dye-sensitized solar cells and metal oxides like silica, alumina, titania, and zinc.

Invited Talks

Improving Sensitivity toward Sulfur Dioxide by Modifying Structure and Interface of Zinc Oxide

Ni Luh Wulan Septiani1,2*, Brian Yuliarto2,3, Yusuf Valentino Kaneti4, and Yusuke Yamauchi4

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4 School of Chemical Engineering and Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Brisbane, QLD 4072, Australia.

Abstract:

Zinc oxide is renowned for its widespread use in gas sensors due to its abundance, high sensitivity, and ease of fabrication. However, gas sensors based on ZnO encounter certain drawbacks, such as limited selectivity and the need for relatively high operational temperatures. Our research focuses on enhancing ZnO's selectivity for SO_2 detection at lower temperatures by modifying its structure and interface. To achieve this, we introduced modifications to the ZnO formation process during solvothermal conditions, utilizing glycerol and anthocyanin as modifiers. Glycerol led to the creation of a three-dimensional wool ball-like structure, where two-dimensional particles were organized into a porous arrangement. Conversely, anthocyanin resulted in hollow sphere structures, assembled from small ZnO particles approximately 30 nm in size. Upon testing for SO_2 detection, both modified structures exhibited effective performance at 350°C, demonstrating high response rates but limited selectivity. However, by incorporating a small amount of multiwalled carbon nanotubes (MWCNTs), the response to SO_2 was tripled at lower temperatures compared to pure ZnO. Furthermore, the presence of MWCNTs notably elevated ZnO's selectivity towards SO_2 in contrast to other harmful gases. This improved sensitivity and selectivity in SO_2 detection is attributed to the combined advantageous physicochemical properties of ZnO and the electrical properties of MWCNTs, which synergistically enhance the overall sensing characteristics.

Oral Talks

Improved Capacitive Properties of ZIF-67 via CTAB-Assisted Synthesis for Supercapacitor Electrode Active Material

Anggita Bayu Krisna Pambudi[12]*, Istiqomah[3], Chandra Wulandari[3], Ni Luh Wulan Septiani[34], Muhammad Iqbal[5], Brian Yulianto[5*]

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Abstract:

Metal-Organic Framework Zeolitic Imidazolate Framework-67 (ZIF-67) has been extensively reported as a template for forming nanoporous carbons (NPCs), composites, and cobalt oxide as active electrode materials for supercapacitors due to its synthesis flexibility, chemical stability, and thermal stability. However, the effect of morphological modification of ZIF-67 before being used as an active electrode material in supercapacitors has not been widely reported. This study investigates the influence of adding hexadecyltrimethylammonium bromide (CTAB) on the morphology and electrochemical performance of ZIF-67 compared to the ZIF-67 dodecahedron material. The addition of CTAB results in smaller ZIF crystal sizes, enhancing the diffusion capability of electrolyte ions. Modified ZIF-67 was characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier Transform Infrared (FTIR) Spectroscopy to confirm the material's structure and morphology. The electrochemical performance was tested through cyclic voltammetry (CV) and galvanostatic charge-discharge (GCD). Electrochemical testing reveals that adding CTAB in the ZIF-67 synthesis process increases the specific capacitance from 70 F/g to 87 F/g in a 3M KOH electrolyte at a current density of 1 A/g. Based on these results, modified ZIF-67 shows great potential as an active electrode material for supercapacitors.

Biography:

Anggita Bayu Krisna Pambudi, born on December 9, 1993, is a Master's degree candidate in Engineering Physics at Institut Teknologi Bandung. He has also worked as an engineer at PT PLN (Persero) UIP2B, an Indonesian government utility company, since 2018. He is currently conducting research on electrode materials for supercapacitors and batteries.

Solvothermal Synthesis and Characterization of Cobalt-Nickel Triethanolamine Complex

Muhammad Fadlan Raihan1,2,*, Ni Luh Wulan Septiani3 , Ahmad Nuruddin1,2, Robeth Viktoria Manurung4 , Brian Yuliarto1,2,5,*

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15314, Indonesia; 4Research Centre for Electronics, National Research and Innovation Agency (BRIN), Komplek LIPI Gd. 20, Jl. Cisitu Lama, Dago, Kecamatan Coblong, Bandung 40135, Jawa Barat, Indonesia; 5Research Center for Nanoscience and Nanotechnology (RCNN), Institut Teknologi Bandung, Jalan Ganesa 10, Bandung 40132, Indonesia

Abstract:

The extensive use of nickel and cobalt in various applications highlights the importance of exploring their potential characteristics. In this study, a cobalt-nickel triethanolamine complex was successfully synthesized using a solvothermal technique in an autoclave chamber at 180°C for 16 hours. Comprehensive analyses, including Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Fourier Transform Infrared (FTIR) spectroscopy, were conducted to characterize the resulting material. This research offers valuable insights for optimizing the synthesis of materials incorporating nickel and cobalt.

Biography:

Muhammad Fadlan Raihan is a Ph.D. candidate from the Engineering Physics Department at Institut Teknologi Bandung. He is currently focusing on research involving functional materials as biosensors for detecting the dengue virus.

Unlocking the Potential of Bimetallic Nickel Cobalt Phosphates as Novel Materials for High Performance Supercapacitor

Istiqomah[1,2]*, Ni Luh Wulan Septiani[2,3,4], Nugraha[2,5], Brian Yuliarto[2,5]

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Abstract:

Bimetal phosphate has been known to have outstanding performance as a supercapacitor electrode. This work reports the synthesis of bimetal phosphate using the solvothermal method, starting with glycerate as the template. Introducing additional solvent as a solution mixture can actually change the morphology and performance of the supercapacitor. In this work, hexanol was used as a solvent mixture in ethanol and showed morphological changes. The metal phosphate was calcined at 600°C resulting in pores on the surface. These pores will enhance morphological optimization and electrochemical performance by promoting faster electrolyte ion diffusion for better electrolyte ion penetration. The electrochemical tests revealed satisfactory results, showing that a specific capacitance of 862 Fg^{-1} in 6 M KOH electrolyte could be obtained at a current density of 1 Ag^{-1}. Based on these results, bimetal phosphate has tremendous potential as a positive electrode material for supercapacitors.

Biography:

Istiqomah, born on March 2, 1999. She is a PhD candidate studying physics engineering at the Bandung Institute of Technology. Since earning his master's degree, she has worked in the field of energy storage research, especially with supercapacitors. She began by conducting experiments with several materials that may be utilized as electrodes for supercapacitors, beginning with a mixture of activated carbon and metal oxide material (MnO_2). Currently, she is working on doping various metals to create metal phosphate materials that are ideal as active materials for supercapacitors.

Simple Synthesis and Characterization of Triethanolamine-Modified CuBTC/rGO Material as an Electrochemical Sensor Material

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Abstract:

The application of metal-organic frameworks (MOFs) as electrochemical sensor materials has experienced significant development. With their tunable porous properties, high stability, and high conductivity, MOFs possess considerable potential for modification. In this study, we synthesized a CuBTC/rGO composite material using triethanolamine as a modulator for use as an electrochemical sensor material. Triethanolamine (TEOA) was used as a ligand deprotonation agent and structuredirecting agent. In-depth analysis using scanning electron microscopy (SEM), x-ray diffraction (XRD), and Fourier transform infrared (FTIR) was conducted to determine the unique characteristics of the synthesized material. The results show that the material was successfully synthesized and wellcharacterized.

Biography:

Mochamad Hielmy Ismet Haekal is a final-year undergraduate student from the Department of Engineering Physics at Bandung Institute of Technology. Currently, he is conducting research focused on developing functional materials for electrochemical applications, particularly biosensors for the dengue virus. Additionally, he is pursuing a master's degree in biotechnology through an integrated bachelor'smaster's program from the Bandung Institute of Technology.

Numerical Optimization of FTO/TiO_2/$FASnI_3$/P3HT/Carbon Perovskite Solar Cells

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Center for Nanosciences and Nanotechnology (RCNN), Institut Teknologi Bandung, Bandung 41032, Indonesia; 4Research Center for Electronics National Research and Innovation Agency, (BRIN), KST Samaun Samadikun, Jl. Sangkuriang Cisitu, Bandung 40135, Indonesia.

Abstract:

Due to environmental and health concerns associated with lead, researchers have explored lead-free perovskite materials. Tin-based perovskites have gained attention as viable alternatives for lead-free perovskite solar cells owing to their appropriate bandgap and exceptional electronic properties. In this work, we developed a perovskite solar cell device architecture with a configuration of FTO/TiO2/FASnI3/P3HT/Carbon. We optimized parameters such as the thickness of the absorber layer, the defect density in the absorber, and the operating temperature. The simulations were performed using a solar cell capacitance simulator (SCAPS 1D). The optimized cell demonstrated excellent performance metrics, with a short-circuit current density (Jsc) of about 27.868 mA/cm^2, a high fill factor (FF) of 85.03%, an opencircuit voltage (Voc) of around 1.1838 V, and a power conversion efficiency (PCE) of 27.67%. These findings highlight the potential of this architecture for lead-free and environmentally friendly solar cell applications.

Biography:

Rossyaila Matsna Muslimawati, born on January 23, 1999, is currently pursuing her Ph.D. under supervision of Prof. Brian Yuliarto at Bandung Institute of Technology. Her research interests include perovskite materials for optoelectronic applications, such as solar cells and photodetectors. Presently, she focuses on material design, simulation, and experiments on lead-free perovskites.

The Potential of Magnesium Oxide in Surface Plasmon Resonance Technolog for Glucose Detection

Dhika Marlia Subekti1,2,3*, Gilang Gumilar4, Robeth Viktoria Manurung4, Brian Yuliarto2,3

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Abstract:

Diabetes is a dangerous disease that can threaten human life. This disease is characterized by high levels of human blood glucose. The development of a glucose detector with fast, accurate, and sensitive detection is crucial. Theoretically, a surface plasmon resonance (SPR)- based biosensor is proposed to detect glucose levels. The SPR spectrum of magnesium oxide (MgO) material, which has a wavelength of 281 nm, contributes to increase the sensitivity of the sensor. In this study, the magnesium oxide was synthesized by the sol-gel method and deposited on a gold chip by the spin-coating method. The crystallization of magnesium oxide was characterized by XRD. It demonstrated a high degree of crystalline structural purity, with a crystalline size of 13.89 nm. In addition, the

morphology and composition of magnesium oxide were characterized by SEM and EDS. The synthesized material shows an irregular shape with the presence of Mg and O at peaks of 0.3 keV and 0.1 keV, respectively. Furthermore, the SPR performance was evaluated by examining the detection of 10 mM glucose on Au deposited with MgO and bare Au. The result shows that Au deposited with MgO has a significantly higher association process than bare Au, which indicates that MgO has the potential for the SPR biosensor that was encouraged to be used in diabetes detection.

Biography:

Born on March 16, 1999, Dhika Marlia Subekti is a master's student at the Bandung Institute of Technology. She is supervised by Prof. Brian Yuliarto from the Bandung Institute of Technology and Dr. Gilang Gumilar from the National Research and Innovation Agency (BRIN). Her research is conducted on material experiments with a focus on biosensor surface plasmon resonance applications.

Synthesis And Characterization Ni/Fe-MOF and its Performance For Supercapacitor Application

Hakim Habibi[13]*, Muhammad Iqbal[2], N. L. Wulan Septiani[24], N. Astri Lidiawati[2], Brian Yulianto[2]*

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Abstract:

Metal Organic Frameworks (MOFs) are widely used for supercapacitor electrodes due to their large surface area, high porosity, and adaptability. However, the low conductivity of pure MOFs limits their application as electrode materials. To overcome this, various techniques are employed, including the creation of bimetallic MOFs or making a composite. This study focuses on the novel bimetallic Ni/Fe-MOF, comparing its characteristics to Ni-MOF. The synthesis of MOFs is achieved using a single-step solvothermal method at 150 ºC for 48 h, using terephthalic acid (BDC) as ligans. For solvent, ethylene glycol is added as a capping agent. Ni/Fe-MOF exhibits high capacitive properties, with a specific capacitance of 817.5 Fg^{-1} at 0.5 Ag^{-1}. Both have almost the same Flake-like morphology. These findings suggest that bimetallic Ni/Fe-MOF using solvothermal are promising candidates for improving Ni-MOF performance as supercapacitor electrodes, potentially advancing energy storage technology.

Biography:

As the first author, I am pursuing a master's degree in physical engineering at Bandung Institute of Technology, Indonesia. I have also worked as a researcher at PT PLN (Persero) Puslitbang, an Indonesian government utility company, since 2019. My research concerns smart grids, energy storage, and high-voltage equipment. Before that, I take my bachelor's degree in electrical engineering at Sepuluh Nopember Insitute of Technology, Indonesia.

Room-Temperature Synthesis of CsPbBr3 QDs with Blue Emission and Enhanced Optical Properties

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dAdvanced Functional Materials (AFM) Laboratory, Department of Engineering Physics, Institut Teknologi Bandung, Bandung 40132, Indonesia.

Abstract:

The synthesis of high-efficiency light-emitting materials is pivotal for advancing optoelectronic devices such as LEDs, solar cells, and displays. Among these materials, Cesium lead bromide (CsPbBr3) quantum dots (QDs) are notable for their exceptional optical properties, including high photoluminescence quantum yield, narrow emission bandwidth, and tuneable emission wavelengths. However, room-temperature synthesis of CsPbBr3 QDs often results in suboptimal properties or necessitates complex, costly processes. This study introduces a novel, cost-effective room-temperature synthesis method for CsPbBr3 QDs exhibiting blue emission with enhanced optical properties. By optimizing precursor solutions and reaction conditions, this approach circumvents the need for high-temperature processing, producing QDs with superior stability and emission characteristics. Characterization of the synthesized CsPbBr3 QDs was conducted using various spectroscopic techniques, revealing a strong blue emission at 457 nm under 345 nm excitation, indicative of quantum confinement effects. Additional green emissions at 571 nm and 618 nm under 525 nm excitation suggest the presence of defect states. The dual emission behaviour highlights the influence of nanocrystal size distribution and surface states on the emission properties. Furthermore, the reflectance spectrum and Tauc-plot analysis confirmed the direct bandgap energy of 2.27 eV, emphasizing the material's suitability for optoelectronic applications. Raman spectroscopy identified vibrational modes consistent with a tetragonal phase of CsPbBr3, supported by the observed complexity and multiple peaks in the spectrum. The findings demonstrate the efficacy of the developed synthesis method, providing a reliable pathway for producing high-quality CsPbBr3 QDs with potential for integration into next-generation optoelectronic devices.

Biography:

Sudirman is a doctoral student in the Chemistry program at Institut Teknologi Bandung. His research is centered on materials science, specifically focusing on solar cells and electronic materials, including perovskites and conductive polymers. In addition to his primary research, Sudirman works intensively on spectroscopy characteristics, utilizing techniques such as Diffuse Reflectance and Transmittance UV-Vis Spectroscopy, Raman Spectroscopy, and Photoluminescence. Passionate about advancing sustainable energy solutions, Sudirman is dedicated to exploring innovative materials that can enhance the efficiency and performance of solar cells and electronic devices. His work aims to contribute to the development of cutting-edge technologies in the field of renewable energy.

Synthesis and Characterization of Nickel Metal-Organic Framework for Supercapacitor Electrodes

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Abstract:

Supercapacitor is an energy storage device that boasts high energy and power density. Supercapacitors store energy through an electrostatic double-layer mechanism and pseudocapacitance reactions, enabling rapid energy storage and release without efficiency loss over numerous cycles. Electrode materials, such as nickel, play a crucial role in the electrochemical performance of these energy storage devices. Nickel has garnered attention due to its high theoretical capacitance, availability, ease of synthesis, and chemical stability. Despite these advantages, challenges such as inadequate rate capability and limited cycling properties hinder its widespread application. Nickel Metal-Organic Framework (Ni-MOF) has been synthesized using a solvothermal method at a temperature of 150°C and applied as a supercapacitor electrode. This environmentally friendly MOF-based material is selected as a supercapacitor electrode due to its excellent surface area, numerous mesopores that enhance electrolyte ion transport, controllable morphology, abundant active sites, and good electrical conductivity, all contributing to the improvement of the supercapacitor's specific capacitance. Ni-MOF was synthesized and characterized using various analytical techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier Transform Infrared (FTIR) Spectroscopy, and Brunauer-Emmett-Teller (BET) analysis to confirm the material's structure and morphology. The electrochemical performance of the Ni-MOF-based supercapacitor was tested through cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS) measurements. The test results show that the supercapacitor with Ni-MOF electrodes has a specific capacitance of 94.4 F g-1 at a current density of 0.5 A g-1, highlighting the significant potential of this material for high-power energy storage applications.

Biography:

As the first Author, I am currently pursuing a physisc engineering master's degree at Bandung Institute of Technology, Indonesia. I have also worked as an engineer at PT PLN (Persero) West Java Transmission Regional (UITJBB), an Indonesian government utility company, since 2016. I am currently conducting research on nanotechnology and electrode materials for supercapacitor. Before that, I take my bachelor's degree in physics engineering at Telkom University, Indonesia.

Synthesis and Characterization of Silica Nanoparticle-Based Nanofluid from Geothermal Sludge

Witjaksono Adi Suwito[1,2*], Brian Yuliarto[3], Muhammad Iqbal[3], N. L. Wulan Septiani[3,4], N. Astri Lidiawati[3], Ahmad Nuruddin[3*]

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Abstract:

The utilization of nanoparticles enables nanofluids to achieve higher thermal conductivity. The increase in thermal conductivity provided by silica nanoparticles can significantly enhance thermal efficiency. Current technological advancements enable the production of pure silica from geothermal sludge, which has great potential as a base material for nanofluid production. This geothermal sludge contains a high silica content, about 90-98% amorphous silica, along with traces of metal compounds, making it a promising source for silica nanoparticle production. The synthesis silica nanoparticles from geothermal sludge using the sol-gel method. Silica powder was mixed with 400 ml of 1.5 N sodium hydroxide (NaOH) to form sodium silicate (Na_2SiO_3). The mixture was stirred, then separated into sodium silicate solution and solids. The sodium silicate solution was titrated with HCl to form a gel at pH 5 and allowed to an aging time process with 6 hours. The synthesized nanoparticles specific surface area were characterized using FTIR (Fourier Transform Infrared), XRD (X-Ray Diffraction), SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy), and BET (Brunauer–Emmett–Teller) methods. The results show that the produced silica nanoparticles have the quality and properties suitable for application in nanofluids, thereby significantly improving thermal efficiency. Utilizing geothermal waste as a silica source provides an effective and environmentally friendly solution for nanoparticle production.

Biography:

As the first Author, I am currently pursuing a physisc engineering master's degree at Bandung Institute of Technology, Indonesia. I have also worked as a engineer at PT PLN (Persero), an Indonesian government utility company, since 2017.

Day 3 (Room 1)

Session: Biomedical Applications of Nanotechnology

Keynote Talks

Technique Developments for Exploration of Membrane Curvature-Sensing Proteins and Gold Nanoparticle Synthesis Peptides

Masayoshi Tanaka*

Tokyo Institute of Technology, Japan

Abstract:

Organisms employ various strategies to adapt to diverse environments. By deepening our understanding of biological phenomena in microorganisms and animal cells at the molecular level, we strive to create innovative bionanomaterials/molecules for applications in nanotechnology and biomedicine. Our current efforts are focused on developing technologies to explore proteins involved in recognizing membrane curvature. These proteins are crucial for understanding cellular functions and diseases as they are typically associated with deforming cell membranes, cell division, and the formation of intracellular vesicles. Additionally, we are committed to developing environmentally friendly methods for synthesizing functional nanoparticles using peptides that mimic the mineralization processes observed in living organisms, such as those found in bones and teeth. During this presentation, I will discuss these two topics along with our latest advancements.

Biography:

Masayoshi Tanaka received the M.Eng. and D.Eng. degrees from the Tokyo University of Agriculture and Technology, Japan, in 2005 and 2008, respectively. In 2009, he was awarded the Newton International Research Fellowship by the Royal Society, UK, and worked at the University of Leeds (UK) for two years. In 2011, he became an Assistant Professor at the Tokyo University of Agriculture and Technology, and he moved to the Tokyo Institute of Technology in 2014. In 2022, he was promoted to Associate Professor at the Tokyo Institute of Technology. He is the author or co-author of more than 90 papers in international refereed journals.

Two Photon Polymerization of Structures with Small-Scale Features for Biomedical Applications

Roger Narayan1*

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Abstract:

Two photon polymerization is an additive manufacturing approach that involves the use of pulses from a titanium:sapphire laser or a fiber laser to excite photoinitiator molecules within a photosensitive resin for selective polymerization of the resin. Polymerization of biomedical devices containing microscale and sub-microscale features can take place due to the fact that the two photon absorption process exhibits a nonlinear relationship with the incident light intensity. Two photon polymerization has been used to perform additive manufacturing of biomedical devices with microscale and sub-microscale features out of photosensitive polymers (including acrylate-containing materials) and organically-modified ceramic materials (including zirconium oxide hybrid materials). Several types of medical devices, including sensors, tissue engineering scaffolds, and drug delivery devices, have been prepared by means of two photon polymerization. For example, we utilized two photon polymerization for additive manufacturing of small-scale lancet-shaped devices known as microneedles; these devices have potential use for transdermal drug delivery or transdermal detection of analytes in fluid obtained from the skin. Approaches to optimize the processing parameters and postprocessing steps associated with two photon polymerization for medical device applications will be discussed. For example, innovations related to the use of various photoinitiators for use in medical applications will be considered. In addition, functional evaluation (including biological evaluation) of two photon polymerization-created medical devices will be described. Appropriate steps in the development of two photon photopolymerization-based methods for commercially scalable manufacturing of medical devices will be considered.

Biography:

Dr. Roger Narayan is a Distinguished Professor in the Joint Department of Biomedical Engineering at the University of North Carolina and North Carolina State University. He is an author of over three hundred publications as well as several book chapters on the processing, characterization, and modeling of biomedical materials. He serves as an editorial board member for several academic journals, including as associate editor of Applied Physics Reviews (AIP Publishing). He has been elected as a Fellow of the American Ceramic Society, ASM International, AAAS, ASME, AIMBE, TMS, and the Materials Research Society.

Invited Talks

Studies on Cell Biocompatibility of Electroconductive Carbon Nanofiber Nanoparticle-Containing Biomaterials

Iruthayapandi Selestin Raja*

Pusan National University, South Korea

Suspension/Solution Plasma Spray Coating for Biomedical Applications (Online)

Yuichi Otsuka

Nagaoka University of Technology, Japan

Session: Emerging Smart Materials

Keynote Talks

Failure Analysis of Conveyor Belt Joint and Its Improvement of Mechanical Strength by Cold Splicing

Lydia Anggraini1 *, Fath Nurrahmat2, Rachmat Cahya Putra3

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Abstract:
In cement production, material transportation equipment such as belt conveyors is used to facilitate material movement at each stage. Belts used in conveyor can be made from various materials, such as rubber, leather, plastic, or metal, depending on the nature and type of material to be transported. By using conveyor belt, companies can save production costs and can increase production at a significant and stable speed. To maintain is by prevent tearing or breaking of the belt, and if this happens, connecting it using the splicing and mechanical joint method. The splicing method involves gluing both sides of the belt with two options, i.e. cold and hot splicing, while the mechanical joint method unites the two sides of the belt with tiger nails (fasteners). In this research, the failure strength analysis of the conveyor belt connection was carried out between the cold splicing and mechanical joint methods. The results shows the highest tensile test were obtained at 11.15 MPa, using the cold splicing, while the lowest tensile test results were 5.06 MPa, using the mechanical joint method. Conveyor belts made by the cold splicing have better durability compared to connections made by the Mechanical Joint method. Thus, the cold splicing method can be considered a better choice for the selection of conveyor belt joints. The use of Rema Tip-Top SC2000 brand adhesive in cold splicing joints can affect the tensile strength results.

Biography:
Lydia Anggraini received Bachelor degree from Trisakti University in 2005, Master and Doctoral degrees from Mechanical Engineering, Ritsumeikan University, Japan in 2008 and 2012. She join the company, Indonesia EPSON Industry in 2005 and State-Owned Construction Company in 2012. Since 2015, she has been a Chairperson of the Mechanical Engineering Study Program. Currently, she is an Associate Professor at Study Program of Mechanical Engineering, President University. Her research interests are nanotechnology, micromachining, materials science and materials characterization. She has been serving as reviewer for some respective worldwide journals and assigned as the board of committee in some International scientific meetings.

Mechanism of Electrically Responsive Graphene-Based Smart Membranes for Simultaneous Steam and Power Generation

Tsung-Han Huang[a,b], Wei-Song Hung[a,b*]

[a] *R&D Centre for Membrane Technology and Department of Chemical Engineering, Chung Yuan University, Taoyuan, 32023, Taiwan*

[b] *Graduate Institute of Applied Science and Technology, Advanced Membrane Materials Research Center, National Taiwan University of Science and Technology, Taipei, 10607, Taiwan.*

Abstract:

Water and electricity shortages constitute a global energy crisis that cannot be ignored. The sun is an unlimited source of energy, and oceans provide abundant water and renewable energy resources. In this study, poly(vinylidene fluoride) (PVDF)/graphene solar evaporator membranes are fabricated for simultaneous freshwater production and power generation. Graphene addition transformed the PVDF crystal from the α-phase to the piezoelectric self-assembly β-phase. The resulting membrane is used to convert the mechanical energy of waves to electrical energy. The membrane has an output voltage of 2.6 V (±1.3 V) and an energy density of 2.11 Wm−2 for 1 Hz simulated waves, which are higher than values reported in the literature. The stacked graphene and polymer formed a wood-lumens-like mesoporous structure with a photothermal effect. Under one sun illumination, the water production rate is 1.2 kg m−2 h−1, and the solar-thermal energy conversion efficiency is 84%. Finally, a prototype is built to prove a single evaporator's feasibility that can simultaneously obtain freshwater and generate electricity. Thus, this membrane serves as an ocean wave power generation device that can provide all-weather energy generation, convert stored electrical energy into thermal energy at night and on cloudy days, and continuously provide safe drinking water.

Invited Talks

Dissociation Dynamics of Methane on The Ni80 Nanocluster (Online)

Rizal Arifin[1]*, Yoyok Winardi[1], Ida Widaningrum[1], Zulkarnain[2], Abdurrouf[3], Darminto[4]

[1]*Universitas Muhammadiyah Ponorogo, Indonesia;* [2]*Universitas Muhammadiyah Mataram, Indonesia;* [3]*Brawijaya University, Indonesia;* [3]*Institut Teknologi Sepuluh Nopember, Indonesia*

Abstract:

This study explores the mechanism of methane dissociation using Ni_{80} nanoclusters as a catalyst through reactive molecular dynamics simulations. The simulation system had a density of 0.58 g/mL and simulations were conducted at 1500 K to accelerate the reaction process. During a simulation period of 100 ps, we observed the sequential dissociation of hydrogen atoms from the methane molecule. This led to the adsorption of carbon atoms onto the Ni80 nanocluster. At the same time, the hydrogen atoms on the catalyst surface showed active hopping behavior. It is worth mentioning that certain hydrogen atoms came into contact, resulting in the creation of H_2 molecules. The findings provide valuable insights into the mechanism of methane dissociation on Ni_{80} nanoclusters, showcasing their potential for use in heterogeneous catalysis. This study highlights the importance of

Ni_{80} nanoclusters in enabling C-H bond cleavage and H_2 formation, which has significant implications for improving catalytic processes in industrial applications. In addition, the reactive molecular dynamics simulations provide insights into important atomic interactions that are crucial for understanding the efficiency and selectivity of Ni80 catalysts in methane dissociation reactions. This study's findings are expected to support the development of catalysts that are both efficient and sustainable for converting methane into valuable products.

Biography:

Rizal Arifin, Yoyok Winardi, and Ida Widaningrum are Senior Lecturers at Universitas Muhammadiyah Ponorogo. Rizal Arifin teaches in both the Mechanical Engineering and Electrical Engineering programs. Yoyok Winardi is a lecturer in the Mechanical Engineering program, while Ida Widaningrum specializes in Informatics Engineering. Zulkarnain, a Senior Lecturer at Universitas Muhammadiyah Mataram, focuses on physics education. Abdurrouf, an Associate Professor at Universitas Brawijaya Malang, excels in material science and applied physics. Darminto, a Professor at Institut Teknologi Sepuluh Nopember, Surabaya, is renowned for his research in condensed matter physics. Collectively, they advance education and research across diverse scientific fields.

Joint Interface Engineering - Low Cost MgB2 Based Superconducting Joints for Next Generation MRI Operated in Persistent Current Mode (Online)

Hao Liang*, Md Shahriar A. Hossain*

The University of Queensland, Australia

Interplay Between Phase Kinetics, Microstructure, Microtexture and Superconducting Properties of Zr-modified Nb3Sn in a Cu (Sn)-Nb System (Online)

Sangeeta Santra*

IIT Delhi, India

Oral Talks

A Novel Quenchant Featuring Submicron PCB Particles and Cetyl Trimethyl Ammonium Bromide for Enhanced Hardness of S45C Steel

Wahyuaji Narottama Putra[1*], Myrna Ariati[1], Bambang Suharno[1]

[1]Department of Metallurgy & Materials, Faculty of Engineering, Universitas Indonesia, Indonesia

Abstract:

Martensite is an essential steel phase with very high strength and hardness. Austenitization and quenching are the most common techniques steel manufacturers use to obtain the Martensite phase. However, the cooling stage is the most crucial as it will determine the final characteristics of the steel. The cooling rate of the too-fast or too-slow quenchant may result in cracking or low hardness, respectively. A solid particle can be added to the quenchant to control the cooling rate. This study features a particle from recycled printed circuit boards (PCBs). The PCB-based particle was leached, pyrolyzed, and milled mechanically to reduce the particle size. After milling, the minimum size of the particle was 589.1 nanometers. The synthesized PCB-based particle was added to distilled water as base fluid in different concentrations, such as 0.1%, 0.3%, and 0.5%. To improve the dispersion of the PCB-based particle in the base fluid, Cetyl Trimethyl Ammonium Bromide (CTAB) was added as a surfactant in a variation of 3%, 5%, and 7%. The thermal conductivity was measured on each fluid variation, and it showed that the maximum thermal conductivity achieved was 0.76 W/mK for the fluid with 0.5% particle. Thermal conductivity increased by up to 25% compared to distilled water. Subsequently, all the fluid was used as a quenchant to quench an S45C carbon steel. The hardness of the steel was improved to 55 HRC, or roughly a 28% increase compared with the steel quench in distilled water. Higher hardness may indicate the faster cooling rate of the quenchant with additional PCB-based particles and CTAB surfactant. However, excessive CTAB surfactant could negatively impact thermal conductivity and steel hardness. CTAB also showed a degradation at high temperatures, creating a gel-like substance in the quenchant.

Biography:

Wahyuaji Narottama Putra, a lecturer in the Department of Metallurgy & Materials Engineering at Universitas Indonesia, has been contributing to the field of Heat Treatment and Surface Engineering, particularly for ferrous-based materials and Microstructure Analysis (Metallography) since 2012. His current research focuses on synthesizing nanoparticles from waste PCB for an advanced quenching medium in the heat treatment process, a topic directly relevant to the present study.

Block-Copolymer-Assisted Synthesis of Mesoporous Gold-Based Nanoparticles for Optical and Electrocatalytic Applications (Online)

Asep Sugih Nugraha*

The University of Queensland, Australia

Unravelling the Electrical, Dielectric, and Electrocatalytic Properties of Bimetallic Cobalt-Based Metal-Organic Frameworks (Online)

Manjeet Godara*

The University of Queensland, Australia

Carbon Nanotube-Decorated Hierarchical Porous Nickel/Carbon Hybrid Derived from Nickel-Based Metal-Organic Framework for Enhanced Methyl Blue Adsorption (Online)

Ping Cheng*

The University of Queensland, Australia

Hollow Two-Dimensional Bimetallic Metal-Organic Framework Hexagonal Nanoplates for Ammonia Sensing (Online)

Silvia Chowdhury*

The University of Queensland, Australia

Session: Nanomaterials Synthesis and Characterization

Keynote Talks

Supramolecular Self-Assembly of Fullerene and Derived Hierarchically Porous Carbon Materials for Energy Storage Applications

Lok Kumar Shrestha[1,2]*

[1] Research Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba 305-0044, Japan; [2] Department of Materials Science, Institute of Pure and Applied Sciences, University of Tsukuba; 1-1, Tennodai, 305-8573 Tsukuba, Ibaraki, Japan

Abstract:

Buckminsterfullerene (C60), a well-known ideally zero-dimensional (0D) molecular nanocarbon building block, can be assembled into various nanostructures, including can be assembled into a wide variety of nanostructures including one dimensional (1D) fullerene nanorods or nanotubes, two-dimensional (2D) nanosheets, and three dimensional (3D) cubes at the liquid-liquid interface. These nanostructures result from the supramolecular assembly of fullerene molecules due to the π-π stacking interactions. These fullerene nanomaterials have emerged as novel π-electron-rich carbon sources for producing shape-controlled porous carbon materials demanded in the sensing, energy storage, and energy conversion applications. In this talk, we will discuss the recent advances in the production of self-assembled fullerene crystals from zero-to-higher dimensions, including porous fullerene crystals with bimodal pore architectures and hierarchical superstructures composed of fullerene nanorods growing out of a cubic solid core. We also discuss the direct conversion of these fullerene nanomaterials into nanoporous carbon materials by direct carbonization at higher temperatures (900 to 2000 °C) and their applications in vapor sensing and energy storage. The insertion of micro/mesoporosity enhances energy storage performances due to the ultrahigh specific surface areas and rapid diffusion of electrolyte ions through the interconnected channels of their mesoporous structures.

Biography:

Lok Kumar Shrestha received a Ph.D. Degree from Yokohama National University in 2008. He joined the National Institute for Materials Science (NIMS) as an ICYS-MANA researcher in 2010. He is a Principal Researcher at the Research Centre for Materials Nanoarchitectonics (MANA), NIMS. He has also been appointed Associate Professor at the University of Tsukuba. His current research includes supramolecular self-assembly of fullerenes from zero-to-higher dimensions and ultrahigh surface area nanoporous carbon materials designed from synthetic and natural precursors for high-performance supercapacitors.

Self-assembled Organic Nanomaterials for Sensing and other Applications

Jonathan P. Hill*

National Institute for Materials Science (NIMS), Japan

Abstract:

Modulation of the properties of organic chromophores is made possible by their incorporation in aggregated structures, and so it has become an extremely active research area. Supramolecular chemistry and self-assembly methods are key means to influence aggregative processes, and can be used to control the emergent properties of self-assembled organic nanomaterials. In this work, we have controlled the self-assembly of chromophore compounds with the emphasis on porphyrin, pyrazinacene, hexabenzocoronene and oligophenylene (e.g., sexiphenyl) molecules. Different methods of achieving this include synthetic molecular design, surface assembly (under ambient or UHV conditions), and the use of interfacial media for Langmuir and Langmuir-Blodgett techniques. In the latter, principles of amphiphilicity have been applied to generate on-interface structures that can be extracted as multilayered films and exploited for application in electronic devices. Here, we will describe the self-assembly properties based on precipitation, self-assembly at solid surfaces, printable structures, and interactions at an air-water interface. Molecular structure is emphasized as a key feature including the effects of structural amphiphilicity, π-π stacking, and conformational flexibility. Self-assembly and supramolecular techniques stand out as the most effective methods for obtaining organic nanomaterials having the molecule-level definition of structure important for many applications including sensing. From this point-of-view, sensing applications based on chiro-supramolecular effects or device incorporation of self-assembled materials will be discussed. In particular, the detection of enantiomeric excess has been demonstrated as well as selective sensing of vapor analytes using porous self-assembled structures.

Biography:

Jonathan P. Hill is a Group Leader at the Research Center for Materials Nanoarchitectonics at NIMS, Tsukuba, Japan. He has been living and working in Japan since 2002 with previous appointments in UK (University of East Anglia), Germany (Karlsruhe Institute of Technology) and Japan (Osaka National Research Institute). Hisresearch encompasses synthesis of organic chromophores and their incorporation into self-assembling systems, and potential uses especially in sensing/switching, catalysis or photodynamic applications.

Carbon Nanowalls: Functionalization and Applications

Mineo Hiramatsu*

1Meijo University, Japan

Abstract:
Carbon nanowalls (CNWs), also called as graphene nanowalls and vertical graphenes, are like porous membrane with distorted honeycomb pattern, and are synthesized by plasma enhanced chemical vapor deposition on heated substrates employing methane and hydrogen mixtures. CNWs and related materials are characterized by self-supported few-layer graphene sheets with open boundaries, standing almost vertically on the substrate. They possess large specific surface area and ample spaces surrounded by vertical graphene sheets. Therefore, CNWs can be used as electrode for capacitors. CNWs can also be used as electrode for electrochemistry, since reported potential window for CNW electrode is nearly 3 V, which is as wide as to that for boron-doped diamond electrode. Moreover, the surface modification of CNWs with metal nanoparticles, metal oxide films/nanoparticles and bio molecules has been conducted to add new features to CNWs as composite catalysts. For example, the surface of CNWs was decorated with ZnO, SnO2 and NiOx by thermal decomposition of aqueous solutions containing metal acetates and nitrates. In addition, glucose oxidase (GOD) was selected as the enzyme, and was immobilized on the surface of CNWs. Then, GOD-immobilized CNWs were used as electrode materials for glucose fuel cell. Electrochemical experiments demonstrate that CNWs can be promising electrode materials for electrochemical sensing, biosensing and energy conversion applications.

Biography:
Prof. Mineo Hiramatsu received Ph.D. from Nagoya University and is a Full Professor of Department of Electrical and Electronic Engineering, Meijo University, Japan. He served as the Director of The Japan Society of Applied Physics. His main fields of research are plasma diagnostics and plasma processing for the synthesis of thin films and nanostructured materials. He is an author of more than 150 scientific papers and patents on plasma processes for materials science. He was awarded the Japan Society of Applied Physics Fellow in 2017.

Invited Talks

Performance Enhancement of Spray-Coated SWCNT Thin Films via Nitric Acid Treatment: A Promising ITO Alternative

Iskandar Yahya*[1], Arulampalam Kunaraj[1], P.Chelvanathan[2], Avinash Kumaresan[1], Ahmad AA Bakar[1], Huda Abdullah[1].

[1] Faculti of Engineering and Built Environment, Universiti Kebangsaan Malaysia, Malaysia; [2]Solar Energy Research Institute (SERI), Universiti Kebangsaan Malaysia, Malaysia.

Abstract:

The exceptional conductivity, flexibility, transparency, and cost-effective fabrication of single-walled carbon nanotubes (SWCNTs) position them as a leading contender for thin-film applications, particularly as transparent conductors in optoelectronic devices. Optimizing SWCNT thin film quality depends on CNT purity, fabrication techniques, and post-treatment processes. This study demonstrates the effectiveness of automated spray coating for controlled SWCNT thin film deposition, followed by nitric acid vapor treatment to significantly enhance optoelectronic properties. Nitric acid treatment not

only removes residual impurities but also introduces functional groups that promote doping and improve charge carrier mobility within the SWCNT network. The resulting SWCNT film achieves an outstanding combination of low sheet resistance (9.8 Ω/square) and high transmittance (60.4% at 800 nm). These results, which rival the performance of many currently used transparent conductors, highlight the potential of spray-coated, acid-treated SWCNT films as a superior and cost-effective alternative to ITO for applications in displays, solar cells, and flexible electronics.

Biography:

Dr. Iskandar Yahya is a Senior Lecturer at Universiti Kebangsaan Malaysia, specializing in Electrical, Electronic, and Systems Engineering. He holds an MEng from The University of Sheffield and a PhD from the University of Surrey, focusing on semiconductor devices, nanoelectronics, and advanced carbon-based devices. His research interests include micro and nanoelectronic devices, carbon-based devices and advanced semiconductor materials. His particular expertise is in the application of carbon nanotubes and graphene in electronic devices, other than the fabrication of sensors and thin films based on advanced materials and nanomaterials.

Nanocellulose: A Sustainable Solution in Health and Agriculture Industries

Nasim Amiralian*[1], Sandya Athukorala[1], Divya Rajah[1]

[1] Australian Institute for Bioengineering and Nanotechnology, The University of Queensland, Brisbane, Australia.

Abstract:

Cellulose represents the most abundant renewable polymer on Earth. Its earliest human use dates back thousands of years, with extensive utility today in products such as paper, cellophane, packaging, textiles, and dietary fibres. During the last decade, there has been a large amount of work surrounding the conversion of a broad range of biomass sources into nanocellulose, which includes cellulose nanocrystals and nanofibres.

Nanocellulose materials form an exciting sub-class of a broader family of polysaccharide-based nanomaterials. Nanocellulose can be derived from plants (e.g. wood, grass, cotton), marine animals (e.g. crustacean shells, tunicates, algae or 'sea squirts'), and bacteria. Nanocellulose boasts desirable mechanical properties such as high specific stiffness and strength, and excellent chemical and thermal stabilities combined with low weight and biodegradability, which make them ideal candidates for a range of different applications. While nanocelluloses derived from various sources share a common molecular backbone, their structure, properties, surface chemistry, cost and practical uses can vary enormously depending upon the plant or animal sources and method of extraction or isolation.

This presentation gives an overview of the fundamental aspects of nanocellulose production and applications in several different industries including nanocomposites, health, and agriculture. Specifically, it demonstrates the nanocellulose application for medical devices, and as an efficient carrier for agrochemical delivery to plants.

Microwave-Based Hydrothermal Synthesis of Hydroxyapatite-Containing Nanomaterials Derived from Crab Shell Wastes

Athanasius P. Bayuseno1, *,Samsul A. Perwira Negara1, Yustina M. Pusparizkita2, Rifky Ismail1, Jamari1

1Department of Mechanical Engineering, Diponegoro University, Semarang Indonesia50275
2Department of Environmental Engineering, Diponegoro University, Semarang, Indonesia50275

Abstract:

Nanotechnology has emerged as one of the most significant scientific frontiers in the last decade. Its wide range of applications and rapidly increasing demand have paved the way for novel approaches to producing higher-quality hydroxyapatite nanomaterials. The need for more ecologically friendly synthesis techniques stems from the pollution that conventional synthesis methods cause. Compared to traditional furnace heating, the microwave synthesis method improves kinetics with a shorter reaction time, making it one of the most effective green synthesis techniques. This low-temperature synthesis with microwave energy can produce highly homogeneous and pure nano-sized hydroxyapatite. The present study synthesized nano-sized hydroxyapatite by recovering calcium resources from crab shell waste. The obtained shells were crushed to a powder with a mesh size of 100 before being calcined at 900 °C for 5 hours. The calcined product was then titrated with microwave-produced diammonium phosphate to grow hydroxyapatite. The microwave method has power levels of 80, 240, and 400 watts and a three-minute hold time. Ideal results using the microwave method of hydroxyapatite synthesis required 240 watts of power and three minutes of synthesis time. XRD, SEM, and FTIR analysis revealed that the crystallite size was 8- 14 nm, with a crystallinity index of 99.5%. Recent studies on reusing marine biogenic waste from crab shells as a powder feedstock have produced promising results in synthesizing hydroxyapatite nanoparticles. Green synthesis can be adopted into large-scale manufacturing and scientific research to mitigate the limitations of conventional synthesis methods. Keywords: Green synthesis; Calcination; Nanomaterials; Crab shells; Hydroxyapatite

Biography:

Athanasius P. Bayuseno is a materials science and engineering professor at Diponegoro University's Mechanical Engineering Department. Research interests include new material synthesis and characterization, and waste processing. He has published over 200 research articles and book chapters in Scopus-indexed international journals and proceedings. He is currently publishing a book chapter titled "Utilization of Biogenic Waste as a Valuable Calcium Resource in the Hydrothermal Synthesis of Calcium-Orthophosphate Nanomaterials" in Green and Sustainable Approaches Using Wastes for the Production of Multifunctional Nanomaterials. Editors: A. K. Bhardwaj, K. Dwivedi, M. Sillanpaa, and A. L. Srivastav. Elsevier. Jan 19, 2024; ISBN: 9780443191831.

Chemical Transformation Synthesis of Nanoparticles for Electrocatalysts in Water Electrolysis

Don-Hyung Ha*

School of Integrative Engineering, Chung-Ang University, South Korea

Abstract:

Chemical transformations of as-synthesized nanoparticles (NPs) are an emerging and powerful method to tailor the composition and morphology of NPs. Nanosynthetic chemistry has centered on creating new NPs using these transformations. However, beyond works employing empirical qualitative

analysis, few works have addressed the underlying atomic mechanisms for these transformations. Works using chemical transformations of NPs for applications are also an under-studied field. This presentation spans from fundamental understandings of the atomic structural evolutions and mechanisms in chemical transformations for NPs, to use of these methods to create and characterize new structures, to the final applied stage of electrochemical energy applications of these chemically transformed materials, such as electrocatalysts for water electrolysis.

Biography:

Dr Don-Hyung Ha is an Associate Professor at the School of Integrative Engineering in ChungAng University. He obtained his MS and PhD from University of Pennsylvania and Cornell University, respectively. He then pursued a post-doctoral fellowship at MIT. His group research interests center on the synthesis of functional nano materials and nanostructured films, especially for the electrocatalyst for water electrolysis.

Spent Bleaching Earth Filled PVDF Hollow Fiber Membranes for Multifunction Application: Preparation and Properties

Muthia Elma1,2,3* and Aulia Rahma[2,3], Rhafiq Abdul Ghani[3], Evia Salma Zaurida[1], Arun Dwi Nugroho[1]

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[2]Environmental Science Doctoral Program, Lambung Mangkurat University, Jl Brigjen H. Hasan Basri, Kayutangi, Banjarmasin 70123, South Kalimantan, Indonesia
[3]Materials and Membranes Research Group (M^2ReG), Jl. A. Yani Km 36, Banjarbaru 70714, Indonesia

Abstract:

Fabrication and characterisation of SBE filled PVDF hollow fiber membranes were explored and investigated in this work. The collected of SBE from crude palm oil (CPO) bleaching process in refinery was regenerated using organic solvent extraction and sintering treatment. SBE filled PVDF dope was prepared by mixed PVDF:TiO_2:SBE:DMAc (dimethylacetamide) with varied wt% ratio of TiO_2:SBE i.e., 0-3%. Then followed by incorporated of SBE as filler via blending mixture method where the inorganic particle was added into PVDF polymer solution. Afterward, SBE filled PVDF dope was casted by dry jet wet technique utilizing spinneret single layer hollow fiber membrane. The SEM (scanning electron microscopy) images of SBE filled PVDF hollow fiber membrane morphologies exhibit have finger-like structures on the outer and inner layers, separated by a sponge-like layer. When SBE was added, the membrane structure changed significantly, and the outer surface became more porous less with smaller and irregular finger-like pores. While porous membrane structure was also contributed by its hydrophobicity. A highly hydrophilic properties result in membrane swelling, reducing the effective pore volume and lowering membrane porosity. Moreover, as the air gap length increases, the pore size of the inner and outer membrane becomes elongated and the membrane thickness decreases. In other hand, SBE filled PVDF membranes perform a good and affordable flux for multifunction application i.e., ultrafiltration of organic industrial wastewater, pervaporation of peat water, and membrane distillation of saline water.

Biography:

Muthia received her PhD from School of Chemical Engineering, the University of Queensland-Australia. She’s currently focusing on Membrane Technology and Derived Silica Membranes for Waste, Water and Wetland Water Treatment to develop her expertise in research and publication. She has secured $1.122 M USD for completing her projects including fabrication many varieties of membrane types and modules performed for many applications, such as wastewater, acid mine drainage, wetland and wetland saline water and other water treatment and gas separation in accordance with her expertise.

The Design of Thermosensitive Nanoliposomal Curcumin

Shazwan A Shukor1,2*, Paul Cressey2, Maya Thanou2

1Agri-Nanotechnology Program, Biotechnology & Nanotechnology Research Centre, MARDI, Malaysia 2 Institute of Pharmaceutical Science, King's College London, United Kingdom

Abstract:

The rhizome of Curcuma longa, majorly consists of curcumin has been broadly used for various medication purposes where severalstudies had remarkably reached clinical trials involving the treatment of multiple myeloma, pancreatic and colorectal cancers. However, issues regarding to poor bioavailability, rapid metabolism and clearance rates distressed the efficiency of curcumin to be delivered to targeted disease sites. Therefore, by designing a thermosensitive nanoliposomal curcumin (TnLC), curcumin can be released from nanoliposomes assisted by an external stimulus such as ultrasound which induces hyperthermia at slightly above physiological temperature. This strategy may avoid pre-mature release of curcumin. The analysis of curcumin was highlighted by exposing curcumin to different pHs and evaluations in ammonium acetate buffer solution (in different pHs i.e pH3, pH7.4 and pH10) were performed by fluorescence spectrometry analysis. TnLC formation was assessed by comparing diameter size and polydispersity index (PDI) values of nanoliposomes using dynamic light scattering (DLS) analyser. The thermosensitive property of TnLC was examined using differential scanning calorimetry (DSC) analyser based on different curcumin concentrations in lipids. The encapsulation efficiency of curcumin in nanoliposomes were also analysed. As a result, curcumin dissolves better in pH10 ammonium acetate buffer solution compared to other pHs. The diameter size and PDI values for each curcumin-loaded nanoliposomes were between 100 to 200nm and below 0.3, respectively which met the study target. The transitional melting (Tm) point for each TnLC was slightly above physiological temperature except for nanoliposmes synthesised with 12.5w/v% of curcumin. The encapsulation efficiency of curcumin in nanoliposomes were almost 100%. In conclusion, TnLC can be synthesised and characterised which could potentially be useful for further applications involving biomedical and therapeutic applications. International Conference on Nanotechnology and Smart Materials July 15-17, 2024 | Bali, Indonesia.

Biography:

Name: Dr Shazwan Abd Shukor Job Title: Research Officer Affiliation: Agri-Nanotechnology Program, Biotechnology & Nanotechnology Research Centre, MARDI, Malaysia Qualifications: BSc Pharmaceutical Sciences (Hons) – University of Strathclyde, United Kingdom MSc Biopharmaceuticals – King's College London, United Kingdom PhD Pharmaceutical Sciences – King's College London, United Kingdom Area of Expertise: Pharmaceutical Nanotechnology, Sonodynamic Therapy, Toxicology, PreClinical Studies.

Cobalt-Based Nanomaterial Electrode Prepared by A Fast Chemical Method

Nuha A. Alhebshi

Department of Physics, College of Science in Yanbu, Taibah University, Yanbu 41912, Saudi Arabia

Abstract:

The demand for nanomaterials is rapidly increasing in most applications, such as energy storage devices. Many nanomaterial synthesis methods are energy-consuming methods requiring high temperatures, prolonged reaction time, complicated steps, or expensive equipment. Herein, nanoflakes of cobalt hydroxide chloride, $Co_2(OH)_3Cl$, have been directly deposited on carbon cloth microfibers by a simple step of chemical bath deposition in only one hour at room temperature. $Co_2(OH)_3Cl$ nanoparticles appear in only 10 minutes of the deposition time, then the nanoflakes are grown in 60 minutes, as imaged by scanning electron microscope. The crystal structure of $Co_2(OH)_3Cl$ is characterized using X-ray diffraction, while the results of energy-dispersive X-ray spectroscopy confirm the elemental analysis. The electrochemical energy storage mechanism of $Co_2(OH)_3Cl$ electrode in potassium hydroxide electrolyte depends on the semi-reversible redox reactions as investigated by the cyclic voltammetry and by the galvanostatic charge-discharge measurements. As a result, the prepared electrode in 60 min exhibits a maximum specific capacitance of 313 F/g versus 293 F/g at 1 A/g for the prepared electrode in 10 min. The good electrochemical performance is attributed to several features, including the nanoflakes morphology that enables electrolyte ions to penetrate the electrode freely, the well-crystallized structure, and the solid electronic path between the current collector and the active material indicated by the Nyquist plot of electrochemical impedance spectroscopy. Our cost-effective synthesis of cobalt hydroxide chloride nanomaterials on woven substrates offers flexible binder-free electrodes in alkaline electrolytes. It can be further developed as a power source in smart textiles and wearable electronics.

Biography:

Prof. Nuha A. Alhebshi is an associate professor of Physics at Taibah University in Saudi Arabia. She has a Ph.D. and M.S. in Materials Science and Engineering. She is interested in developing energy storage devices by optimizing nanomaterials and has publications in many high-impact journals. In addition, she has a U.S. patent in 2022. She won several awards, including the 2nd Prize of Creativity and Technical Innovation for the Young Researchers from the Arab League Educational, Cultural & Scientific Organization (ALECSO), the 2nd Prize in the (IEEE) Scientific Photo Competition, and the Dow Sustainability Innovation Student Challenge Award (SISCA).

Oral Talks

Graphene Oxide-Melamine Nanofilm Composite Membrane for Efficient CO2 Gas Separation

Januar Widakdo[1,3]*, Grandprix Thomryes Marth Kadja[4], Anawati Anawati[1], T.M. Subrahmanya[3], Hannah Faye Mercado Austria[3], Tsung-Han Huang[3], Edi Suharyadi[2], and Wei-Song Hung[3]

[1]Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok 16424, Indonesia; [2]Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Yogyakarta 55281, Indonesia; [3]Advanced Membrane Materials Research Center, Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan; [4]Division of Inorganic and Physical Chemistry, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Jalan Ganesha No. 10, Bandung 40132, Indonesia; [5]Research Center for Nanosciences and Nanotechnology, Institut Teknologi Bandung, Jl. Ganesha No. 10, Bandung 40132, Indonesia.

Abstract:

Technologies that absorb CO_2 are essential for meeting the world's carbon–neutral and carbon-negative goals. When compared to the traditional adsorption/absorption processes, membrane separation is more energy efficient. Graphene oxide (GO) membrane is one such kind of membranes that is anticipated to provide a solution for separating CO_2 gas. The repulsive forces between carboxyl groups on GO nanosheets in GO membranes typically result in excessively high interlayer distance and poor performance for fine molecule separations such as gas separation. The GO interlayer channels can be effectively tuned by adding new binders/crosslinkers to enhance their size-discriminating capabilities. Here, we introduce melamine, a small molecule, for the first time into the GO layer, where it reacts with oxygen-containing groups to enrich the amine functional group, which aims to facilitate CO_2 transport. With a CO_2 permeance of 68.02 Barrer and a CO_2/N_2 ideal selectivity of 37.75, which is double that of pure GO, the produced ultrathin GO-melamine membrane (~0.5 μm) demonstrated good gas separation capability. Throughout the continuous separation tests of mixed gases, the membrane retains its structural and performance stability.

Biography:

Januar Widakdo is a lecturer at Department of Physics, UI, He was a Postdoctoral Researcher at Taiwan Tech He received Ph.D. in Applied Science and Technology in 2021 from the National Taiwan University of Science and Technology, He also received a master’s degree in physics in 2017 from Universitas Gadjah Mada. He has been a researcher in the Advanced Membrane Materials Research Center at the National Taiwan University of Science and Technology since 2018.

Regeneration and Recycling of Spent Bleaching Earth as Tubular Ceramic Support Membrane Preparation: Impact on Properties

Aulia Rahma1,3, Muthia Elma1,3*, Muhammad Roil Bilad2, Isnasyauqiah1, Rahmad Apridho Patria2,3, M Ziqri2,3, and Rhafiq Abdul Ghani3

1Lambung Mangkurat University, Indonesia; 2Universiti Brunei Darussalam, Brunei; 3Materials and Membranes Research Group (M2ReG), Indonesia

Abstract:

We studied the effect of spent bleaching earth (SBE) loading (wt.%) as sub material for preparation of ceramic tubular support membranes. SBE is a solid waste from crude palm oil refining industry that is enriched by silica contain. The ceramic tubular support membrane fabrication was prepared from regenerated and recycling of SBE with various method i.e., treated by steam water, n-Hexane, and acetone as solvent to oil removal of SBE. The SBE ceramic tubular support membranes were casted by centrifugal casting at rotating rate 3000 rpm then followed by sintering it under air condition using programmable furnace (heating rate of 2°C/min). The functionalization properties of raw SBE material after regeneration shows high Si-OH and Si-O-Si peaks. The highest Si-O-Si and Al-OH-Al peak exhibits at SBE regenerated using n-Hexane solvent, meanwhile steam water is the lowest peak. The SBE ceramic tubular support membrane casted by centrifugal casting present smooth and asymmetric structure. On the other hand, all prepared membranes that have the contact angle of hydrophilic properties at <60° which conducted the membrane has potential and is able to be applicated as membrane support for water filtration with pore size distribution of 31-45 nm.

Biography:

Aulia Rahma is a third-year Ph.D. student in Environmental Science at Lambung Mangkurat University. She holds a Master's degree in Chemical Engineering from the same institution. Her current work on inorganic membranes derived from solid waste spent bleaching earth from the agricultural industry. Aulia is part of the Materials and Membranes Research Group (M2ReG) in Banjarbaru, South Kalimantan - Indonesia. Since 2021, she has volunteered as a reviewer for high H-index journals, including the Journal of Water Process Engineering, Journal of Separation and Purification, and Journal of Membrane Science. Her h-index scopus 13 per June 2024.

The Addition of Polyethylene Glycol and Dispersed Submicron PCB-Based Particle as a Novel Heat Treatment Quenchant for Enhancing the Hardness of Medium Carbon S45C Steel

Wahyuaji Narottama Putra[1*], Myrna Ariati[1], Bambang Suharno[1]

[1]Department of Metallurgy & Materials, Faculty of Engineering, Universitas Indonesia, Indonesia

Abstract:

Heat treatment is commonly used by steel manufacturers to enhance the characteristics of steel, especially its strength and hardness. Heating the steel at the austenization temperature and quenching it will form a Martensite phase. However, the cooling rate of the quenching process is crucial. An improper cooling rate would result in low hardness or cracking. Particle addition in the fluid could control the cooling rate of the quenchant. This study synthesized the particles from e-waste, specifically recycled printed circuit boards (PCBs). The PCB-based particles were produced through a series of leaching and pyrolysis processes. Planetary ball milling was utilized to reduce the particle size. The measurement of particle dimension showed that the minimum size of the milled particle was 589.1 nanometers. The PCB-based particle was then added to distilled water with varied concentrations of 0.1%, 0.3%, and 0.5%. Polyethylene Glycol was used to improve the dispersion in different concentrations, i.e., 3%, 5%, and 7%. Thermal conductivity measurement revealed that the thermal conductivity increased to 18% in the fluid with 0.5% particle and 5% PEG surfactant at 0.71 W/mK. All variations of the particle- and surfactant-added fluid were then used as quenchants to rapidly cool an S45C carbon steel. The hardness of the steel increased by 30% at 56 HRC compared to the steel quenched with distilled water. The increased hardness may be because of the faster cooling rate of the quenchant with PCB-based dispersed particles and PEG surfactant.

Biography:

Wahyuaji Narottama Putra, a lecturer in the Department of Metallurgy & Materials Engineering at Universitas Indonesia, has been contributing to the field of Heat Treatment and Surface Engineering, particularly for ferrous-based materials and Microstructure Analysis (Metallography) since 2012. His current research focuses on synthesizing nanoparticles from waste PCB for an advanced quenching medium in the heat treatment process, a topic directly relevant to the present study.

Mesoporous Gold-Based SERS Assay for Detecting Ovarian Cancer-Derived Extracellular Vesicles (Online)

Javeria Bashir*

The University of Queensland, Australia