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ABSTRACT BOOK

# THE 8TH INTERNATIONAL CONFERENCE ON SOLID STATE SCIENCE AND TECHNOLOGY (ICSSST 2021)

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*"Emerging Trends in Solid State Science for Smart Society"*

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# BOOK OF ABSTRACTS

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# VIRTUAL ORAL PRESENTATION

# Low-Pt Catalysts by Laser Processing for PEM Fuel Cell

**Ching-Hsien Lin[1], Szu-yuan Chen[2,3] and Chung-Jen Tseng[1]***

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Pulsed laser deposition (PLD) in Ar atmosphere is used to deposit Pt nanoparticle onto gas diffusion layer (GDL), and its application in PEM fuel cell is optimized and characterized. With a Pt loading of only 17 μg/cm$^2$ at anode and 100 μg/cm$^2$ at cathode, the single cell performance is comparable to that of a cell with commercial E-TEK Pt/C of 200 μg /cm$^2$ Pt loading at anode and 400 μg /cm$^2$ Pt loading at cathode. Using accelerated degradation test, it is found that the PLD sample retains 60 % of its initial electrochemical active surface area (ECSA) after 5000 potential cycles, much higher than that with E-TEK Pt/C, which retains only 7 % of its initial ECSA. Furthermore, a picosecond laser was used to fabricate grooves on the GDL surface to increase the effective surface area for Pt deposition, thereby reducing local Pt film thickness. Both proton diffusion length and gas diffusion length requirements can be reduced. The power density is further increased by using laser micro-machined periodic grooves of 20 μm depth, reaching a 0.6-V power density of 853 mW /cm$^2$ and a maximum power density of 1.2 W /cm$^2$ with a cathode Pt loading of 200 μg /cm$^2$.

**Keywords:** *Low-Pt Catalyst, Pulsed Laser Deposition, PEM Fuel Cell, Laser Micro-machining*

# The Prospect on Renewable Energy Development in Malaysia

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Energy demand in Malaysia is increasing by 7% every year. Based on 2016 data, 86% of the energy supplied is mainly contributed from conventional fossil fuel namely coal and gas, with approximately 13% comes from hydro. The contribution from renewable energy however has been negligible. Apparently, as much of fossil fuel have been utilized, the $CO_2$ emissions for Malaysia has increased from 105,454.3 kt in 1997 to 266,251.5 kt in 2016 growing at an average annual rate of 5.10 %. Hence, to comply with the Kyoto Protocol in reducing the greenhouse gas (GHS) emission, and in consideration of depleting in fossil fuel, Malaysia has strategized the utilization of energy mix to include renewable energy by 20% particularly solar energy as one the main energy contributor by the year 2025. The discussion covers the traditional sources of energy generation including gas, coal and big hydro stations, and also in depth the potential and prospect of solar energy development and utilization in Malaysia.

# Rapid Synthesis of Advanced Functional Materials & Devices by Hyperbaric Laser Chemical Vapour Deposition

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For over 25 years, hyperbaric pressure laser chemical vapor deposition (HP-LCVD) has been studied by various authors as a mean for growing 3-dimensional structures, textiles, and electronic devices [1-2]. Novel normallyimmiscible materials (NIMs) [3], amorphous/glassy ceramics [4], and high-strength fibers have been grown [5]. Our group has found it useful to synthesize materials from high pressure fluids, where the ensuing cooling rates after deposition can exceed 106 K/s. This has enabled the growth of (metastable) amorphous and nanostructured materials, including diamond-like carbon, boron carbides, and silicon carbide [7-8]. However, the highest experimental pressures to date have only reached beyond the critical point of certain alkanes (<60 bar) [6], and there are a wide variety of potential functional materials and solid-state devices that can be grown. In recent work, our group has been able to grow novel and nanocermet materials, including the synthesis of Al- Si-C nanocermet fibers, where aluminum is present within the silicon carbide matrix. In this meeting, we review prior work in fabricating high-aspect-ratio (HAR) microelectronic and MEMS devices and discuss the potential for "3D printing" complex three-dimensional microelectronic sensors, optoelectronic devices, and fiber networks for large-scale integration. We will also discuss the rapid growth of glassy ceramic and nanocermet materials for textiles & composites, and the potential for integrating embedded sensors into "smart textiles."

**Keywords**: laser deposition, laser chamical processing, area selective deposition, hyperbaric laser chemical vapor deposition,

**Acknowledgments**: This work was supported by the La Trobe University Strategic Reserve Fund.

# Biopolymer Scaffolds for the Design of Tunable Adsorbents with Anion Uptake Properties

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The uncontrolled release of nutrients in aquatic environments globally and the resulting effects of eutrophication and excessive algae growth have created a need for sustainable water treatment methods. Biopolymer materials have promising potential as adsorbents for the controlled removal of oxyanion species in water and wastewater due to their molecular tunability and sustainability. This presentation will provide an overview of research progress at the University of Saskatchewan related to the design and characterization of biopolymer platforms as adsorbent materials for uptake of environmentally relevant anions. In particular, case studies of sorbents with high affinity toward oxyanion species are described, where synthetic modification of biopolymers in a modular fashion (surface functionalization, cross-linking, and composite formation) reveal enhanced physicochemical properties related to adsorption and responsive behaviour to external stimuli [1,2]. Selected examples of molecular materials that show reversible adsorption–desorption processes and high efficiency of oxyanion removal are highlighted. This research contributes to the development of advanced biosorbent materials for controlled removal of oxyanion waterborne species for sustainable water treatment processes [3-5].

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# PAPER ID: 120

Invited Speaker: Assoc. Prof. Dr. Abdul Mutalib Md Jani

## Spatially Controlled the Growth of Gold Decorated Carbon Nanotubes on a Porous Membrane and Its Unique Catalytic Activity

**Farah Wahida Ahmad Zulikifli[1], Hanani Yazid[2], and Abdul Mutalib Md Jani[3]***

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The potential applications of carbon nanotubes (CNTs) functionalized with various inorganic nanoparticles such as metal or metal oxides have further improved their properties and applications. Here, we highlight a new and facile approach to spatially control the growth of gold decorated carbon nanotubes grafted on porous materials. The use of porous supports has been of particular interest because the combination of two or more active components on a porous membrane with a uniform distribution is expected to be beneficial for various applications of porous-based composite materials. In this work, porous alumina was first fabricated by electrochemical anodization method, modified with silane moiety and coated with CNTs by spin-coating approach. To provide a surface that is suitable for the growth of gold nanoparticle, different compositions of CNTs were obtained by adjusting the concentration of CNTs in the slurry prior to the spin-coating process. Subsequently, the CNTs composite membrane was dried and immersed in a gold solution for 2 hours. The gold-CNTs-porous alumina assemblies were tested for catalytic performance in the reduction of p-nitrophenol (p-NP) to p-aminophenol (p-AP). The developed catalytic system exhibited superior catalytic activity, with a reaction rate (k) of 1.2 x 10-3 s-1, higher than those of previously reported work. Additionally, the gold-CNTs prepared with porous membranes spanning of different porosities showed that the catalytic activity increased as the pore diameter increased from 40 to 100 nm. It was also observed by FESEM that the pores of the porous membrane remained unclogged after CNTs coating. The porous structure is beneficial for reducing restacking-induced surface area loss because the CNTs are in powder form. These nanocomposites assemblies can potentially serve as a platform for various catalytic activities.

**Keywords:** *Gold nanoparticles, carbon nanotubes, porous support, catalytic activity*

Invited Speaker: Prof. Dr. Zainal Abidin Talib

# Investigation on the Formation of Lead-free Cesium Bismuth Bromide Perovskite

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This study examines the effect of the precursor stoichiometry ratio on the formation of $Cs_3Bi_2Br_9$ via a re-precipitation synthesis method. X-ray diffraction analysis showed that the precursor stoichiometry ratio was critical for the $Cs_3Bi_2Br_9$ phase formation. The CsBr-rich or $BiBr_3$-rich precursor resulted in impurities formation. Unreacted $BiBr_3$ precursor remains in supernatant solution under $BiBr_3$-rich condition. The degradation of powder sample in toluene was found decreased as the $BiBr_3$ concentration increased. The PL characteristics of the sample powder and supernatant solution were discovered to differ in terms of peak location and intensity, as the precursor stoichiometry ratio is crucial in controlling them. The outcome of this work proposes a precursor ratio $CsBr/BiBr_3$ of 1.2 to 2.0, for the successful formation of $Cs_3Bi_2Br_9$.

# PAPER ID: 147

Invited Speaker: Prof. Dr. Huda Abdullah

## $Zn_{1-x}Sn_xO$ (Zinc-Tin-Oxide) as an Alternative CZTS Solar Cell Buffer Layer

**Huda Abdullah[1] *, Kang Jian Xian [1], Md. Akhtaruzzaman[2], Iskandar Yahya[2], Mohd Hafiz Dzarfan Othman[3], Brian Yulianto[4]**

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Copper Zinc Tin Sulfide thin-film solar cells also called as CZTS solar cell has interesting structure characteristic that can be improved. This has caught our attention and it is now part of our research. In our study, we focus the problem on the Cadmium Sulfide (CdS) buffer layer of the CZTS solar cell. Cadmium sulfide is a widely used buffer material in thin-film solar cells, which has significant advantages over other alternate buffer materials in terms of efficiency and low cost of production for large-area processing of thin films. However, the toxicity associated with the use of cadmium is a big issue. Therefore, an idea of using Zinc Tin Oxide (ZTO) instead of Cadmium sulfide emerge. In our research, we planned to fabricate a complete thin-film CZTS solar cell by incorporating ZTO as a buffer layer and analyze its performance. To realize high power conversion efficiency, we identify and optimize the compositional ratio of ZTO for the buffer layer in CZTS solar cell by numerical simulation. We successfully synthesize $Zn_{1-x}Sn_xO$ (ZTO) thin film deposited by spin-coating, with various of concentration of Zn and Sn (x= 0.1, 0.143, 0.167. 0.2, 0.333). The annealing temperature for thin film is between 350°C and 500°C. XRD and XPS are used to identify the element content. FESEM and AFM are used to identify the physical structure. UV-VIS is used found out the bandgap value. Electrical properties analyze by using Electrochemical Impedance Spectroscopy (EIS). The solar cell fabricated by ZTO buffer layer predicting exhibited the power conversion efficiency of between 0.25% to 2.00%. In conclusion, our research grows the technology of CZTS thin-film solar cells and making a great impact in solving energy problems for Malaysia and the world.

**Keywords**: *Copper Zinc Tin Sulfide, thin film, ZTO, Solar Cell.*

# PAPER ID: 148

Invited Speaker: Assoc. Prof. Dr. Mohammad Hafizuddin Hj. Jumali

## Development of High-Performance Piezoelectric Nanogenerator based on $BaTiO_3$/PVDF Nanocomposite Fibers

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Performance of piezoelectric nanogenerators (PNGs) as energy harvester from naturally occurred vibrations depends on the piezoelectric charge coefficient ($d_{33}$) of its active material. Due to lower $d_{33}$, polymer based PNGs such as poly(vinylidene fluorides) (PVDF) always exhibit inferior performance compare to its ceramics counterpart. This is because the $d_{33}$ in PVDF not only depends on the content of piezoactive b-phase but also on its monomer arrangement. The main motivation of this work is to improve the overall performance of PVDF based PNGs using a simple and safe technique. This work was divided into 2 parts. The first part was the production of PVDF fibers using homemade fast-centrifugal spinning technique. The primary focus was on the optimization of two production parameters namely the ratio between the solvents and the spinning speed. The second part specifically explored the potential of $BaTiO_3$/PVDF nanocomposite fibers as active material for PNG. Besides improving the b-phase content, the first part of this work successfully demonstrated the self-polarization characteristics of the fibers. The second part of this work confirmed that the performance of nanocomposite PNGs is positively dependent on the content of $BaTiO_3$ nanoparticles. The highest PNG performance was recorded with nanocomposite fibers containing 50 wt% of $BaTiO_3$ nanoparticles. This PNG produced $V_{OC}$, $I_{SC}$ and power density of 160 V, 16 mA and 980.2 $mW.cm^{-2}$ respectively. More importantly, the fabricated PNG also exhibited long term stability and durability when tested up to 50,000 compression cycles. Practical application of the PNG was demonstrated when 7 LEDs were successfully lit up directly from the device and while 32 LEDs were effectively lit-up after collecting and storing the harvested energy in the 10 mF capacitor.

**Keywords:** *piezoelectric nanogenerator; fast-centrifugal spinning; β-PVDF; self-polarization*

Invited Speaker: Dr. Jeyashelly Andas

# Turning Waste Chicken Bones into Heterogeneous Catalyst for Biodiesel Synthesis from Waste Cooking Oil

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Depletion of non-renewable energy sources such as petroleum had triggered researchers to design green catalyst for the synthesis of biodiesel. Thus, joining this effort, in this work, chicken bones were subjected to calcination-hydration-dehydration treatment to obtain catalyst off high activity for the production of biodiesel from waste cooking oil (WCO). The physicochemical properties of the synthesized catalysts were studied by Fourier Transform Infrared Spectroscopy (FT-IR) and $N_2$ adsorption-desorption analysis. The catalyst obtained from calcination-hydration-dehydration treatment (C900-600) exhibited improved BET surface area and BJH pore diameter of 71.14 $m^2g^{-1}$ and 31.03 nm, respectively in comparison to chicken bone derived catalyst calcined at 600˚C (C900) and commercial CaO catalyst with 31.72 $m^2g^{-1}$, 29.35 nm and 2.21 $m^2g^{-1}$, 15.98 nm, respectively. The activity of 5 wt.% catalysts in the transesterification of WCO with 1:15 oil to methanol ratio at 65 °C increased as the following trend: C900-600 (92.15%) > C900 (80.63%) > commercial CaO (73.30 %). Gas Chromathography-Mass Spectrometry (GC-MS) analysis verified the presence of three major constituents; dodecanoic acid methyl ester, 10-Octadecadienoic acid methyl ester and docosanoic acid methyl ester. Acid value (AV) of the biodiesel determined by ASTM D-6751 and EN 14214 biodiesel standards confirmed the AV over C900-600 and C900 were 0.15 and 0.37 mg KOH/g, respectively, indicating a high-quality product. C900-600 was truly a stable and reused catalyst, sustaining its activity of 84.22 % even after five consecutive cycles. This research undoubtedly promises a cheap utilization of waste chicken bones as green catalyst for the conversion of WCO into renewable energy sources.

**Keywords:** *Waste Chicken Bones, Biodiesel, Waste Cooking Oil, Acid Value, Reusability*

# PAPER ID: 144

Invited Speaker: Assoc. Prof. Ts. Dr. Mohd Hafiz Dzarfan Othman

## Inexpensive Ceramic Membranes Derived from Alternative Materials for Water & Wastewater Treatment

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Today, access to clean, safe and secure water is one of the grand challenges facing the world. Membrane technology is one of the most important and widely recognized technologies for desalination and wastewater treatment. While polymeric membranes are known to show drawbacks such as low thermal and chemical resistivity, the development of cost effective ceramic membranes from natural ceramic material (clays, waste agricultural ashes and waste animal bones) have grown inexorably to solve some of the underlying issues. As a matter of fact, these ceramic membranes exhibited precious properties such as superhydrophilicity, excellent flux and high thermal stability. In this work, a variety of cost effective ceramic hollow fibre membranes were successfully prepared from a number of alternative materials such as silica sand, bauxite, kaolin dan ball clay via a combination of phase inversion and sintering technique. Prior to the extrusion based process phase inversion technique, the ceramic suspension for each ceramic membranes were prepared through ball milling process consisting of ceramic powder as the main material, polyethersulfone (PESf) as polymer binder, N-methyl 2 -pyrrolidone (NMP) as solvent and Arlacel P135 as dispersant. The dope suspensions were then extruded into coagulant bath, dried and sintered. Subsequently, the membrane characterizations were measured in term of its morphologies, mechanical strengths, porosities and pore size distributions. On the other hand, the performances of each membrane were conducted based upon their ability and properties towards different water treatment applications. The special features of each ceramic material showed capabilities of separating and adsorbing the targeted interested species presented in the water and act as adsorptive ceramic membrane, for the first time. Interestingly, some of the cost effective ceramic membranes were successfully modified into hydrophobic ceramic membranes through simple grafting process for energy-efficient membrane distillation application. It is worth mentioning that both hydrophilic and hydrophobic membranes have excellent thermal and chemical resistance. This study may provide insightful information towards researcher in alternative ceramic membrane for water and wastewater treatment application.

# PAPER ID: 164

Invited Speaker: Asst. Prof. Dr. Nabil Hayeemasae

## Insight into Relationship between Mechanical Strength and Strain-induced Crystallization of Natural Rubber/Halloysite Nanotubes Composites

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The correlation between the mechanical strength and the crystallization behavior of natural rubber (NR)/halloysite nanotubes (HNT) composites is discussed. The tensile strength of NR is improved with the addition of HNT. This improvement is attributed to the unique structure of HNT, which facilitates good dispersion and strong interfacial interaction. HNT also play an important role in assisting the strain-induced crystallization of NR. Crystallization under strain is observed using synchrotron wide-angle X-ray scattering. The stress–strain curves and the corresponding degree of crystallinity after straining provide further evidence. The crystallization after stretching of this composite can be further increased by improving the compatibility between NR and HNT. Therefore, compatibilizer is a material of choice to incorporate in such compound. In this study, bio-based compatibilizer was also discussed which was prepared by modification of palm stearin. The presence of special functionalities of modified palm stearin (MPS) was confirmed by Fourier transform infrared (FTIR) analysis. It was then varied from 0.5 phr to 2.5 phr to the NR matrix. It was found that the addition of MPS significantly enhanced the modulus, tensile strength, and tear strength of the composites. This clearly corresponded to interaction between NR and HNT promoted by MPS. The X-ray diffraction patterns and scanning electron microscopy images were also utilized to verify the behavior of MPS in the NR/HNT composites. As for the crystallization of the composites, the results obtained from stress–strain curves are in very good agreement to the outputs observed by the synchrotron wide-angle X-ray scattering. This corresponding interaction of MPS has greatly influenced on assisting the strain-induced crystallization of composites.

# PAPER ID: 36

Invited Speaker: Assoc. Prof. Dr. Noor Baa'yah Ibrahim

## Pure polycrystalline barium hexaferrite film prepared without buffer layer, using a sol-gel method

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Pure polycrystalline barium hexaferrite films have been successfully prepared using a sol-gel method without a buffer layer to prevent inter diffusion between substrate and films. The films were annealed at temperature range of 700 to 900 $^{o}$C in air and oxygen surroundings for 2 hours. An X-ray diffraction analysis showed that films annealed in air at 800$^{o}$C and 900$^{o}$C, were crystallized into a single phase of barium hexaferrite. However, the film which annealed in oxygen at 900$^{o}$C showed a non-magnetic phase of $BaFeSi_4O_{10}$. The magnetic properties analysis showed films annealed in air surroundings at 800$^{o}$C and 900$^{o}$C have big coercivity values (5208 Oe and 5067 Oe, respectively) and high saturation magnetization (210 emu/cm$^3$, 286 emu/cm$^3$, respectively). However, films which were annealed at 800$^{o}$C and 900$^{o}$C in oxygen surroundings showed high coercivity (949 Oe and 5600 Oe, respectively) but low magnetic saturation magnetization values (80 emu/cm$^3$ and 63 emu/cm$^3$, respectively). The low magnetic saturation in the film might be attributed to the non-magnetic phase of $BaFeSi_4O_{10}$ which exist due to the inter diffusion of Si from quartz substrates into the films.

**Keywords:** *Annealing, Magnetization, Coercivity, Oxygen, Air*

# PAPER ID: 116

Invited Speaker: Assoc. Prof. Dr. Chen Soo Kien

## Critical Current Density of Sintered Ex-situ $MgB_2$ Superconductor

**Nurhidayah Mohd Hapipi[1], Soo Kien Chen[1,2*], Abdul Halim Shaari[1,2], Mohd Mustafa Awang Kechik[1], Kean Pah Lim[1], Kar Ban Tan[3], Oon Jew Lee[4], Sai Srikanth Arvapalli[5] and Muralidhar Miryala[5]**

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In this study, commercial prereacted $MgB_2$ powder was used to serve as *ex-situ* $MgB_2$. Sintering of the samples was carried in a temperature range of 600 °C – 1000 °C for 1 - 3 h. Another set of samples was prepared by adding the *ex-situ* $MgB_2$ with 0.5 mol of Mg powder. The samples were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM). Magnetic properties of the samples were also measured in order to determine their critical transition temperature ($T_c$) and critical current density ($J_c$). $MgB_2$ phase decreased as the sintering temperature was increased due to formation of higher fraction of MgO and $MgB_4$. However, addition of Mg increased the partial pressure of Mg and thus suppressed decomposition of $MgB_2$ during the sintering. All of the samples had randomly oriented grains with irregular shape as shown by the SEM images. Onset of $T_c$ was remained relatively unchanged at around 38 K. It was found that $J_c$ increased with the sintering temperature and sintering time. Increment of $J_c$ was even greater for the Mg added samples. The enhancement of $J_c$ is attributed mainly due to the improved grain connectivity.

**Keywords:** *Superconductivity, Ex-situ $MgB_2$, Mg addition, Critical temperature, Critical current density*

# PAPER ID: 152

Invited Speaker: Dr. Wan Izhan Nawawi Wan Ismail

## Immobilized $TiO_2$/PEG by Double Sided Adhesive Tape (DSAT) for Photocatalytic Decolorization of Methylene Blue

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Methylene blue (MB) is an example of dye pollutants that are difficult to degrade by chemical or biological methods in water. A photocatalysis mediated by $TiO_2$ have been considered as an interesting subject to degrade these toxic substances. Thus, studies on the development of $TiO_2$ photocatalyst have been conducted through various tests in suspension and immobilization methods. While this is the case, suspended $TiO_2$ particles increases running cost and difficult to apply. Alternatively, to solve this problem, immobilization technique of $TiO_2$-polymer has become a focus for industrial application. This research is conducted to modify the immobilized $TiO_2$ using DSAT to improve its adhesiveness between the film-glass contacts as well as to characterize the properties of the films. Immobilized $TiO_2$/PEG films have been prepared via brush coating method from Degussa P-25 titania combined with polyethylene glycol for such purposes, a process known as photocatalytic oxidation. The films were deposited on double sided adhesive tape (DSAT)-taped glass which act as a thin layer binder and annealed by a thermal treatment at 100 ºC. Based on a pseudo first order kinetics, the study showed that the films resulted in 1.8 time's higher photodegradation rate than $TiO_2$ slurry. The resulted immobilized photocatalyst film turned out smooth, crack-free and porous due to the effect of brush coating with sufficient amount of $TiO_2$ to PEG 6000 polymer ratio. The potentiality of porosity (i.e. larger mesopores) as exhibited by the XRD, SEM and BET analysis accounts for numerous active sites that are often associated with high photodegradation rates. The photocatalytic activity performance of immobilized $TiO_2$/PEG DSAT is the highest at 75 mL $min^{-1}$ aeration rate and pH 11 of MB dye. Moreover, the FT-IR, XPS and PL spectra proved that the existence of C=O in $TiO_2$/PEG films has led to a significant photoresponse under normal light and visible light irradiation. The C=O bond can act as an electron injector that initiated the formation of hydroxyl radical thus eventually degraded the MB dye pollutant. Through the application of DSAT, it was found that the films turned out reusable up to 30 cycles and achieved zero contaminations through the COD analysis.

**Keywords:** *Pgotocatalysis, immobilization, PEG, decolorization*

# PAPER ID: 131

Invited Speaker: Prof. Dr. Md. Rahim Sahar

## Cullet Titanium Nitrate Glass Ceramics

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Recycle glass as a major component in ceramic fabrication has received a tremendous attention due to multi advantages as a starting material. Series of glass ceramics based on recycle glass cullet-kaolin clay containing titanium nitride has successfully been made. The X-ray diffraction technique has been used to characterised the ceramic while their elemental concentration has been determined using Energy Dispersive Analysis of X-ray (EDAX). Meanwhile, the physical properties such as density has been determined using the Archimedes Principle and their mechanical characteristic such as Vickers hardness and Young's Modulus have been determined in a usual manner. It is found that the ceramic is characterised by the occurrence of major crystalline peaks of Quartz and Tridymite while alumina and titania coexist as the minor phases. The density is observed to varies depending upon the cullet content while the hardness and elasticity is very much depending on the concentration of titanium nitrate.

# PAPER ID: 153

Invited Speaker: Dr. Nur Nasulhah Kasim

# Effect of Sequential Pre-treatment on the Thermal Behaviour of Pretreated Palm Empty Fruit Bunch using Thermal Gravimetric Analyzer

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Bio-oil produced from untreated biomass through pyrolysis process consists of undesirable oxygenated chemical compounds that contribute to the low quality of products. Utilizing sequential pre-treatment of demineralization and torrefaction on biomass prior to pyrolysis has showed to be promising in enhancing the solid fuel feedstock properties. In this study, the thermal behaviour profile of torrefied palm empty fruit bunch (TPEFB) and torrefied-demineralized palm empty fruit bunch (TDPEFB) were compared with that of the untreated palm empty fruit bunch (PEFB) using thermogravimetric analyzer (TGA). The aim of this study is to further investigate the suitable biomass feedstock for pyrolysis process by monitoring the thermal degradation behaviours of different pretreated PEFB prior to pyrolysis process. Thermal analyses of all samples were performed using a Mettler Toledo TGA at a heating rate of 20 °C·min$^{-1}$ with nitrogen flow of 100 mL·min$^{-1}$ from ambient temperature to 900 °C. The thermogravimetric analysis displayed that the TDPEFB has experienced major weight loss of 61.53% at its active degradation temperature. Meanwhile, TPEFB shows a lower amount of weight loss compared to TDPEFB since the presence of alkali and alkaline earth metal (AAEM) in TPEFB which inhibits the primary reaction, thus leads to the retention of mass in the biochar fraction. In comparison, percent weight loss for untreated PEFB was recorded to be the lowest among the three samples which is about 33.9% during the active pyrolysis process. The results support the argument that the demineralization process has assisted primary reactions by the removal of AAEM. This in turns contribute to higher weight loss of sample as more volatile matters and cellulose content could be released during thermal degradation of the TDPEFB. Subsequently, the quality and quantity of bio-oil produced could be enhanced. This sequential pre-treatment was suggested to be an effective approach for upgrading the quality of solid fuel feedstock for further thermal conversion processes such as pyrolysis.

***Keywords:*** *Thermal degradation; Palm Empty Fruit Bunch; Torrefaction; Demineralization; Pre-treatment.*

# PAPER ID: 159

Invited Speaker: Prof. Dr. Abdul Halim Shaari

## Effect of Indium and Yttrium substitution in Bismuth Ferrite Ceramics

**Abdul Halim Shaari[1*], Rahimah Mustapa Zahari[1], Ammar Abd Ali Najm[1], Hussein Baqiah[2], Zulkifly Abbas[1], Ismayadi Ismail[1], Chen Soo Kien[1], Lim Kean Pah[1] and Mohd Mustafa Awang Kechik[1]**

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$BiFeO_3$ or BFO, is a multiferroic material that specifically possesses a simultaneous coexistence of antiferromagnetic and ferroelectric ordering at the room temperature. Indium substituted $BiFe_{1-x}In_xO_3$ ($x$ = 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6) ceramics and Yttrium substituted $BiFe_{1-x}Y_xO_3$ ($x$ = 0.0, 0.1, 0.2, 0.3, 0.4, and 0.5) ceramics were synthesized by solid state method and modified thermal treatment method respectively.The samples' microstructure, dielectric, electrical and magnetic properties were investigated by X-rays diffractions (XRD), scanning electron microscopy (SEM), dielectric analyser, electrometer and vibrating sample magnetometer (VSM). From XRD, pristine BFO sample exhibited single phase rhombohedral crystal structure, space group R3c 161. Introduction of $In^{+3}$ into BFO matrix promoted the growth of $BiInO_3$ and $Bi_{25}FeO_{40}$ phases. However, BFO remained the dominant phase up to $x$ = 0.4. XRD analysis of $Y^{+3}$ substituted samples indicated that the phase transformation has occurred from rhombohedral R3c ($x$ = 0.0–0.1) to orthorhombic Pnma ($x$ = 0.2–0.4), and to cubic Fm-3 m ($x$ = 0.5). The secondary phases belonged to the $Bi_{25}FeO_{40}$, $Bi_2Fe_4O_9$, $YFeO_3$, $Bi_{0.75}Y_{0.25}O_{1.5}$, $Y_3Fe_5O_{12}$, From SEM results, BFO exhibited large homogeneous grain morphology with average grain size 2.04 µm, which get distorted, decreased with introduction of $In^{+3}$. With the increase of Y-concentrations, the average grain size was decreased from 354 to 90 nm. From VSM analysis, pure BFO showed antiferromagnetic behaviour while weak ferromagnetic was observed with $In^{+3}$ substitution. The highest magnetisation 0.04 emu/g and magnetic remanence $6.22 \times 10^{-4}$ emu/g were recorded for sample $x$ = 0.3. The magnetic analysis indicates the saturation magnetization, $M_s$ and remnant magnetization, $M_r$ at $x$ = 0.2 was enhanced about 3.95 emu/g and 1.21 emu/g respectively. Dielectric measurement of $In^{+3}$ substituted sample showed increasing of dielectric constant $\varepsilon'_r$ from 26.5 for pure BFO to 372 for sample $x$ = 0.6. The leakage current density was reduced with $x$ from $9.24 \times 10^{-4}$ A/cm$^2$ for pure BFO to $9.8 \times 10^{-7}$ for sample $x$ = 0.6. A/cm$^2$. Impedance spectroscopy and dielectric modulus were used to further understand the dielectric behaviour of the samples and the relevant results were analysed and discussed in detail.

**Keywords:** *Thermal-treatment method, Bismuth ferrite, Multiferroic*

# PAPER ID: 139

Invited Speaker: Assoc. Prof. Dr. Mohd Mustafa Awang Kechik

## Improvement of Flux Pinning of $YBa_2Cu_3O_{7-\delta}$ Films by Gd2411 Nano Inclusions

**M. M. Awang Kechik[1]*, P. Mikheenko[2], J.S. Abell[2], I. A. Crisan[2], P. Paturi[3], H. Huhtinen[3], S.K. Chen[1], S.A. Halim[1] and K.P. Lim[1]**

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In order to improve the performance of $YBa_2Cu_3O_{7-x}$ films, enhancement of critical current density ($J_c$) and flux pinning force in this system is crucial. Incorporation of nano-inclusion particles is proven to be an alternative economic approach to enhance $J_c$ for Y123 films. the $YBa_2Cu_3O_{7-x}$ / $Gd_2Ba_4CuWO_{12}$ films grown on STO single crystal substrates revealed an enhancement in the critical current density at temperatures exceeding 50 K compared to pure YBCO films. This enhancement of $J_c$ in high fields is due to the artificial pinning centres induced by the $Gd_2Ba_4CuWO_{12}$ nano-inclusions. However, as the film thickness increases above 1 $\mu$m, a significant reduction of $J_c$ was observed in all Gd2411 films which become even lower than the $J_c$ of the 0.96 $\mu$m-thick pure YBCO film. The position of the peak in pinning force $F_p$ dependence on the reduced field is at $b$ = 0.2 for the thinner film (0.78 $\mu$m and 0.96 $\mu$m), meaning that the normal surface pinning centre is dominant. The results of pinning force scaling in the Dew-Hughes model for the thicker films (1.29 $\mu$m to 2.65 $\mu$m) show that point pinning is the dominant pinning mechanism.

**Keywords**: *Flux pinning, YBCO, films, Gd2411*

# PAPER ID: 151

Invited Speaker: Prof. Dr. Suhairul Hashim

## Thermoluminescence Properties of Pure Gold Nanoparticles Embedded $BaSO_4$-$TeO_2$-$B_2O_3$ Glasses co-doped with Rare Earth Ions as a solid TL Detector

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Ionizing radiation exposure from both the natural and artificial sources is almost unavoidable. Thus, the use of radiation dosimetry to avoid adverse effects is inevitable. The most widely used radiation dosimeter is the thermoluminescence (TL) dosimeters. TL is a kind of luminescence that is displayed by certain materials when previously absorbed electromagnetic energy or ionizing radiation is re-emitted as light upon heating. The key issue in achieving an accurate dosimeter is improving the luminescence characteristics of rare earth doped borate glasses. The TL properties of any material are heavily influenced by the lattice defects. Thus, determining the kinetic parameters is crucial in understanding the overall TL process. Herein, the kinetic parameters of pure gold embedded Barium-Sulfur-Telluro-Borate glass co-doped with samarium/Dysprosium were evaluated using the peak shape, initial rise, whole glow curve, and computerized glow curve deconvolution methods, respectively. The co-doped and AuNPs embedded glasses exhibited TL response exhibiting a simple second-order glow curve with maximum intensity ($I_m$) at 272°C. The appearance of $I_m$ at high-temperature region indicated that the glass was resistant to fading effect. The activation energies of the optimum glass obtained using the peak shape, initial rise, whole glow curve and computerized glow curve deconvolution methods were 1.021, 1.50, 1.537, and 1.369 eV, respectively. In conclusion, the synthesized glass samples were found to be suitable for TL applications due to the simple TL glow curve. These attractive features will pave the way to its use in radiation dosimetry.

**Keywords:** *Ionizing Radiation, Thermoluminescence process, Kinetic Parameters, Borate glasses, Rare Earth Ions, Glow Curve*

# PAPER ID: 158

Invited Speaker: Dr. Mohd Fairul Sharin Abdul Razak

## The Study of the Modification Dye Sensitized Solar Cell using Biopolymer and Conducting Polymer as Modifiers

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The dye-sensitized solar cell (DSSC) has been investigated during the last three decades. Nevertheless, there are still many aspects to be explored to further improve their performance. The modifications of DSSC are been made based on these four components; photoanode, dye, electrolyte and counter electrode. The purpose of these modifications are to produce high efficiency of DSCC with superior long-term chemical stability during conversion of any artificial light or sun light into electrical energy. In this study, biopolymer and selected conducting polymer will be used as modifiers in the DSSC system. With these modifications make DSSC technology more competitive in term of device efficiency and stability, as well as further reduce the material and manufacturing costs.

# PAPER ID: 143

Invited Speaker: Dr. Wan Yusmawati Wan Yusoff

## Influence of Gamma Radiation Exposure Towards Hardness, Intermetallic Compound and the Area of Eutectic Phase of Lead-Free Solder

**Wan Yusmawati Wan Yusoff[1*], Nur Farisa Nadia Mohmad Lehan[1], Ku Zarina Ku Ahmad[2], Mohamad Faizal Abdullah[2], Azuraida Amat[1], Azman Jalar[3], Norliza Ismail[4] and Irman Abdul Rahman[4]**

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The usage of electronic devices today becomes crucial in our everyday life and employed in variety of applications commonly in consumer or household products. In this study, the mechanical and microstructure properties of SAC305 solder radiated with gamma radiation were characterized. The solder paste was deposited on the printed circuit board manually using a technique called stencil printing. It was then undergone reflow soldering process at 260˚C and then exposed to variance of dose gamma radiation (10,20, 30, 40 and 50 Gy). To observe the cross-section of interface between solder and substrate, the samples were subjected to a metallographic procedure prior the indentation test. The hardness value, intermetallic compound (IMC) thickness, and eutectic phase area after irradiation were observed via nanoindentation test and optical microscope. It was found that the hardness of the solder decreases as radiation dose increases due to the structural and atomic rearrangements of the SAC305 solder alloy. In addition, exposure to gamma radiation alter the microstructure of solder resulting an increased in the thickness of IMC between the solder and the copper substrate. Lastly, the exposure to various dose of gamma affects the phase distribution of eutectic in the SAC305 solder. The eutectic phase area showed a similar trend to the value of hardness obtained.

# PAPER ID: 150

Invited Speaker: Prof. Dr. Azman Jalar

## Microstructural Stability of Intermetallic Compound Layer of Metallurgical Interconnection in Semiconductor Packaging

**Azman Jalar**

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Wire bonding and soldering are considered the most important characteristic for electronics or semiconductor packaging. During wire bonding and soldering process, intermetallic compound layer (IMC) normally formed due to metallurgical reaction. This IMC plays important role in determining the reliability of the joints/interconnection. However, this IMC is not thermodynamically stable leading to reliability issues of electronics devices. Device miniaturisation has made IMC issue become critical and become major failure factor of the devices. This paper review fundamental aspects of the IMC and its microstructural instability with regard of materials aspect, thermal properties and miniaturisation effect. Common investigation on the microstructural instability and reliability of the joint also commented with regards to thermally activated process. Failures in term of crack formation and propagation will be highlighted. This subject of interest has shed some insight on the relationship between microstructure – properties – performance relationship for further developing robust and reliable metallurgical interconnection and joining especially beyond submicron technology.

# PAPER ID: 125

Invited Speaker: Assoc. Prof. Dr. Iskandar Shahrim Mustafa

## Optical Characterization of $Na_2O$-ZnO-$B_2O_3$-$SiO_2$ Glass System using Various $SiO_2$ Sources

**Iskandar Shahrim Mustafa[1, *], Azhar Abdul Rahman[1], Nuridayanti Che Khalib[1], Thair Hussein Khazaalah[1], Hanisha Mohd Shariff[1] and Muhammad Fadhirul Izwan Abdul Malik[2]**

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A series of quaternary sodium-zinc-borosilicate glasses were successfully fabricated using the melt-quenching technique. The amorphous nature of the glasses was validated from a broad hump at the lower Bragg angle between 20° to 40° in the XRD results. The density of the prepared glass samples with the various sources of silica dioxide ($SiO_2$) from commercial chemicals, rice husk ash (RHA) and recycled glass was determined as 3.43 g/cm$^3$, 3.52 g/cm$^3$ and 3.64 g/cm$^3$ respectively. UV-Vis spectroscopy was performed to obtain the absorption spectrum used in the calculation of the optical band gap, the Urbach energy and the refractive indices. The various pattern in the values of the optical band gap (3.45 eV to 3.02 eV) for indirect and the band tail (0.60 eV to 0.31 eV) is associated with structural changes in the glass samples based on a different source of network former. Further evaluation is confirmed with the bonding analysis using Fourier Transform Infrared (FTIR) spectroscopy results. Based on current studies, it shows that the glass with $SiO_2$ from RHA having similar characteristics as the commercial chemical $SiO_2$.

**Keywords**: *Material science, glass, borosilicate, optical band-gap, refractive indices.*

# PAPER ID: 154

Invited Speaker: Dr. Zuliahani Ahmad

## Improved Mechanical and Corrosive Properties of Unsaturated Polyester-Graphene Treated with Silane Coupling Agent

**Hasniraaiman Abdul Hamid[1], Zuliahani Ahmad*[1,2], Siti Nor Din[1], Mohd Azlan Mohd Ishak[1], Rozyanty Rahman[2] and Sharifah Nafisah Syed Ismail[2]**

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The optimization studies of unsaturated Polyester filled graphene with silane coupling agents was successfully conducted by using different mixing techniques (ultrasonication and mechanical stirring) and different mixing times at 30, 60, and 90 minutes. Both mixing method shown the optimum anti-corrosive and mechanical properties at 60 minutes mixing times. The optimum corrosion rate for ultrasonication method is 0.375 mmpy whilst for mechanical stirring method is 0.536 mmpy. Similar trend was found pencil hardness at 5H and 0% of coating being detached from the substrate for cross-cut adhesion strength. The optimum pull-off adhesion strength has been observed for ultrasonication method and mechanical stirring method at 3.78 MPa and 3.58 MPa respectively at 60 minutes mixing time via ultrasonication method. This is due to ultrasonication method produced more uniform dispersion of GR as a good vibration energy dissipation to enable a better disentanglement of GR. The enhancement of UPE-GR 2% using 3-APTES with different loading (1, 3, 5 and 7%) by using ultrasonication method at 60 minutes mixing time was also successfully conducted. The results showed the optimum properties with improved mechanical and anti-corrosive behaviour at 3% of APTES. The corrosion rate is found at 0.073 mmpy with 1.289 x 10-8 Ω.cm2 conductivity. Whilst the mechanical properties also showed the optimum condition at 3% of treated GR with 5H of the pencil hardness, attributed to the 3-APTES that acted as a dispersion agent and enhanced the interaction of GR with UPE resin as well as improved the mechanical and anti-corrosive properties of the coatings. Therefore, it can be concluded that the UPE-GR treated silane coupling agent for metal corrosion protection has been successfully developed.

**Keywords:** *Primer coatings, Unsaturated Polyester, Graphene, Coupling Agent, Electrical Impedance Spectroscopy*

# PAPER ID: 157

Invited Speaker: Dr. Mohammad Saifulddin Mohd Azami

## Silver deposited On Graphitic Carbon Nitride Prepared Under Microwave Irradiation for Photodegradation of 2-Chlorophenol

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2-chlorophenol (2-CP) has been extensively utilized in various industrial such as agricultural, cosmetic, paper, and biocide. The 2-CP has become a dangerous pollutant that can cause serious water pollution. Photocatalytic degradation is one of the effective destructive methods to remove 2-CP pollutant. Silver deposited on graphitic carbon nitride (Ag/g-$C_3N_4$) was prepared using solid-state method without using any solvent and treated under microwave irradiation. The photocatalysts were characterized using UV-Vis DRS, $N_2$ adsorption-desorption, FTIR, FESEM analyses. The result shows that the band gap energy was drastically narrowed after introduce Ag on g-$C_3N_4$. The deposited Ag on g-$C_3N_4$ provided a high performance (80%) of 2-CP after irradiated for 240 min under visible light. The photodegradation was significantly influenced by the effect of synergistic between g-$C_3N_4$ and Ag. The existence of Ag metal on g-$C_3N_4$ prepared under microwave markedly can enhanced a great potential photocatalyst for organic pollutants wastewater treatment.

**Keywords:** *Silver; Graphitic carbon nitride; Microwave; 2-chlorophenol; Visible light.*

# PAPER ID: 160

Invited Speaker: Assoc. Prof. Ali H. Jawad

## Chitosan- Biohybrid Nanocomposite Material for Wastewater Treatment

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Chitosan has attracted a great attention as an adsorbent for textile dyes due to its a low cost, renewable and eco-friendly biomaterial. On contrast, chitosan has low chemical stability in acidic environment, and unfavorable pore properties in terms of low surface area and total pore volume that limit its adsorption application. The versatility and functionality of chitosan offers convenient modification and conversion to various synthetic biocomposite derivatives. In this respect, various inorganic/organic nanomaterials such as $TiO_2$, ZnO, and fly ash, were utilized for improving the surface area and total pore volume of chitosan. Moreover, various types of chemical cross-linking agents such as glutaraldehyde, glyoxal, benzil, epichlorohydrin, ethylene glycol diglycidyl ether, tripolyphosphate were utilized to enhance the chemical stability and reducing swelling capacity of chitosan in acidic environment. Box-Behnken design in response surface methodology is preferable statistical approach to achieved best synthesis conditions and optimum removal of textile dyes from aqueous environment.

**Keywords:** Biomaterial; Chitosan; Nanocomposite; Crosslinking; Textile dyes; Optimization

Invited Speaker: Dr. Arlina Ali

# Synthesis and Characterization of Aluminium Oxide Added with Zinc Oxide Nanostructures for Against UV Protection

**A. Arlina[a*], Sarizam Mamat[a], Mohammad Azwadi Sulaiman[a], Hakimin Adullah[a], An'Amt Mohamed Noor[a] and Pao Ter Teo[a]**

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Nanostructured zinc oxide (ZnO) is widely used in a variety's applications such as glass, ceramics, electronics, rubber tires, foods, and cosmetics. Numerous cosmetic products, such as sunscreen, lotion, foundation, cream, eye shadow and sunscreen contain additives such as ZnO. Hence, nanoscale zinc oxide nanostructured (ZnO) is frequently used in commercials due to its versatile and broad range of UV protection properties. In this paper, we study on the effect added Aluminium oxide ($Al_2O_3$) with ZnO on the structural, morphology dan optical properties. The samples were synthesized by using hydrothermal method by added with $Al_2O_3$ at 0, 0.5, 1.0, 1.5 and 2.0 mol% in the ZnO nanostructures. The characterization of the samples done by X-ray Diffraction (XRD), Scanning Electron Microscope (SEM) and UV-vis spectroscopy for all samples. From the XRD results, the samples showed the crystallite structure for all samples and new peaks appear at 1.5 -2.0 mol %. From SEM result, the samples shown the nanorod shape like structure. UV-vis spectroscopy showed that the absorption peak is in the range 200 to 400 nm for all samples. ZnO with nano-architectures has attracted promising utilization in against ultraviolet radiation.

VIRTUAL ORAL PRESENTATION

# Unsaturated Polyester Composite Filled with Coconut Shell Natural Fibre: Preparation and Mechanical Performance

**Sharifah Nafisah Syed Ismail*, Siti Amirah Mohamad Noor[1], Salamiah Zakaria[1], Siti Noorashikin Jamal[1], Khuzaimah Nazir[1], Nor Mazlina Abdul Wahab[1], Noor Aishatun Majid[1] and Zuliahani Ahmad[1]**

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Coconut shell (CS) has been a popular material for reinforcing polymers due to its natural lignocellulose that is not environmentally destructive. As a result, the effect of CS particles on unsaturated polyester resin (UPR) was investigated in this study using various CS compositions treated with alkaline solution. The treated and untreated CS UPR composites were compared using tensile, hardness, impact test, water absorption, Fourier Transform Infrared (FTIR), and Differential Scanning Calorimetry (DSC) for characterisation testing. The composite samples were created with varied fibre weight percentages, namely 5%, 10%, 15%, and 20% using the hand lay-up technique. The addition of CS treated fibres increased the tensile strength, hardness, and impact intensity of the UPR composite, but increasing the elongation at break resulted in a drop in its quality. In a water absorption test, the treated UPR/CS showed the least amount of absorption. In conclusion, the ideal condition for treated CS was 20 php, which resulted in high tensile strength, high modulus, greater impact intensity, decreased elongation at break, and low liquid absorption. As a result, natural fibre CS that has been alkaline treated has excellent mechanical characteristics and has a lot of promise as a natural filler in UPR composites.

**Keywords:** *natural filler, alkaline treatment, unsaturated polyester, coconut shell, fibre*

# Preparation and Characterization of Biocomposite Film Derived from Microcrystalline Cellulose (MCC) of Jackfruit Rind Waste

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Biocomposite cornstarch films with various microcrystalline cellulose (MCC) derived from jack fruit rind (JR) had prepared via the solution casting method. This study aimed to investigate the effects of jackfruit rind microcrystalline cellulose (JR-MCC) composition on the properties of cornstarch biocomposite films. The FTIR analysis demonstrated that the addition of JR-MCC did not significantly change the chemical structure of the obtained composites. The mechanical test revealed that the tensile strength and Young's Modulus decreased with increasing JR-MCC content while the value of elongation at break also increased. As JR-MCC content increased from 2.5% to 15%, the water solubility decreased significantly from 21.80% to 12.73%. This phenomenon happened because JR-MCC reduced the water solubility of cornstarch-based films. JR-MCC was firm to dissolve in water and needed a longer time to dissolve. The moisture uptake and biodegradability of the films reinforced with JR-MCC also increased due to the sensitivity towards moisture.

**Keywords:** *Biocomposite, jackfruit rind, microcrystalline cellulose, biodegradability, solution casting*

# Effect of Electrode Thickness and Surface Morphology on Electrochemical Performance of EDLC based Solid Polymer Electrolyte

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Electrode plays a crucial role in electrochemical performance of solid-state supercapacitor. This includes the proper control over the thickness of electrode. In this research, electrochemical double-layer capacitor (EDLC) was fabricated using different thickness (i.e. 100, 200 and 300 µm). Carboxymethyl cellulose-ammonium nitrate was employed as solid polymer electrolyte. The surface morphology and cross-section were observed using scanning electron microscope. Microscopic surface observation showed that thinner electrode has less voids, thus increase adhesion properties among carbon particles. The reduced adhesion and the electrolyte decomposition in the thicker electrodes were likely to be connected to their performance deterioration. The electrochemical performance was investigated using galvanostatic charge-discharge technique at different constant currents. The highest specific capacitance of 18.6 F/g was exhibited by the Cell 1 (60 µm) electrode. Thinner electrode could maintain higher specific capacitance. Increasing electrode thickness shows an increase in the cell voltage gradient (27 mV), resulting in a smaller specific capacity because the transport of the electrolytic ions into or from active layer becomes more difficult.

**Keywords:** *EDLC, electrode, thickness, surface morphology, electrolyte*

# The study of Hubbard U correction on structural, electronic and optical properties of $LiNbO_3$

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In these work, first-principles calculations were performed to obtain the structural, electronic, and optical properties of lithium niobate, $LiNbO_3$ using CASTEP code. The underestimate band gap energy was corrected using Hubbard U based on the experimental results. The underestimate bang gap value obtains using exchange correlation, GGA- PBEsol was found 3.547 eV, while the experimental results reported is 3.78 eV. To address this problem, a Hubbard U correction is used for Nb orbital using different Hubbard U values and was found at U=11 eV, the band gap energy for $LiNbO_3$ was 3.771 eV. Significance from the change of band gap values of $LiNbO_3$ at U=11 eV will give change in structural parameter and optical properties of $LiNbO_3$ too.

**Keywords:** *$LiNbO_3$, First-principles study, Hubbard U, band gap energy*

# PAPER ID: 13

# Polymer-free Transfer of Graphene-Based Material Derived from Cooking Palm Oil by Chemical Vapor Deposition Technique

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Chemical vapour deposition (CVD) of cooking palm oil precursors using a metal catalyst is an established method for producing graphene-based material. The major challenge of the CVD process is the transfer process of a graphene sheet from the substrate surface to a selected target substrate. The usage of well-known poly (methyl methacrylate) (PMMA)-assisted graphene transfer method promotes defects, impurities, folds, and wrinkles in the graphene sheet, which can affect its properties. Therefore, this study demonstrates polymer-free graphene transfer technique for graphene sheet on Ni substrate derived by cooking palm oil. A dropwise of hexane layer is used as a substitution of PMMA supporting layer during the etching process to remove Ni substrate. The quality of the graphene sheet is studied by optical microscopy and scanning electron microscopy (SEM). The results show that this method exhibit macroscopically clean, crack-free, and less complicated process as compared with PMMA-assisted graphene transfer technique. Raman spectroscopy reveals that the graphene peaks are visible with polymer-free method compared with PMMA-transfer method.

**Keywords:** *Graphene, Chemical Vapor Deposition, Polymer-free Transfer*

# Synthesis and Characterization of Layered Double Hydroxides with Varying Divalent Metal Cations: $Mg^{2+}$, $Zn^{2+}$, $Ca^{2+}$

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A series of nitrate-based layered double hydroxides (LDHs) material was synthesized by using aluminium as a trivalent cation with varying divalent metal cations such as magnesium, zinc, and calcium ions to prepare magnesium-aluminium layered double hydroxide (MgAl-LDH), zinc-aluminium layered double hydroxide (ZnAl-LDH) and calcium-aluminium layered double hydroxide (CaAl-LDH), respectively. MgAl-LDH and ZnAl-LDH were synthesized by co-precipitation method, whereas CaAl-LDH was prepared by hydrothermal method. The samples were characterized by powder X-ray diffraction (PXRD), Fourier transform infrared spectra (FTIR), thermogravimetric and differential thermogravimetric analysis (TGA/DTG), field emission scanning electron microscope (FESEM) and accelerated surface area and porosity (ASAP) analysis. The PXRD patterns showed that MgAl-LDH (9.8 Å) had the greatest interlayer spacing, followed by ZnAl-LDH (8.9 Å), and CaAl-LDH (8.7 Å). The FTIR spectra clearly confirmed the presence of nitrate anions in the structure of the LDHs. Two steps degradation behavior of the samples were observed in the TGA curve. The LDHs exhibited the isotherms of Type IV and hexagonal structures were observed on the FESEM images. This study was aimed to investigate the physicochemical properties of the LDHs with different divalent metal cations.

**Keywords:** *Layered Double Hydroxide, Hydrotalcite, Hydrocalumite*

# Structural and Electrical Properties of La-Ca-Mn-O/ZnO Composites

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Colossal magnetoresistance (CMR) is widely used in magnetic field sensing industry. Research on magnetoresistance effect has huge impact on the development of novel electronic devices. Nevertheless, a full understanding of the CMR effect remains elusive especially in the development of the manganites composites. In this work, La-Ca-Mn-O manganite compound was prepared via sol-gel and added with different concentrations of ZnO. The structural and electrical properties of La-Ca-Mn-O/ZnO composite were investigated by an X-ray diffraction (XRD), a thermogravimetric analysis (TGA) and a four-point probe (4PP) system. Parent compound was sintered at 800 °C to obtain the single phase LCMO as suggested by TGA result. XRD patterns showed there are two phases coexisted in the composites. LCMO exhibited orthorhombic phase and ZnO crystallised in hexagonal phase. The Rietveld refinement showed there is no reaction occur between LCMO and ZnO as the addition of ZnO does not change the structure of LCMO. The resistivity of the composites increased with the content of ZnO. Also, the addition of ZnO into the LCMO composites has shifted the metal-insulator transition temperature ($T_{MI}$) to lower temperatures.

**Keywords:** *CMR, LCMO, Sol-gel*

# Electrochemical Polarization Studies on Corrosion Inhibition of Alloy by Tannin and Catechin

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The purpose of this study is to investigation the corrosion behavior of three types of alloy by using electrochemical polarization methods in 3.5% NaCl medium. The corrosion studies have been carried out on AA6061 (Al-Mg), AA2214 (Al-Cu) dan AA7175 (Al-Zn) through anodic, cathodic and linear polarization resistance (LPR) assessment. Besides, the corrosion inhibition effect has been evaluated in the presence of two organic corrosion inhibitors; catechin and tannin. Result shows that the anodic polarization of AA6061 alloys exhibits activation polarization in 3.5% NaCl medium with the existence of pitting potential, $E_{pit}$ on each slope. While for both AA2214 and AA7175 alloys, a passivation phenomenon was occurred along the anodic response. Out of the three alloy, AA7175 were found to be more susceptible to corrosion. However, alloy AA7175 shows the decreased in current density, $I_{corr}$ in both tannin and catechin as evaluated in cathodic polarization curve. The electrochemical reaction at electrode surface was affected by the charge transfer and mass transport. In the presence of tannin, AA6061 alloy performed 86% inhibition efficiency (IE%) with an average $R_p$ value 84 k.Ohms.cm$^2$ at 10 hours exposed. Meanwhile, alloy AA2214 dan AA7175 only showed low resistance signified deficit in IE% and high corrosion rate. Corrosion inhibition by tannins shows a higher $R_p$ values than catechin indicated tannin molecules provides more barrier for corrosion. It is concluded that the corrosion behavior of alloys was dependent on the alloys composition as discussed through corrosion kinetic parameters and tannin revealed its potential as corrosion inhibitors agent.

**Keywords:** *Alloy, Organic Material, Corrosion, Electrochemical Polarization, Inhibition*

# First-Principles LDA+U and GGA+U Calculations on Structural and Electronic Properties of Wurtzite ZnO

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First-principles calculations with density functional theory (DFT) were carried out to explore the effects of Hubbard on-site Coulombic correction on the structural and electronic properties of wurtzite zinc oxide (ZnO). For an accurate prediction of ZnO properties, adequate Hubbard terms must be established due to changes in structural parameters produced by the correction of hybridization between Zn *d* states and O *p* levels. The calculations based on the local density approximation (LDA) and the generalized gradient approximation (GGA) for Perdew-Burke-Ernzerhof (PBE) and Perdew-Burke-Ernzerhof for solids (PBEsol) were performed by applying Hubbard corrections $U_d$ to Zn 3*d* states and $U_p$ to O 2*p* states. The lattice parameters were closer to the experimental data when Hubbard corrections $U_d$ and $U_p$ was applied in the calculation. The combination of the correction terms $U_d$ and $U_p$ managed to improved the underestimated bandgap of wurtzite ZnO, which might solve the standard DFT problems and resulted in good agreement with experimental data.

**Keywords:** *Wurtzite ZnO, First-Principles, Density Functional Theory, Hubbard Correction, Electronic*

# Effects of Hubbard U correction on the structural and electronic properties of rutile, anatase and brookite $TiO_2$

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First-principles calculations using density functional theory (DFT) have been performed to investigate the structural and electronic properties of $TiO_2$ polymorph in anatase phase. The effects of Hubbard $U$ correction on the structural and electronic properties of anatase $TiO_2$ were explored using the local density approximation (LDA) and generalized gradient approximation (GGA) for Perdew-Burke-Ernzerhof (PBE) and Perdew-Burke-Ernzerhof for solids (PBEsol) method by applying Hubbard corrections $U_d$ in Ti 3*d* states and $U_p$ in O 2*p* states. There are changes in the structural parameters caused by the Hubbard U correction in Ti *d* states and O *p* states. The best agreement of $U$ values to improve the electronic band gap of rutile was found at $U_d$ = 3.0 eV and $U_p$ = 7.0 eV from LDA, $U_d$ = 2.0 eV, $U_p$ = 6.0 eV from GGA-PBEsol for anatase and $U_d$ = 3.0 eV and $U_p$ = 4.0 eV for brookite using GGA-PBEsol. The combination of both $U_d$ and $U_p$ correction terms managed to widen the band gap of rutile, anatase and brookite $TiO_2$ which is close to the experimental value.

**Keywords:** *First-principles calculations, $TiO_2$, Hubbard U, electronic properties*

# PAPER ID: 21

## Structural, Electrical, and Magneto-transport Properties of $Pr_{0.7}Sr_{0.3}MnO_3$: $Al_2O_3$ Composites

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Colossal magnetoresistive (CMR) materials have always been the research interest attributed to their potential application in magnetic field sensing industry. Incorporation of an insulating secondary phase into the manganite composites is an effective measure to enhance the low field magnetoresistance (LFMR). This work reports the structural, electrical, and magneto-transport properties of (*1-x*) $Pr_{0.7}Sr_{0.3}MnO_3$ (PSMO): *x* $Al_2O_3$ composites synthesized by solid-state reaction method. Different compositions of $Al_2O_3$ nanoparticle (*x*= 0.00, 0.05, 0.10, 0.15 and 0.20) were appended into the samples. X-ray diffraction (XRD) patterns showed all samples exhibited PSMO as the major phase. $Al_2O_3$ nanoparticle has acted as a barrier to charge transport and caused an increase in resistivity for composite samples. The addition of $Al_2O_3$ into the PSMO composites has shifted the metal-insulator transition temperature ($T_{MI}$) to lower temperatures. The magnetoresistance values were found to increase monotonically with the decrease in temperature and LFMR has been observed. The PSMO: $Al_2O_3$ presented here is a promising manganite composite which can be utilized in the magnetic sensor elements.

**Keywords:** *LFMR, PSMO, Solid-state reaction*

# Excellent Visible -Light-Induced Photocatalytic Activity of $SrTiO_3$ in Terms of Structural and Electronic Properties: A DFT + U Investigations

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A systematic investigation based on spin-polarized Hubbard U (DFT+U) has been carried out to study the structural and electronic properties of cubic $SrTiO_3$. The Pardew-Burke-Ernzerhof (PBE) for solid function was chosen as the exchange correlation potential within the generalized gradient approximation (GGA). The interaction between valance electron and ionic core was approximated with the ultra-soft pseudo potentials. The on-site +U corrections are typically applied to p orbitals ($U_p$) of Oxygen and d orbitals ($U_d$) of Titanium to reproduce the experimental indirect band gap data of 3.2 eV. The calculated band gap of pure $SrTiO_3$ is improved using GGA+U method by choosing appropriate U values by comparing to the experimental value. The optimized lattice parameters of pure $SrTiO_3$ that are consistent with the experimental and theoretical data also contributed to method use. The preliminary work of doping on the electronic and structural properties and photocatalytic activity of the $SrTiO_3$ system were investigated using first-principles study also shows the improved band gap and consistent lattice parameter to the experimental value. The Density of States (DOS) is changed for doped structure confirms that increased of band gap.

**Keywords:** *$SrTiO_3$, First-principle, Perovskite, Photocatalytic Water-Splitting, DFT*

# Structural and Optical Properties of Reduced Graphene Oxide-coated Tellurite Glass Doped with Erbium Nanoparticles

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Graphene-based nanomaterials have the significant potential to be used as coating materials towards glass performance. In this work, reduced graphene oxide (rGO)-coated tellurite glass was synthesized via melt-quenching and low-cost spray coating techniques for high efficiency to improve the optical properties inside the glassy matrix. The structural properties investigated using X-ray Diffraction (XRD) confirmed the structural arrangement of an amorphous in nature phase meanwhile Field Emission Scanning Electron Microscopy (FESEM) analysis proved the morphological structure images of rGO onto the tellurite glass surface. The Ultraviolet-Visible (UV-Vis) Spectroscopy was conducted to identify the optical characteristics in glass materials. The refractive index of rGO-coated glass was found higher in the range of 2.402-2.775 due to the graphene-based effects. The optical bandgap energy of rGO-coated glass was decreased from 1.913 to 2.980 eV which correlated to the changes in absorption characteristics when coated with rGO. The Urbach energy ascribed the high number of defects in absorption with the presence of rGO structures.

**Keywords:** *Refractive index, Optical bandgap energy*

# PAPER ID: 28

## Synthesis of Hydrophobic Benzoyl Carrageenan as Polymer Electrolyte

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Hydrophobic benzoyl carrageenan has been successfully synthesized by Friedel Craft acylation method. The chemical structure and physical properties of benzoyl carrageenan are well synthesized by Fourier transform infrared spectroscopy, Nuclear magnetic resonance, X-ray diffraction, CHNS analysis, Thermal gravimetric analysis and Water contact angle. FTIR analysis showed successful substitution by the formation of new carbonyl (C=O) and C=C bonds. H-NMR confirmed the substitution of benzoyl into carrageenan matrix. XRD analysis showed reduced crystallinity of the synthesized carrageenan while CHNS analysis revealed the increase percentage of carbon in the synthesized carrageenan. TGA showed lower degradation temperature in the synthesized carrageenan while WCA confirmed the hydrophobicity of benzoyl carrageenan.

**Keywords:** *benzoyl, carrageenan, electrolyte, biopolymer*

# PAPER ID: 30

## Superconductivity in ($Fe_{1-x}SeSn_x$) Superconductor

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$Fe_{1-x}SeSn_x$ superconductor has been prepared by solid-state reaction through vacuum sintering process at 845$^o$C for 3 hours and cooled in the closed air tube furnace. In the first stage, Fe powder (99.99%) and Se powder (99%) were mixed together in an agate mortar by stoichiometric ratio 1:1. The precursor was homogenized using agate mortar for 1.5 h. In the socond stage, precursor powder (FeSe) was mixed with Sn powder (with purity of 98.5%) obeying a stoichiometric ratio of Fe: Se: Sn = (1-x) :1: (x), where x= 1-wt% Sn, 5-wt% Sn and 10-wt% Sn, respectively. The powder was then grained for 1.5 h before being inserted into dies to form pellet. Finally, the sample sintered in the furnace tube at 845$^o$C with heating rate of 5$^o$C/minute held for 3 hours. The sample cooled with closed close air at room temperature. Phases identification was carried out using *X-Ray Diffraction* (XRD) with Cu Kα (λ = 1.5418Å) at the angle of 2θ = 10$^o$–70$^o$. Citical temperature, $T_c$ was observed by plotting the resistance graph versus time in a *Teslastron Cryogenic Magnetic*. The Four Point Probe (FPP) method was applied with silver paste as ohmic-contact. The result showed that the superconductivity occurred at 13.33 K to 15.87 K, respectively. XRD pattern showed that the phase of β-FeSe as the main phase whereas δ-FeSe as a second phase.

**Keywords :** Cryogenic, β-FeSe, Superconductor, Sintering

# PAPER ID: 31

## Greenish Blue Phosphor of Europium and Dysprosium Doped Magnesium-Strontium Aluminate Prepared by Combustion Synthesis

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Europium and dysprosium doped $MgSrAl_{10}O_{17}$ nano-phosphor were prepared by urea combustion synthesis method at temperature of temperature 600°C. X-ray Diffraction (XRD) and Photoluminescence (PL) Spectroscopy were used to determine the crystalline structure and optical properties of these materials. The result show, from the X-RD, the crystalline size of $MgSrAl_{10}O_{17}:Eu^{2+}$, Dy3+ was 52.9 nm and the emission spectra of the phosphors show broadened band at 467 nm. The chromaticity coordinates were obtained from the luminescence emission spectrum that shows europium and dysprosium doped $MgSrAl_{10}O_{17}$ nano-phosphor is greenish-blue colour. By adding more magnesium ion into phosphor also improves the blue luminescence emission spectra under UV excitation when doped Eu2+ and co-doped $Dy^{3+}$. The properties of $MgSrAl_{10}O_{17}$ promising host candidates for lanthanide and transition metal ions compared to the other alkaline earth aluminate.

**Keywords:** *Greenish-blue Phosphor, Europium, dysprosium, MgSrAl10O17 Nano-material phosphors, Combustion synthesis; Long-after glow.*

# Proton Relaxation in Several Laboratory Magnetic Resonance Imaging (MRI) Phantoms

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Alternative materials that are potentially useful for magnetic resonance imaging (MRI) phantom have been studied to investigate their proton relaxation properties. The laboratory prepared materials should first fulfil characteristics such as inexpensive, non-toxic, easy to handle, easily prepared, stable over a long period of time and should possess properties of tissues. Two important quantities of interest that were investigated are the longitudinal (*T1*) and transversal (*T2*) relaxation times. In this work, the SNR relaxations of three laboratory-made MRI phantoms which were agar gel, agarose gel and poly[vinyl] alcohol (PVA) slime were measured using a 3-T MRI system. A standard spin-echo pulse sequence was used. The data obtained fulfilled the exponential behaviour of the form SNR $\alpha$ 1 – $e^{-TR/T1}$ for *T1* curve and of SNR $\alpha$ $e^{-TE/T2}$ for *T2* curve. By using a curve-fitting method, it was found that the addition of relaxation modifier has significantly shortened the *T1* relaxation time of the pure agar, agarose and PVA slime. Their *T2* relaxation time was less affected. This indicated the sensitivity of the longitudinal relaxation of the protons to changes in their surroundings (or lattice). The shortening of *T1* relaxation time has brought these laboratory-made MRI phantoms closer the properties of a standard MRI water phantom.

**Keywords:** *lattice, magnetic field, saturation, spin, SNR uniformity*

# Effect of Dilution Gas to Silicon Carbide Thin Film Using Very High Frequency – Plasma Enhanced Chemical Vapour Deposition

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Dilution of gas is used in order to investigate the surface morphology and surface topography of Silicon Carbide (SiC) film deposited using Very High Frequency – Plasma Enhanced Chemical Vapour Deposition (VHF-PECVD) method. The VHF-PECVD is operated using excitation frequency of 150 MHz at 20 W RF power. During the deposition process, the dilution of Argon and hydrogen carrier gas are set at 5 sccm and 5 sccm respectively. Whilst the silane ($SiH_4$) and methane ($CH_4$) precursor gases are fixed at 2 sccm and 8 sccm respectively. Direct observations indicated that the surface morphology of deposited ns-SiC films shown layer-island structure in all samples with different island density and size formation above the critical layer thickness. The surface topography and roughness of the deposited SiC films are examined by non-contact mode Atomic Force Microscopy (AFM) and are found that all the samples shown different roughness, surface topography structure and average grain diameter.

**Keywords:** *Silicon Carbide, Plasma Enhanced Chemical Vapour Deposition, Dilution Gas, FESEM, AFM*

# Photocatalytic Degradation of Methylene Blue Dye using Mg-doped ZnO under UV Light Irradiation

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Heterogeneous photocatalysis is a viable treatment approach for removing organic dye compounds from textile wastewater, and ZnO-based photocatalysts are an appealing system to investigate. In this work, Mg-doped ZnO have been synthesized using modified sol-gel technique to evaluate the effect of different Mg molar concentration towards the photocatalytic degradation performance of methylene blue (MB) dye and characterized by X-ray diffraction (XRD), scanning electron microscope (SEM) and Energy dispersive X-ray (EDS) analysis. In particular, according to XRD analysis, all samples showed a hexagonal wurtzite structure with average crystallite sizes approximately in the range 74.82–81.64 nm. The SEM-EDS results demonstrated that the particle-like Mg-doped ZnO samples consist of element Zn, O and Mg. The photocatalytic activity of the pure ZnO and Mg-doped ZnO was investigated by photodegradation of MB under ultraviolet radiation. The results showed that 1 mol% Mg-doped ZnO exhibited enhanced photocatalytic activity with percentage degradation of 89.54 % and photodegradation rate constant, $k$ of 0.0432 $min^{-1}$. Extended visible absorption, inhibition of photoexcited electron and hole recombination, and higher absorptivity of MB dye on the surface of Mg-doped ZnO photocatalyst might be contributed to the increased photocatalytic activity.

**Keywords:** *Magnesium, methylene blue, photocatalyst, photocatalytic, ZnO*

# Water-based Preparation of Immobilized Ag-doped $TiO_2$ Photocatalyst for Photocatalytic Degradation of RR4 Dye

**Nureel Imanina Abdul Ghani[1], Muhammad Afiq Rosli[1], Siti Raihan Hamzah[1], Nadiah Sabihah Natar[1], Nur Syazana Nazeri[1], Syahirul Ikhwan Ab Aziz[1], Sarina Mohamad[1] and Wan Izhan Nawawi Wan Ismail[1]***

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In this study, silver (Ag) metal was used as a dopant for titanium dioxide ($TiO_2$) photocatalysts to enhance the photocatalytic performance of commercially available Degussa P25 $TiO_2$. The preparation of Ag-$TiO_2$ was conducted via photo-deposition method with silver nitrate ($AgNO_3$) as Ag precursor at various ratios of Ag dopant to $TiO_2$. The immobilization of Ag-$TiO_2$ was prepared via water-based immobilization by using DSAT method and the obtained photocatalyst was characterized by FESEM-EDS, XRD, and UV-Vis/DRS. The photocatalytic performance of Ag-$TiO_2$ was measured by photocatalytic degradation of Reactive Red 4 (RR4) dye. The optimum photocatalytic performance of immobilized Ag-$TiO_2$ was obtained at 0.2 wt% of Ag-$TiO_2$ (named as immobilized 2AT sample) with complete degradation of 30 ppm RR4 dye was achieved within 30 min under 55W fluorescent lamp irradiation with 1.6 times faster compared to immobilized unmodified $TiO_2$. The acquired results from FSEM-EDS and XRD analyses indicated that presence of Ag on Ag-$TiO_2$ with no phase transformation. The 2AT has shown the same photocatalytic degradation rate under immobilization and suspension modes due to the water-base formulation in the post-preparation of immobilization that able to retain the photocatalytic activity.

**Keywords:** *Photocatalysis, titanium dioxide, silver, RR4 dye, water-base immobilization*

# The Porosity Study of Immobilized $TiO_2$/ENR/PVC under Photoetching Process for Light Harvesting Enhancement Through Photocatalytic Degradation of RR4 Dye

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$TiO_2$ immobilization is one of the significant wastewater treatment techniques. However, the lower photocatalytic performance of immobilized $TiO_2$ is recently reported as compared with the normal suspension mode. This is due to the less of light harvesting in immobilized $TiO_2$ surface covered by the polymer binder. In this study, $TiO_2$ was immobilized by using dip coating technique. Epoxidized natural rubber (ENR) and polyvinyl chloride (PVC) were used as a polymer to bind the $TiO_2$ on the glass substrate. This immobilized $TiO_2$/ENR/PVC was undergo photoetching process at various time to increase the porosity by degrading the polymer binders. Reactive red 4 dye was used as a model pollutant for photocatalytic performance. All immobilized $TiO_2$/ENR/PVC samples under photoetching process were showed higher photocatalytic activity compared to without photoetching process (TEP0 sample). TEP24 sample has shown the highest photocatalytic degradation where the first order rate constant (k) value was *ca.* 0.1164 $min^{-1}$. This optimum sample is 7.5 times faster as comparing with immobilized $TiO_2$/ENR/PVC without photoetching. The significant increment of porosity has the main reason for the highest photocatalytic activity of TEP24 sample where the surface area value for TEP24 and TEP0 were 50 and 30 $m^2$ $g^{-1}$ respectively. The result supported by the SEM image where the porous surface was observed under TEP24.

**Keywords:** *porosity, immobilized $TiO_2$, photoetching, light harvesting, photocatalytic degradation.*

# The Surface Morphology and Recyclability Studies of Immobilized Titanium Dioxide Under Surfactant as Dispersing Agent

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Immobilized titanium dioxide ($TiO_2$) was prepared using commercially available carbon doped $TiO_2$ from Kronos VLP 7000. $TiO_2$ was immobilized by using low amount of polymer and surfactant onto glass plate as support material by using double sided adhesive tape (DSAT) technique. The photocatalytic activity of the immobilized $TiO_2$ was evaluated by photocatalytic degradation of methylene blue (MB) dye. All prepared immobilized $TiO_2$ without surfactant shows an inferior coating with uneven surface layer, while it shows a significant surface improvement by adding surfactant due to the dispersion enhancement of PVA binder. No phase transformation from anatase to rutile was observed on prepared immobilized $TiO_2$ observed by the XRD spectrum with the peaks being identical compared with the $TiO_2$ control. C-C, C-O and O-H bonding peaks were observed in immobilized $TiO_2$ representing PVA molecular structure detected by FTIR analysis. Immobilized $TiO_2$ has demonstrated good photoactivity, which is nearly three times greater than $TiO_2$ control in suspension mode. The immobilized $TiO_2$ shows good recyclability in terms of adhesiveness. However, photoactivity in degrading MB dye has decreased throughout the cycle and is stable after the 10th cycle, with the 1st order rate constant after the 10th cycle comparable to $TiO_2$ control in suspension mode.

**Keywords**: *Immobilized $TiO_2$ , Surface Morphology, Kronos*

# Effect of Water as Dispersing Agent for Prepared Immobilized Titanium Dioxide

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The immobilized titanium dioxide ($TiO_2$) was prepared by applying a low amount of polyvinyl alcohol (PVA) binder using double-sided adhesive tape (DSAT) at different volumes of water in the formulation. The photocatalytic activity of immobilized $TiO_2$ was determined by photocatalytic degradation of reactive red 4 dye (RR4). 0.08% PVA/$TiO_2$ in 40mL water formulation denoted as $TiO_2$-40 was the optimum immobilized $TiO_2$ with 0.068 ±0.003 $min^{-1}$ as compared with 0.03 $min^{-1}$ under normal immobilized $TiO_2$ using 16.7 wt% of PVA. No phase transformation from anatase to rutile was observed for all immobilized $TiO_2$ samples due to the moderate temperature used during the preparation. The coating surface of the immobilized $TiO_2$ has shown the various crack sizes found by stereomicroscope. Amount of PVA in immobilized $TiO_2$ has increased the O-H and C-H bonding peaks in FTIR spectrum corresponding to the rising amount of PVA loading. The immobilization using DSAT technique has a significant effect in terms of minimizing the amount of binder usage and 2.27 times better in photodegradation as compared with normal immobilized $TiO_2$.

**Keywords:** *Immobilized titanium dioxide, Photocatalyst, Surface coating, Dye*

# PAPER ID: 46

# Preparation of Water-base Immobilized N doped $TiO_2$ using DSAT Technique for Photocatalytic Degradation of Methylene Blue Dye

**Nadiah Sabihah Natar[1], Nur Syazana Nazeri[1], Syahirul Ikhwan Aziz[1], Siti Raihan Hamzah[2], Muhammad Afiq Rosli[2], Nureel Imanina Abdul Ghani[2], Mohd Azlan Mohd Ishak[2], Sharin Razak[3] and Wan Izhan Nawawi Wan Ismail[2]***

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Photocatalytic degradation of $TiO_2$ photocatalyst under suspension mode has widely been studied among researchers. However, the application is limited due to the complexity in separation and non-recyclability of photocatalyst. Immobilization is one of the promising methods to overcome this problem. Most of the prepared immobilization modes showed lower photocatalytic activity compared with the suspension due to the chemical reaction of solvent with the modified $TiO_2$. Therefore, a free solvent preparation of immobilized $TiO_2$ is critical in retaining it photocatalytic activity. Immobilization via double-sided adhesive tape (DSAT) was introduced previously by our research team, it works the best of others in replacing polymer binder in immobilization system making it a free solvent preparation process. The aim of this research is to prepare immobilized $TiO_2$ and N doped $TiO_2$ by using DSAT technique. A comparison between immobilized and suspension modes of unmodified and N-$TiO_2$ were examined under photocatalytic degradation of methylene blue (MB) dye. The photocatalytic performance of modified N-$TiO_2$ has shown 53% increment with unmodified $TiO_2$ under suspension mode where the photodegradation rate for unmodified and N-$TiO_2$ were 0.0645 and 0.138 $min^{-1}$ respectively. Under immobilization system, unmodified $TiO_2$/DSAT and N-$TiO_2$/DSAT have shown the same photocatalytic performance as their condition under suspension mode. This is due to the free solvent usage in the immobilization system making it no chemical interactions occurred.

**Keywords:** *Photocatalysis, titanium dioxide, nitrogen, methylene blue dye, water-base immobilization*

# Optimizing Mode-Mismatched Thermal Lens Method for Study of Liquid Thermal Diffusivity

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Mode-mismatched thermal lens method has been proven to be greater in signal-to-noise ratio. Greater signal-to-noise ratio will ensure the penetrating of the beam source to the sample studied in thermal diffusivity study. The physical meaning behind thermal diffusivity is associated with the speed of propagation of heat during changes of temperature over time. In this study, the samples chosen are distilled water, ethylene glycol and glycerol. The beam profiling study has been carried out first before deciding the excitation beam and probe beam lasers.

# PAPER ID: 48

## Characterization and Mechanical Properties of Polylactic Acid (PLA) Biocomposite Filled Microcrystalline Cellulose (MCC) Extracted from Kenaf

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Microcrystalline cellulose (MCC) was successfully extracted from kenaf bast fibre plant (Hibiscus cannabinus L.) and incorporated into Polylactic Acid (PLA) biocomposite. The kenaf bast fibre undergone alkali treatment and bleaching prior to acid hydrolysis using 1M $HNO_3$ in obtaining MCC. Several characterizations on isolated MCC and PLA/MCC biocomposite conducted such as Fourier-transform infrared (FT-IR) spectroscopy and crystallinity index. Further characterization was made on the PLA/MCC biocomposite to study its mechanical and physical properties. FT-IR spectral indicated the successive elimination of non-cellulosic constituents in MCC. Differential scanning calorimetry (DSC) analysis revealed the percentage of crystalline region in the MCC obtained from kenaf bast fibre is higher at 88.53, making it suitable to be used as reinforcement filler in PLA biocomposite. Whilst tensile testing on various loading of PLA/MCC composites showed increment in tensile strength and elastic modulus but decrement in percent elongation. The optimum parameters were found at 9% MCC loading at 18.7 MPa in tensile strength attributed to well mixing of PLA and MCC and 88.53 crystallinity index. In addition, the tensile results manifested the lower % of MCC needed to enhance the mechanical properties of PLA biocomposite.

**Keywords:** *Biocomposite, Kenaf, Microcrystalline Cellulose, Polylactic Acid*

# PAPER ID: 49

# Influence Of Milling Time on the Microstructural Properties of $ZnO$-$Bi_2O_3$-$Sb_2O_3$-$CoO$- $MnO_2$-$Al_2O_3$ Based Ceramic-Varistors

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The raw materials powder from multi-elemental oxides for the subsequent formation of a green sintered pellets is a major processing in the fabrication of zinc oxide (ZnO) varistors. The ceramic sintered pellets with chemical composition 97%ZnO-1%$Bi_2O_3$-0.5%$Sb_2O_3$-0.5%CoO-0.5%$MnO_2$-0.5%$Al_2O_3$ (in mol%) were prepared by mixing raw materials in a ball milling. The different milling time (12, 24, 36, 48 and 60) hours with 300 rotation per minute (rpm) was investigated. The goal of this research was to determine the milling time that produced the best homogeneity of dopants within the mixture as well as their microstructure properties. These properties include the relative density, crystallite size, phase formation, and average grain size. They were evaluated with X-ray diffractometer, electronic densimeter, scanning electron microscope, respectively. The results reveal that microstructure properties change with milling time. The optimum result was achieved when the sintered pellets is milled for 48 h at 300 rpm.

**Keywords:** *Ball Milling, Milling Time, Density, Varistor, Zinc Oxide*

# PAPER ID: 50

## Characterization of Ethylene-vinyl Acetate/Natural rubber (EVA/NR)-based Thermoplastic Elastomer for Fused Deposition Modelling (FDM)-3D Printing Material

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Potential development in application sector for flexible filaments have attracted special attention due to their rubber-liked properties. Preliminary study on ethylene-vinyl acetate/natural rubber (EVA/NR) thermoplastic elastomer (TPE) blends was carried out for fused deposition modelling (FDM)-3D printing application. Two types of grafted EVA namely EVA20 and EVA24 whereby, the vinyl acetate content of approximately 20 and 24% were used respectively and melt blended with NR at various ratio. Melt flow index, mechanical and dynamic properties of selected EVA/NR blend ratio were characterized, and the 3D printing feasibility was tested using FDM method. The tensile strength and melt flow index of the EVA/NR decreased with increasing NR content in the blends compound. Some important characteristics of EVA/NR that influenced the printability process were discussed. It was found that material with insufficient stiffness and the dominance of viscous response at high printing temperature affected the ability to print using 3DGence ONE 3D printer.

**Keywords:** *Ethylene-vinyl Acetate/Natural Rubber Blends, Thermoplastic Elastomer, 3D Printing, Fused Deposition Modelling, Characterization.*

# PAPER ID: 52

# Morphology and Characterization Study on Effective Microorganism (EM) Waterbased Epoxy Coatings

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Waterbased polymeric epoxy coating is an important material in providing protection against extreme weather condition. Crack and fungus formation is a natural phenomenon when coating surface is exposed to extreme weather and normally related to the durability of the coating. It is essentially a coating layers that shields the material from harmful conditions. In this research, Effective Microorganism (EM) was used as additives in the coating formulation. The EM loading was added in 5 different ratios which are 0.5, 1, 1.5, 2 and 2.5% and applied on blasted steel surface. The cured paint was characterized using Thermogravimetric Analysis (TGA), Scanning Electron Microscopy (SEM), hardness, pH, chemical resistance, viscosity, stability adhesion test and exposure to sea water, acid and base water up to 100 days. From the TGA graph result, EM is capable to remove the volatile matter such as water and moisture in coatings formulation. The stability, hardness, chemical resistance, viscosity and pH are slightly affected by EM loading. Meanwhile for adhesion on substrate is reducing with the increasing loading on EM additives. Exposure to sea water, acid and base depict that 0.5% EM coating has resistance towards the acid solution where only small blistering occur. Lastly the morphological studies depict surface failure with high addition of EM. Overall, this study concludes that the use of EM at 0.5% loading has positive effects on the properties of coatings.

**Keywords:** *Characterization, Effective Microorganism (EM), Morphology and Waterbased*

# PAPER ID: 54

# $TiO_2$/MXene-Based Composite Material in Photoelectrochemical Water Splitting Application: A Review

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Hydrogen has been considered as a clean and safe future energy carrier to generate electricity, especially in the transportation sector. However, hydrogen is not available as hydrogen gas on earth, it needs to be extracted from other materials, such as hydrocarbon, water, acid, etc. The photoelectrochemical water splitting process has been considered the ideal method to produce hydrogen. This method uses solar light as an energy source and employing a semiconductor as a photoelectrode material. However, the semiconductor that fulfills the water molecule photocatalytic energies, stable, non-toxic, and cheap are limited. One of the most investigated semiconductor materials is titanium dioxide ($TiO_2$), but it has wide bandgap energy that causing its performance is very low. Several modification techniques have been employed to improve the $TiO_2$ performance, among them is by making a composite with other materials. In the Last 3 years, the composite of $TiO_2$ with mxene materials has been extensively studied and has been reported to produce high photocatalytic and photoelectrochemical performance. Mxene is a new class of two-dimensional material produced from the etching MAX material. Mxene has abundant impressive properties such as excellence of conductivity, stability, large specific surface area, etc. Here, we report the recent progress and performance of mxene material in photochemical and photoelectrochemical water splitting. The preparation methods and emphasis on the future challenges in this application are also presented.

**Keywords:** *hydrogen, PEC, water splitting, $TiO_2$, MXene*

# Photoluminescence Investigation of $BaSi_2$ Epitaxial Film on Silicon Substrate

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Barium disilicide ($BaSi_2$) has attracted increasing interest as light absorber material for solar cells due to a large absorption coefficient which is approximately 30 times higher than Silicon (Si), a large minority carrier diffusion length (~11 µm) and a long minority carrier lifetime (~10 µs). Besides, the room temperature band gap of $BaSi_2$ is ~1.3 eV, which is closer to the ideal band gap of a single-junction solar cell (1.4 eV) compared to Si (1.1 eV). In this work, undoped $BaSi_2$ epitaxial layers on Si(111) substrate grown at a Ba-to-Si deposition rate ratio of 3.7 were studied by power and temperature dependent photoluminescence (PL). At 10 K and low excitation, PL spectrum can be deconvoluted to four Gaussian peaks, which is 1.14, 1.05, 1.0 and 0.88 eV. The low energy peaks become saturated while the high energy peaks become more pronounced with increasing excitation power. We proposed that the PL peaks originated from optical transitions between electron trap due to Si vacancy ($V_{Si}$) and hole trap level (due to Si interstitials ($Si_i$) and Ba antisites ($Ba_{Si}$)) or the valence band maximum. Optical transitions involving $Si_i$ trap level showed a significant saturation and small gradient (~0.23) while transitions involving $Ba_{Si}$ trap exhibited a larger gradient (~0.71). The two distinct gradients indicated that the concentration of $Ba_{Si}$ defects in our sample is significantly higher than the concentration of $Si_i$.

**Keywords:** *Photoluminescence, defects, barium disilicide, solar cells.*

# Synthesis and Characterization of 4-Chlorophenoxyacetic Acid Herbicide Interleaved into Calcium-Aluminium Layered Double Hydroxide

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The herbicide that is mainly used in agriculture, known as the 4-Chlorophenoxyacetic acid (4-CPA) is an anion used to interleave into the interlayers of Calcium-Aluminium layered double hydroxide (Ca-Al LDH) via direct method. The LDH compound acts as a host and support for controlled release formulation of the herbicide. In this work, the synthesis between the aluminium nitrate, calcium nitrate and anion were done at pH 11 under inert atmosphere to form a new nanohybrid herbicide. The successful intercalation was studied using the Powder X-Ray Diffraction (PXRD) pattern at 0.025 M nanocomposite showing the basal spacing has expanded from 8.0 Å to 23.8 Å which proves the intercalation of 4-CPA anions into the interlayer of Ca-Al LDH. The result obtained from ATR-FTIR spectrums further supported the intercalation where the nitrate peak ($NO^-$) diminished and the carboxylate ion ($COO^-$) band appeared at 1653 $cm^{-1}$. Meanwhile, new peak can be observed at 1410 $cm^{-1}$ indicating the intercalation process has caused the peak to slightly shift to a new position. This work indicates the successful interleaving process of the 4-CPA anion and the potential of Ca-Al LDH host as an eco-friendly agrochemical in minimizing the herbicide usage to the environment.

**Keywords:** *4-Chlorophenoxyacetic Acid (4-CPA), intercalation, co-precipitation, LDH, Nanoparticles*

# PAPER ID: 60

# Development of an Electrochemical Impedance based Sensor for the Detection of Malathion using Reduced Graphene Oxide and Gold Nanoparticles

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The widespread use of organophosphorous pesticides primarily in agriculture has raised human health and environmental concerns which has led us to the development of a sensing interface that is able to detect the organophosphorous (OP) compound. Herein, we report gold nanoparticles (AuNPs) decorated reduced graphene oxide (rGO) modified on screen printed carbon electrode (SPCE) as the support for aptamer immobilization to develop an electrochemical impedimetric aptasensor for the detection of malathion, one of the most common used OP compounds. Graphene oxide was electrochemically reduced on SPCE and further modified with AuNPs to produce AuNPs/rGO-modified SPCE which was then utilized for the immobilization of thiolated DNA aptamer by self-assembly method. The stepwise modification process was characterized by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The detection was carried out by using EIS where it is based on the variation of electron transfer resistance associated with the formation of malathion-aptamer complex at the modified electrode surface. The result shows that the value of charge transfer resistance increased upon binding of malathion to the aptamer-modified electrode indicating the successful formation of malathion-aptamer complex that blocks the electron transfer. The aptasensor also demonstrated good selectivity for malathion against other OP compounds such as DMMP, paraoxon and phorate. This proposed impedimetric aptasensor provides a sensitive and selective detection of malathion which can be used for potential application in real samples.

**Keywords:** *Electrochemical Impedance, Chemical Sensor, Gold Nanoparticles*

# PAPER ID: 63

# Characterization of Chromium Doped Zinc Aluminate ($ZnAl_2O_4$) Phosphor Synthesized by Sol-gel Method

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Chromium doped zinc aluminate (Cr doped $ZnAl_2O_4$) phosphor is an excellent material for optical technology applications especially in lighting, bio-imaging and display devices. Suitable synthesis route is important in order to obtain high quality phosphor material. In this project, Cr doped $ZnAl_2O_4$ samples were prepared using sol-gel method by applying citric acid and oxalic acid as chelating agent. The samples prepared using citric acid and oxalic acid were respectively designated as SC and SO. The samples were analysed using X-ray diffraction (XRD), Energy-dispersive spectroscopy (EDS) and Scanning Electron Microscope (SEM). XRD pattern showed that the diffraction peaks of both samples matched with cubic $ZnAl_2O_4$ spinel phase (JCDPS 82-1043). The diffraction peaks were sharp and well-defined diffraction peaks, indicating a good degree of structural order at long-range. The crystallinity indices are 86.88 and 83.40 for SC and SO sample respectively. This indicates that the sample produced using oxalic acid has better crystallinity. Different chelating agent also resulted different surface morphology profile. SC sample consists of less agglomerated small particles and uniform surface morphology with clear grain boundary. Whereas SO sample consist of agglomerated particle with clear grain boundaries and irregular particle distribution. Each sample showed different Zn to Al weight percentage ratio as recorded by EDS analysis. The sample properties can be improved by varying the chromium concentration and Zn to Al ratio.

**Keywords:** *Chromium doped zinc aluminate, phosphor, sol gel, chelating agent*

# Mixed-Halide Hybrid Perovskite with Amino (Methyl) Pyridine-Cation: Structural, Chemical, Optical, and Conductivity Properties

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A mixed-halide hybrid perovskite $C_6H_8N_2PbBr_2I$ has been prepared under a normal air conditions by mixing 2-amino(methyl)pyridine (AMP), lead bromide ($PbBr_2$) and hydroiodide (HI) acidic solution at various mixing ratio under reflux method. The existence of $NH_3^+$, pyridinium and Ar-H ions in the synthesized sample was confirmed by Fourier Transform Infrared (FTIR) spectroscopy analysis. X-ray diffraction (XRD) and ultraviolet-visible (UV-Vis) spectroscopy were used to examine the structural and optical characteristics. With an optical band gap of 2.47 eV, the mixed-halide hybrid perovskite was polycrystalline. The perovskite solar cell was made without a hole-selective layer, using a spin-coating method to build a $TiO_2/C_6H_8N_2PbBr_2I$ layer onto indium-tin-oxide (ITO) covered glass substrates. Electrochemical impedance spectroscopy (EIS) analysis revealed that the cell's bulk conductivity was in the range of $10^{-8}$ to $10^{-6}$ S $cm^{-1}$. Interestingly, by altering the mixed bromide-iodide and improving the perovskite material's stability, the optical band gap achieved under visible light may be modified to lower the energy band gap.

**Keywords:** *Amino(methyl)pyridine, mixed halides, nitrogen-less method, light-harvester materials, semiconductors.*

# PAPER ID: 65

# Effect of Copper Iodide Doping Concentration on the Indoor Photovoltaic Performance of Inverted Type Organic Solar Cell

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Photoactive layer of poly(3-hexylthiophene) (P3HT) :(6,6)-phenyl-C61-butyric acid methyl ester (PCBM) doped with copper iodide (CuI) in inverted type organic solar cell has displayed good potential for indoor application. However, the correlation between the CuI doping concentration and the photovoltaic performance under indoor light has yet to be determined. In this work, the amount of CuI dopant with respect to P3HT was varied in order to obtain an optimum doping concentration in inverted P3HT: PCBM based solar cell under white LED illumination. Electron transport layer of ZnO was spin coated on pre-cleaned fluorine-doped tin oxide (FTO) glass substrates. The P3HT: PCBM photoactive layers with different CuI doping concentrations of 0, 3, 6, 9 and 12 wt% were deposited on top of ZnO and top electrode silver (Ag) was thermally evaporated for device completion. It was found that the device with 9 wt% CuI-doped P3HT: PCBM gave the best power conversion efficiency of 13.83% under 1000 lx white LED illumination due to efficient hole collection and minimal leakage current.

**Keywords:** *Copper iodide, indoor application, organic solar cell, photoactive layer.*

# PAPER ID: 66

# First Principles Study of Electronic and Thermoelectric Properties of Surface (001) $ATiO_3$ (A=Pb, Sn) for Thin Film Application using Density Functional Theory

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Lead (II) titanate ($PbTiO_3$) has been emerged as promising material for thermoelectric sensor application. In this study, we proposed to use density functional theory and the Boltzmann transport equation approximation to investigate the underlying mechanism for improving the thermoelectric efficiency of $ATiO_3$ (A=Pb, Sn). The surface (001) modification through AO termination layer has increases the electrical conductivity, thus increasing the power factor. We discovered that increasing electrical conductivity, which is aided by a high density of states, improves the power factor of $ATiO_3$ (A=Pb, Sn). On the other hand, increasing the Seebeck coefficient, which is aided by declining thermal conductivity, which is aided by low, improves the figure of merit. It is shown that surface (001) tin (II) titanate ($SnTiO_3$) has higher thermoelectric performance compared to $PbTiO_3$, which is significant as a non-toxic material for benchmarking future improvements in thin film application.

**Keywords:** *density functional theory, electronic properties, thermoelectric properties, surface (001)*

# PAPER ID: 67

# Structural and Elastic Characteristics of Ti-Alloys Doped with β-Stabilizer for Human Bone Implant

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Titanium (Ti) and Ti alloys are promising materials for human bone implant due to their excellent in mechanical, biological and physical performance. However, despite of posse's good characteristic the drawback of Ti and its alloy with α-phase stabilizers has large difference in Young's modulus with human bone and may lead to implant failure. Innovative progress of Ti alloys doped with β-phase stabilizer has been developed to counter the issue. These types of alloys provide better characteristics with low elastic modulus and good biocompatibility with human tissue. In this paper, a first principle calculation is used to study the Ti alloy with various chemical β-stabilizers compositions. The theoretical calculation is carried out to evaluate the structural and elastic properties via the density functional theory (DFT) method. The accuracy calculation is confirmed by comparing the obtained data with previous experimental data. The results obtained suggest that the Ti alloyed with β-phase stabilizer significantly reduce the modulus of elasticity as compare with α-phase stabilizers. This finding may offer a better future alloy material for bone implant applications.

**Keywords:** *β-stabilizer, Density functional theory, Elastic properties, Ti alloys.*

# PAPER ID: 68

# Nanohybrid Polysulfone Membrane for Water Treatment Industries: Preparation and Characterization

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The development of nanofiltration (NF) membranes in water treatment industries nowadays is being affected by crucial factors such as high water flux with good separation property. In order to obtain this properties, nanohybrid membranes were fabricated via wet phase inversion method using silver-decorated graphene oxide (Ag-GO) embedded to polysulfone (PSf) dissolved in N-methyl-2-pyrrolidone (NMP) solvent. By adjusting the weight percentage ratio of Ag-GO with PSf polymeric solution, it was found that the addition of Ag-GO nanoplates with various ratio (0.00-1.00 wt%) has increased the hydrophilicity and permeability of the fabricated membranes as the pure water flux has improved from 7.86 to 34.75 $L.m^{-2}h^{-1}$. In addition, the rejection of this membrane to sodium chloride (NaCl) and sodium sulfate ($Na_2SO_4$) has improved from 18.2%, 37.4% to 43.4%, 78.5%, respectively. The rejection shows slightly decreasing trend towards applied pressure but a promising good performance with adjustment of pH due to the definite role over deciding the salt rejection behavior of the membrane. In conclusion, the prepared nanohybrid membrane not only exhibited good separation performance but also mechanically strong enough to withstand operating pressure.

**Keywords:** *Silver-graphene oxide, Polysulfone, Nanofiltration, Salt Rejection, Hydrophilicity*

# PAPER ID: 70

## Electroresistance effect in monovalent doped $La_{0.8-x}Dy_xNa_{0.2}MnO_3$ ($x$ = 0 and 0.1) Manganites

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The observation of electroresistance, ER effect which is related to reduction of resistivity under increased of applied current indicates the potential of manganite material for next generation spintronic based devices. The observed behaviour was attributed to the presence of magnetic inhomogeneity. However, such relation is still not well understood, hence current induced effect on the resistivity in monovalent doped $La_{0.8-x}Dy_xNa_{0.2}MnO_3$ ($x$ = 0, 0.1) manganites prepared using solid state reaction method have been investigated to elucidate the matter. The phase identification investigated using X-ray diffraction (XRD) pattern, showed both samples were single phase orthorhombic crystal structure. An analysis using Rietveld refinement show that unit cell volume decreased from 404.34 $Å^3$ ($x$ = 0) to 402.27 $Å^3$ ($x$ = 0.1) which may be related to smaller ionic radius of $Dy^{3+}$ ($r_{Dy3+}$ = 1.083 Å) compared to $La^{3+}$ ($r_{La3+}$ = 1.216 Å). The resistivity vs. temperature curve shown $x$ =0 sample exhibits metallic behavior in the whole temperature range of 30 K – 300 K while $x$ =0.1 sample exhibits metal-insulating transition behavior with metal-insulator transition temperature, $T_{MI}$ at 216.28 K under applied current of 5 mA. Both samples exhibit reduction in resistivity under high applied current of 10 mA in the wide temperature range of 30 K – 300 K which lead to ER effect. Large ER effect with value of 130% at 300 K observed for $x$ = 0.1 sample, while for $x$ = 0 the ER value is 9% indicates improved sensitivity of the Dy substituted sample towards electric field. The enhancement of ER effect is suggested due to the presence of magnetic inhomogeneities induced by Dy substitution which favours formation of more filamentary conduction paths under the presence of high applied current thus enhanced the conduction process of charge carriers.

**Keywords:** *Dy substitution, Electoresistance, Manganite, Resistivity*

# PAPER ID: 71

# Effect of Magnetic Ions (A=Ni, Cr; $x$ = 0 and 0.03) Substitution in $Pr_{0.75}Na_{0.25}Mn_{1-x}A_xO_3$ Manganite on Structural, Magnetic and Electrical Transport Properties

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The substitution of different types of magnetic ions such as Ni and Cr at concentration of $x$ = 0.03 at Mn-site in charge ordered insulator (COI), $Pr_{0.75}Na_{0.25}MnO_3$ manganite was found dramatically modifies the structural, magnetic, and electrical transport properties. The samples were synthesized using conventional solid-state method. The powder x-ray diffraction pattern shows a single-phase orthorhombic distorted perovskite structure with space group *Pnma* for all samples. Rietveld refinement analysis shown that unit cell volume increased due to $Ni^{2+}$ substitution while it decreased due to Cr substitution which may be due to different ionic radius of both ions. Electrical and magnetic measurement shown that both Ni and Cr substitution in $Pr_{0.75}Na_{0.25}Mn_{1-x}A_xO_3$ ($x$ = 0.03) suppressed COI state and induced ferromagnetic metallic behaviour. Ni-substituted sample exhibit larger metal-insulator transition temperature, $T_{MI}$ (132 K) compared to Cr- substituted sample (122 K). While the former exhibit lower ferromagnetic-paramagnetic transition temperature, $T_C$ (123 K) as compared to the later (132 K). The suppression of CO state and inducement of ferromagnetic-metallic state for the former is suggested due to$Ni^{2+}$ and $Mn^{4+}$ involves in ferromagnetic superexchange interaction, $Ni^{2+}$–O–$Mn^{4+}$ which facilitates double exchange mechanism. While for the later, the observed behaviour is suggested due to inducement of double exchange interaction involving $Cr^{3+}$ and $Mn^{3+}$ ions, $Mn^{3+}$–O–$Cr^{3+}$ which may promote the development of ferromagnetic phase. The variation in electrical and magnetic properties in Ni-substituted sample and Cr-substituted sample is suggested may be due to existence of different strength of ferromagnetic interaction between $Ni^{2+}$–O–$Mn^{4+}$ and $Mn^{3+}$–O–$Cr^{3+}$.

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**Keywords:** *Manganites, Charge Ordering, Magnetic Ion, Double Exchange Interaction,*

# PAPER ID: 74

# X-Ray Analyses and Density Functional Theory Study of NiO- $BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ and NiO-*m*-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ Composite Anode

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This paper discussed on a comparative study of NiO- $BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ (BCZY) anode composite that undergoes XRD and density functional theory (DFT) analyses, respectively. In a few decades, the study of fuel cells that convert chemical energy to electrical energy, has gained worldwide interest. The aim of this work is to focus on the structural properties of sintered NiO-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ and NiO-*m*-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ anode composite. Xpert Highscore and Material Studio are the software that have been used to assist the analyses. The data obtained in this study is compared with literatures to establish the understanding of XRD analysis and DFT study regarding the used of NiO-BCZY anode composite for the application in protonic ceramic solid oxide fuel cell.

**Keywords:** *XRD analyses, Rietveld Refinement, composite anode, PC-SOFC*

# PAPER ID: 75

# Physicochemical and Electrochemical Properties of LSCF and 70LSCF-30BCZY Cathode Composite: A Correlation Study

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The LaSrCoFe-based composite cathode for example $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF)-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{3-\delta}$ (BCZY) is favourable to be used in proton ceramic fuel cell (PCFC) due to the enhancement of reaction sites between electrolyte and cathode layer. In this present study, the pristine LSCF and 70LSCF-30BCZY were synthesized by a sol-gel method and then characterized by X-ray diffractometer (XRD) and electrochemical impedance spectroscopy (EIS). The physicochemical properties of the samples such as specific surface area (determined by Sauter formula considering the X-ray density) and crystallite size (calculated with Scherrer's equation and Williamson-Hall method) were investigated and correlated to the electrochemical properties. The specific surface area obtained in this study was compared with the value obtained using Brunauer-Emmet -Teller (BET) from the literature and the divergence was elucidated. It can be deduced that (i) the specific surface area was found to be inversely proportionate to crystallite size and (ii) a larger specific surface area contributed to the lower area specific resistance (ASR) value, indicating a good performance of LSCF-BCZY as composite cathode for PCFC application.

**Keywords:** *Cathode, specific surface area, crystallite size, area specific resistance*

# PAPER ID: 76

## A Short Review on Catalytic Properties for Dry Methane Reforming

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New clean energy technologies with higher energy conversion efficiency and lower emission are required to address global energy and climate change challenges. Dry methane reforming (DMR) is getting attention as its reaction utilizes greenhouse gases, carbon dioxide and methane as feedstock and reduces their emissions into the atmosphere. However, massive deactivation of catalysts for DMR especially Ni-based catalyst due to carbon coking hinders its industrialization and commercialization. Thus, the development of catalysts that enhance catalytic activity, stability and resistance towards deactivation is crucial. The objective of this short review is to explore the interactions among catalyst components (active metal, support and promoter), particle size and basicity in DMR atmosphere. This study also reviews the catalytic properties required for the development of flexible, durable and robust catalyst for hydrocarbon fuel application in fuel cells. One main finding from this review is that catalyst design should not only take the individual impacts of every catalyst component in DMR reaction into consideration but also the synergistic effects of combining those components.

**Keywords:** *Methane Reforming, Deactivation, Active Site, Support, Review.*

# PAPER ID: 77

# Enhanced the Properties of ZnO Thin Film by Graphene Oxide Coating at Different Concentrations Via Solution Immersion Method

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ZnO-based materials are the most commonly used metal oxide semiconductor film due to their excellent chemical and physical properties. Due to its remarkable qualities, graphene has become the key research subject for the previous few decades among all carbonaceous materials. In this study, the derivative of graphene, Graphene oxide (GO) were coated on ZnO thin film to fabricate the ZnO/GO thin films by using simple solution immersion method. The structural, optical, and electrical properties have been systematically investigated to study the influence of GO concentration ZnO thin film. XRD analysis shows good crystallinity between all the thin films. Gradually increasing the content of graphene oxide up to 0.5mg/ml promoted the peak intensity on (002) plane. The current–voltage measurement results indicate that the ZnO/GO thin film with 0.5mg/ml has good electrical properties with resistance value of 514 cmΩ. Moreover, the ZnO/GO thin film consisting of 0.5mg/ml GO has a high surface area and porosity, which is beneficial to the devices' adsorption and mass transfer of dye.

**Keywords:** *Zinc Oxide, Graphene, derivative, immersion, porosity.*

# PAPER ID: 78

# Effect of Growth Time of Zinc Oxide Nano Rod in Hydrothermal Process to the Performance of Dye-Sensitized Solar Cells

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In this study, the effect of varies growth time of ZnO nanorods to the dye-sensitised solar cells was investigated. ZnO nanorods were grown using hydrothermal method by zinc oxide nanoparticle layer on indium tin oxide coated glass. Then, the layer of chlorophyll and imidazolium is deposited on the grown ZnO layer and left to dry. The structure and morphology of zinc oxide nanorods have been studied using X-ray diffraction (XRD), scanning electron microscope (SEM), UV-vis spectroscopy and two-point electrical probe. The diameter and length of nanorod increased with growth time. This gives effect to the light absorption properties of simple dye-sensitize solar cells. The highest average efficiency with dye is about 6.20% for the sample with 5 hours growth time. With the higher surface area contribute by the growth of nanorod, the interaction between oxide surface with dye molecules can be optimize for efficient photon to electron conversion in dye-sensitized solar cells, thus contribute to higher solar conversion efficiency.

**Keywords:** *Seeding process; hydrothermal method; zinc oxide nanorod; dye-sensitized solar cells.*

# PAPER ID: 81

# Dose Response of Radiation-Induced Low-Dose Film Dosimeter of Inorganic Salt and Red Cresol Dyed Blended PVA

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This work aims to study the effect of X-ray on the optical properties of film dosimeter based on a mixture of inorganic salt and red cresol dyed blended in Polyvinyl alcohol (PVA) matrix. PVA has long been an ideal polymer in the biotechnical and biomedical communities. It is non-toxic, non-carcinogenic, and has good biocompatibility as well as desirable physical properties including elasticity and good film-forming properties. Eventually, the magnesium sulphate $MgSO_4$ was introduced to the blended polymeric system as a stabilizer and also increase the sensitivity of the fabricated dosimetric film. The films were successfully prepared using the casting technique by dissolving magnesium sulphate powder with various molarity into PVA solution. Then, 1 ml of red cresol dye was added to the solution. The dried films were then cut into one-dimensional (1 cm x 5 m) and exposed to the X-ray photon beam with varying kinetic energy from 0 kVp until 80 kVp at 3.2, 5 and 10 mAs. The optical characterization was performed using Shimadzu UV-1800 UV-visible spectrophotometer with a wavelength ranging from (200-800) nm to determine the absorbance spectrum, optical energy bandgap. The absorbance band peaks of the absorbance band spectra were observed at the ultraviolet (UV) region. It was found that the optical energy gaps values for both irradiated and unirradiated samples shifted to the higher energies for indirect optical bandgap and shifted to lower energies for direct optical bandgap. The results of this study demonstrated the potential application of the fabricated polymeric film to be used in the diagnostic range as a dosimeter.

**Keywords**: *PVA, red cresol dye, UV-Visible spectrophotometer*

# PAPER ID: 83

## Effect of Synthesis Temperature on the Morphological Structures of Graphene-ZnO Microsphere Composites Prepared by Solvothermal Method

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Graphene-ZnO microsphere (G-ZnO(MS)) composites were prepared through solvothermal synthesis route at five different synthesizing temperatures (75, 90, 120, 150 and 180 °C) for 24 h. The morphological structures of the samples were characterized using X-ray diffraction (XRD), Raman spectroscopy, field emission scanning electron microscopy (FESEM) and transmission electron microscopy (TEM). The diffraction peaks of the composites revealed the formation of a hexagonal phase wurtzite ZnO structure. The dimension of the ZnO nanoparticles is approximately 30 nm. The existence of graphene and ZnO in the structure of the produced G-ZnO(MS) composites were confirmed by Raman spectra. FESEM investigation showed that homogeneous microspheres consisting of ZnO nanoparticles were decorated on the graphene sheets. The size of the microstructures has grown as the synthesis temperature increased. At temperatures of 120°C and above, TEM analysis revealed that hollow microstructures are formed.

**Keywords:** *Graphene, Zinc Oxide, Hollow Sphere, Supercapacitors, Solvothermal*

# DFT Study on Structural Properties, Density of States and Band Structure of Mono- & Bi-Layer Graphene

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This two-dimensional (2-D) carbon structure, known as graphene, has tremendous potential due to its unique properties. This research intends to identify the existing knowledge gap because of the lack of substantial studies and prior comparisons in bilayer graphene and bring to light any pertinent differences between mono- and bi-layer graphene in this field. So, a density functional theory (DFT) study was done using a Quantum Espresso package for analysing the structural properties of mono- and bi-layer graphene. Generalised gradient approximation (GGA) under Perdew-burke-ernzerhof (PBE) of the DFT study and pseudopotential method was employed in this thesis. Once the relaxation has been calculated, the three parameters that control monolayer and bilayer graphene structures, charge density, the density of states (DOS) and band-structure, were obtained. The findings demonstrated the precise structure of mono- and bi-layer graphene viewed in XCRYSDEN software by looking at the variable cell relaxation calculation. The mono-and bi-layer graphene study has successfully predicted the bandgap and the DOS, proving the zero-gap semiconductor tag. Band-structure of mono illustrated toroidal like shape whereas bilayer projected hyperbolic type of band-structure. The hybridisation of graphene is $sp^2$. Bilayer graphene is more time consuming if compared to monolayer for hybridisation of the orbital.

**Keywords:** Density functional theory, graphene, quantum espresso, structural properties, density of states

# The Effect of Dynamic Vulcanization on the Properties of Ethylene Vinyl Acetate (EVA)/Natural Rubber (NR)/Mengkuang Leaf Fibre (MLF) Thermoplastic Elastomer Composites

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The effect of dynamic vulcanization with different loadings of mengkuang leaf fibre (MLF) on ethylene vinyl acetate (EVA)/natural rubber (NR) thermoplastic elastomer composites vulcanized with sulfur and dicumyl peroxide (DCP) was studied. In this study, the optimum ratio of EVA/NR blends was chosen is 50/50, and MLF loading was varied from 0wt%, 10wt% to 40wt%. Morphological analysis revealed that the addition of MLF resulted in a poor fibre dispersion in the matrix and fibre agglomeration, which may have affected the efficiency of stress transfer and thus may have been responsible for a decrease in tensile and thermal properties. The composites with dynamic vulcanization, on the other hand, have a rougher surface, which could be due to the presence of crosslinking, which requires more force to fail and thus has better tensile and thermal properties. When comparing different vulcanization systems, the study found that the peroxide cure system had higher tensile properties than the sulfur cure system and unvulcanised composites. However, the sulphur cure system outperformed the peroxide cure system in terms of thermal degradation resistance. This was attributed to dicumyl peroxide (DCP), which causes polymer chain degradation or chain scission in composites at high temperatures.

**Keywords:** *Dynamic Vulcanization, ethylene vinyl acetate, natural rubber, Mengkuan leaf fibre, thermoplastic elastomer*

# Effects of Inorganic Salts and Maltose on the Dose-Response of HEMA Polymer Gel Dosimeters at Diagnostic Range

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The first polymer gel that contains maltose and inorganic salts, magnesium sulphate ($MgSO_4$) has been introduced in this research work as a new low toxicity and sensitive polymer gel dosimeter. The assessment is based on the effect of magnesium sulphate and maltose towards the dose-response at the diagnostic range, melting point and density of the polymer gels. Various concentration (0.5 – 1.0 M) of magnesium sulphate ($Mg_2SO_4$) and (0.15 - 0.30 M) of maltose ($MgSO_4$) were added to improve the basic composition of the polymer gel which consist of deionized water, gelatine, N,N'-Methylenebisacrylamide (BIS), ascorbic acid and 2-hydroxyethymethacrylic acid (HEMA). The polymer gels were then exposed with X-ray at different (40-80 kVp; 5-100 mAs) modality energy setup. Maltose is aid in the increments of the polymer gel melting point. Eventually, maltose is a type of sugar which has been demonstrated to improve the thermal stability and density of a polymer gel in order to obtain the desired tissue-equivalent properties. The use of inorganic salts as additives is to improve the dose-response of polymer gel dosimeters based on the indirect optical characterization.

**Keywords:** *Polymer Gel Dosimeter, HEMA, Diagnostic X-ray, UV-Visible spectrophotometer*

# PAPER ID: 92

# Green Corrosion Coating Using Palm Oil Based Urethane Acrylate (POBUA) On Mild Steels in 3.5 NaCl Solution

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The in situ intercalative polymerisation of acrylate palm oil and isocyanate with present of Hydroxyethyl acrylate (HEA) were undertaking to produce Palm Oil Based Urethane Acrylate (POBUA). Several coatings formulation from POBUA with different type of photo initiator were prepared and applied on mild steel surface before exposed under UV irradiation towards green anticorrosion coatings formation. The disappearance of FTIR spectrum of cured POBUA coatings at around 810 $cm^{-1}$ was confirmed the development of crosslinked network. Soxhlet extraction and pendulum hardness test were carried out to investigate the crosslinked network performance in cured film. Meanwhile potentiodynamic polarization analysis in 3.5% NaCl solution was conducted to explain the anticorrosion mechanism of POBUA and TAFEL plot was manipulated in measured the corrosion rate of mild steel. Contact angle (CA) and adhesion test also demonstrated in this work to study surface properties of POBUA. The results indicate mild steel coated with POBUA film owe better corrosion resistance compared to blank mild steel. Crosslink polymer network formation from POBUA was effectively protected the mild steel surface from corrosion agent such as oxygen and water. CA result also showed hydrophobicity behaviour of POBUA give a value added properties in reducing corrosion process.

**Keywords**: *Palm Oil Based Urethane Acrylate (POBUA), Ultraviolet (UV) irradiation technique, Anticorrosion Coating.*

# PAPER ID: 95

# Comparison of Characterization of Regenerated Cellulose Hydrogel Composed with Polyanionic and Polycationic Polymers

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Regenerated cellulose (RC) hydrogel is fabricated by dissolution-regeneration process via 'green' derivatizing system of sodium hydroxide (NaOH)/urea solution. The versatility of RC to be composed with other polymeric materials has shown a great interest to enhance the characteristic of RC hydrogel. In this study, two different ionic interaction RC hydrogels were fabricated successfully via simple one pot method in NaOH/urea system. The ionic interactions in the hydrogel matrix was determine by homogenous blending of RC/carrageenan(CG)/chitosan(CS) and RC/CG/alginic acid (AA) to reflect the polyanionic and polycationic properties, respectively. The respective RC hydrogels were characterized by studying swelling and re-swelling degree, as well as measuring thermal degradation and chemical interaction via Thermogravimetric Analysis (TGA) and Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR). Result on the RC/CG/AA showed an excellent swelling and re-swelling ability due to molecular relaxation of negatively charge ions presented in CG, RC and AA as well as good thermal behaviour.

**Keywords:** *Chitosan, carrageenan, alginic acid, protonation, deprotonation, helical entanglement*

# PAPER ID: 96

## Global Trends in SOFC Scenario and Future Perspectives

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Solid oxide fuel cells are high-efficiency cogeneration devices with the potential to improve the efficiency and cost-effectiveness of a wide range of fuels; hydrocarbon, coal gas, biomass, hydrogen, and other renewable fuels. To date, several types of SOFCs have been used for a wide range of applications, including power generation for the grid-scale, stationary, and portable applications. The common feature of SOFC is the use of ceramic materials that exhibit excellent chemical stability, sufficient mechanical strength and low activation energy. However, the expensive cost of the catalyst and its operating temperature, are major roadblocks to the technology's commercialisation. A few trends and highlights of current scientific advances in SOFC for energy applications are discussed. This review summarises current progress in SOFC development with a focus on; (i) current trends, the publication pattern and (ii) challenges and opportunities in the SOFC advancements.

**Keywords:** *Solid Oxide Fuel Cell, Proton Conducting Fuel Cell, Hydrogen Energy*

# PAPER ID: 98

## Effectiveness of Sulphuric Acid/Lactic Acid as Catalyst towards Bio-based Polyol

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Bio-based polyol derived from lignocellulosic biomass like kenaf is synthesized by using liquefaction process. Kenaf was liquefied in the mixture of liquefying solvents like polyethylene glycol 400/glycerol (PEG400/Gly) called as polyhydric alcohols and use various ratio of sulphuric acid/lactic acid to obtain bio-based polyol. Liquefaction process was conducted at different temperature with constant time. The main objective of this study is to examine the effect of inorganic/organic acid act as catalyst in the process. The liquefaction yield and hydroxyl number were calculated meanwhile the viscosity of polyol was characterized by using viscometer. The obtained solid residue was analysed by utilizing Fourier Transform Infrared (FTIR) spectroscopy. The results showed the highest hydroxyl group which is renewable and safe for environment able to substitute the commercial polyols made from petrochemical based.

**Keywords:** *Liquefaction process, lignocellulosic biomass, kenaf, catalyst, viscosity*

# PAPER ID: 99

## Novel Intercalation Mechanism of Cationic Surfactants Modified Muscovite

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Intercalation of cationic surfactants cetyltrimethylammonium bromide (CTAB) into the interlayer space of muscovite by ion-exchange process was investigated. Changes in the surface and structure of the muscovite modified with CTAB were characterized using WAXD, FTIR and TEM. As revealed by WAXD results, the basal spacing of CTAB-muscovite increase from 0.99 nm to 2.82 nm indicates the formation of an intercalated structure. Through this intercalated structure the $CTA^+$ ions in the muscovite interlayer space were arranged in a paraffin complex that may ease the process of intercalation within the polymer matrices. Fourier transform infrared (FTIR) spectra indicated a new absorption bands at 2922 and 2855 $cm^{-1}$ signifies the presence of long alkyl chain verifying the incorporation of CTAB into the muscovite structure. The FESEM images showed separation within the muscovite layers was more intense, given their flat morphology. These micrographs demonstrate that CTAB addition had expanded the basal spacing in the muscovite layers. The present study thus concludes that the intercalation of CTAB-modified muscovite has a potential for polymer intercalation can be tailored to a specific purpose.

**Keywords:** *Cationic Surfactants, Ion-Exchange,Muscovite*

# PAPER ID: 101

# Effect of Different Types of Fillers on Dielectric and Microwaves Properties of Rubber-based Composites

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This work investigates the effect of different types of fillers on the dielectric and microwave properties of rubber-based composites. The effects of activated carbon-based rice husk (AC-RH), graphite (G), bamboo charcoal (BC), and calcium carbonate (CC) on rubber-based composites were studied and compared in terms of dielectric constant, loss factor and reflection loss. The dielectric properties were measured using the commercial coaxial probe (Agilent 85070E), while the microwave properties using a fabricated monopole sensor in the frequency range between 2 and 20 GHz. The results showed that fillers did improve the dielectric and microwave properties of rubber-based composites. AC-RH has the highest values of dielectric and microwave properties.

**Keywords:** *Activated carbon, rice husk, graphite, bamboo charcoal, calcium carbonate, rubber composites, coaxial probe, monopole sensor, dielectric and microwave properties*

# PAPER ID: 102

## Judd-Ofelt Analysis and Up-conversion of $Er^{3+}/V^{4+}$ Co-doped $Na_2O$-$CaO$-$B_2O_3$ Glasses

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The erbium borate glasses were co-doped with vanadium in order to improve their optical properties for potential optical fiber and glass laser application. In this project, borate glass with the composition $20Na_2O–20CaO–(59 – x)B_2O_3–xV_2O_5–1Er_2O_3$ ($x$ = 0–2.5 mol%) has been successfully prepared by melt-quenching method. Structural investigation of glass samples was determined by XRD and by Fourier transform infrared (FTIR) spectroscopy while optical properties were carried out by UV–Vis–NIR and photoluminescence (PL) spectroscopy. The absorption spectra of glasses exhibited 10 significant bands, which corresponded to the $f$–$f$ transition of $Er^{3+}$ ions with an additional weak absorption band attributed to $V^{4+}$ energy transition. The variation of oscillator strength ($f_{exp}$) and Judd–Ofelt parameters ($\Omega_{2,4,6}$) showed almost similar trend, which exhibit a maximum at $x$ = 0.5 mol% $V_2O_5$. The up–conversion PL spectra for the glasses under 779 nm excitation displayed 3 emissions bands centered at 518, 556 and 647 nm due to the emission from the energy levels of $Er^{3+}$. The enhanced emission at 647 nm (red region) that corresponded to the $^4F_{9/2}\rightarrow{}^4I_{15/2}$ of the $Er^{3+}$ transition was suggested due to energy transfer from $V^{4+}$ to $Er^{3+}$ ions.

**Keywords:** *Borate glass; Judd–Ofelt analysis; up–conversion; energy transfer*

# PAPER ID: 103

# Structural and Electrical Properties of $LiNi_{1-x}Ru_xO_2$ (x=0.3,0.4) as a Potential Electrode for Symmetrical Solid Oxide Fuel Cell

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Symmetrical solid oxide fuel cell (S-SOFC) application is capable of simplifying the manufacturing process, enhancing coking and sulfur poisoning tolerance by converting the anode and cathode, and switching versatility between SOFC and solid oxide electrolysis cell type, which has recently drawn a great deal of attention to this system. In this work, $LiNi_{1-x}Ru_xO_2$ with x=0.3 and 0.4 (later denoted as LNR3 and LNR4) have been studied to make this lithiated compound a feasible S-SOFC electrode material. $LiNi_{1-x}Ru_xO_2$ was synthesized via the sol–gel method and heat-treated at the chosen calcination temperature 700 °C, suiting the lithiated material heating pattern. Calcined $LiNi_{1-x}Ru_xO_2$ powders, which will act as electrodes, were examined for primary element studies. The influence of the different compositions of dopant (Ru) was examined by X-ray diffraction. The pellets were heat-treated at 800 °C and characterized for Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray analysis. The microstructure of the $LiNi_{1-x}Ru_xO_2$ pellets surface observed via SEM analysis exhibits particles of different shapes and percentage of porosity. Lastly, the electrical conductivity behaviors of the $LiNi_{1-x}Ru_xO_2$ pellets were analyzed using direct current measured through a four-point van der Pauw technique for the cathode working environment. In this study, the working mechanism of this material as a cathode was highlighted. The activation energy of the $LiNi_{1-x}Ru_xO_2$ was obtained and analyzed through the electrical conductivity analysis. The activation energy of the electrical conductivity for LNR3 and LNR4 are 4.44 kJ/mol (0.046 eV) and 7.57 kJ/mol (0.078 eV), respectively. These values are higher compared to the undoped $LiNiO_2$ from previous work (0.14 – 0.19 eV). This research highlights that a stable and efficient $LiNi_{1-x}Ru_xO_2$ cathode can be a potential S-SOFC electrode candidate.

**Keywords:** *Electrode; electrical activation energy; lithiated materials; symmetrical solid oxide fuel cell*

# PAPER ID: 104

# Physical, Mechanical Properties and Thermal Shock Resistance of $Li_2O$-$Al_2O_3$-$SiO_2$-MgO-$TiO_2$-$Na_2O$

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The aim of this study is to investigate the effect of thermal shock on the lithium aluminosilicates (LAS) glass-ceramic. LAS glass-ceramic is well known for having low thermal expansion coefficient property, in which this property has been associated with enhanced thermal shock resistance. The physical and mechanical properties of LAS glass-ceramic must also be evaluated in order to investigate their influence on the thermal shock resistance property. The LAS glass-ceramic was prepared by a conventional melt-quenching method and then thermally treated for 210 minutes at 1100°C. The density, porosity, and flexural strength of the LAS glass-ceramic were revealed to be 2.15 g/cm$^3$, 1.87% and 74.54 MPa, respectively. Meanwhile, the effect of thermal shock on the LAS glass-ceramic was accomplished by heating sintered LAS specimens to three different thermal shock temperatures (200 °C, 500 °C and 800 °C) for 15 minutes before quenching the specimens in a distilled water bath container. The LAS glass-ceramic was able to withstand thermal shock at 500 °C while retaining 99% of its initial strength. The findings demonstrated that the improved LAS glass-ceramic in resisting thermal shock is suitable for applications requiring rapid temperature changes of up to 500 °C, such as cooktop panels.

**Keywords:** *Lithium aluminosilicate, flexural strength, thermal shock resistance, thermal shock test*

# PAPER ID: 105

# Mechanical Properties of Natural Rubber Vulcanizates Containing Ethylene Propylene Diene Rubber Waste at Different Types of Vulcanization System

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Ethylene Propylene Diene Rubber (EPDM) waste filled natural rubber (NR) that cured by using conventional vulcanization (CV), semi-efficient vulcanization (semi-EV) and efficient vulcanization (EV) system was successfully compounded by an internal mixer. The ratio of sulphur and accelerator is different for each vulcanization system, that finally affect the vulcanizate properties due to the different structural features of an accelerated sulphur vulcanizate of NR. 60 phr of pulverized EPDM waste was incorporated into 40 phr of NR in each vulcanization system. Studies about the usage of abundantly available EPDM waste as a potential filler is essential towards green environment and minimize landfill area in future. It is found that the cured rubber with CV system has the best properties due to high degree of crosslinking of polysulphidic crosslink. Tensile properties and abrasion resistance of the rubber compound indicated its mechanical properties were investigated. Density and hardness test were also done to study its physical properties. For tensile strength, CV system has 14% increment from EV system because of a stress-relieving mechanism that exhibited in this vulcanization system. As for tensile modulus, M500 for CV system shown 29% increment than EV system. As a result of the decreased chain flexibility caused by the increased crosslinking density in the CV system, the elongation at break of the vulcanizate is the lowest (174 mm) when compared to the EV system (336 mm). CV system shown highest Abrasion resistance index (ARI) i.e 1820%. This indicate that very small amount of mass loss obtained for the CV cured rubber during the testing. CV system gives highest density and hardness values i.e 1.0747 g/cm$^3$ and 52.5 Shore A, respectively. Thus, the results indicated that NR containing EPDM waste cured by CV system is able to be utilized in the development of rubber compound with a compromise property.

**Keywords:** *Natural Rubber, Vulcanizates, Mechanical Properties, Vulcanization System, EPDM Waste*

# PAPER ID: 108

## Functionalization of Carbon Nanofibers using Dodecylamine and Octadecanol and Their Characterization

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In this paper, carbon nanofibers (CNFs) were functionalized using sulphonitric treatment, and then further modified using two different reactants via amidation and esterification process. CNFs-carboxyl was prepared first to introduce carboxyl functional group by adding mixture of $H_2SO_4/HNO_3$. This carboxyl functional group was used as reaction precursor in the amide and ester functionalization. Two different reactants used were choose based on their role in enhancement of dispersibility properties of CNFs. Dispersibility properties of modified CNFs improved after functionalization with carboxyl, ester, and amide group due to functional group could create polar bond with solvent. Modified CNFs were characterized to determine the functionalization effect on the surface of CNFs. The samples were identified and quantified by Fourier Transform - Infrared spectroscopy and Thermogravimetric analysis. The CNFs functionalization was evidenced by Raman analysis comparing the ratio of peaks at 1350 and at 1580$cm^{-1}$.

**Keywords:** *Carbon nanofibers, Amidation, Esterification, Sulphonitric*

# PAPER ID: 109

## Magnet Potential Energy Research for Magnetism System Development

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Rare earth magnets are magnetically attracted to one another. A magnetic field can be generated without the need of electricity by converting electrical and mechanical energy. Previous research and studies in magnets have been conducted in order to generate renewable energy and reduce radiation in the magnet. These objectives can be met by employing a rare earth magnet. The goal of this research is to create a rare earth magnet magnetism system, determine the magnetism of the rare earth magnet, and investigate the relationship between the magnetic field and radiation. Its distinct elemental qualities and characteristics have made it an alternate source for replacing some conventional or traditional mechanical systems in order to improve overall performance and efficiency. Rare earth magnets, specifically N52, are being analysed and tested for this project since their magnetic force is higher than that of any other magnet. This study's technique is based on the use of Finite Element Method Magnetics (FEMM) software to construct, analyse, and simulate a rare earth magnet in order to examine the flux and magnetic field strength. Strong permanent magnets, such as Neodymium-Iron-Boron (NdFeB), are commonly used in the development of non-mechanical contact with high velocity motion. As a result, maintenance requirements like as lubrication and bearing replacement are reduced. This presentation will concentrate on the investigation and analysis of how magnetic potential energy is utilised inside engineering mechanisms such as Magnetic Levitation (Maglev). A continual literature review will be conducted in order to learn more about some theories about permanent magnets and electromagnetic principles. A simple model will be simulated to produce the desired result, such as magnetic flux density within and surrounding the magnets, magnetic field strength estimation, force applied, and so on. Data will be collected by adjusting some parameters and observing the changes in the outcome after a series of simulations.

**Keywords:** *Magnetism, Permanent Magnets, Potential Energy*

# PAPER ID: 110

## Optical Properties of xSrO-(90-x) $B_2O_3$-2$CeO_2$-8$Al_2O_3$ Glasses

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Glass samples with the composition of xSrO-(90-x)$B_2O_3$-2$CeO_2$-8$Al_2O_3$ (x = 25-50 mol%) were prepared by melt-quenching method to investigate the optical properties with respect to the structural changes in glass system. UV–Visible and Luminescence spectroscopes were used in the present work. Presence of crystalline phases along with the glass matrix at x > 35 mol% resulted in higher of optical band gap ($E_{opt}$) and lower of refractive index ($n$) values. Formation of $BO_4$ and partial crystallization have resulted in enhancement and quenching of emission spectra in the SrO-$B_2O_3$-$CeO_2$-$Al_2O_3$ glasses, respectively.

**Keywords:** *Borate glass; Optical properties; Rare earth, Strontium*

# PAPER ID: 111

# Preparation and Physicochemical Properties of Polyester Polyol Plasticized Poly(lactic acid)/Zinc Oxide Films

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Poly(lactic acid) (PLA), a thermoplastic polymer, has been regarded as a potential substitute for petrochemical-based plastics due to its high mechanical properties, biodegradability and low production cost. Additionally, PLA is biocompatible and bioabsorbable which allow its application in biomedical fields. Unfortunately, its brittleness, slow biodegradation rate and poor antibacterial activity have restricted its extensive applications. In this work, polyester polyol was synthesized from palm oil and used as an eco-friendly plasticizer for PLA. Subsequently, the plasticized PLA films was incorporated with various amount of zinc oxide nanoparticles (ZnO-NPs) to impart antibacterial property to the PLA films. The plasticized PLA/ZnO-NPs films were prepared via a solution casting method and characterized using differential scanning calorimetry (DSC), scanning electron microscopy (SEM), tensile, *in-vitro* enzymatic degradation and antibacterial tests. The presence of ZnO-NPs increased the crystallinity, degradation rate and tensile strength of PLA films. SEM micrographs showed that ZnO-NPs were well dispersed within PLA matric at low ZnO-NPs loading, but agglomerations were noted at higher ZnO-NPs loading. In addition, PLA/ZnO-NPs films also displayed good antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*.

**Keywords:** *Poly (lactic acid), Polyester Polyol, Zinc Oxide, Antibacterial; Enzymatic Degradation*

# PAPER ID: 114

# Numerical Study on Refractive Index Modification of Chromium Oxide Coated Silica Optical Fiber Sensor Using COMSOL Multiphysics

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Precision agriculture had recently been employed in main plant commodities in Malaysia, namely palm oil and paddy. The integration of state-of-the-art technologies into the system, particularly optical fiber, had revolutionized agricultural field vastly. However, currently used silica-base optical fiber sensor exhibits low sensitivity to detect amount of Nitrogen in crops. In this study, it is shown by addition of chromium (IV) oxide coating able to produce highly sensitive silica optical fiber sensor. Specifically, the main objective of this study is to simulate, develop and optimize the refractive index modification as a function of chromium (IV) oxide layer thickness coated on silica optical fiber. Using the finite element method (FEM), a numerical study is conducted using COMSOL Multiphysics software to investigate the optimum configurations: chromium oxide thickness and other properties that renders highest sensor sensitivity with good accuracy and considerable economy of time and resources. The addition of chromium (IV) oxide layer around the silica optical fiber modified the refractive index (RI) and enhanced the sensitivity by 40-50 % of the optical fiber sensor. The highly sensitive optical fiber sensor produce in this study can be further extended to broad areas of chemical sensing in agricultural sectors.

**Keywords:** *Chromium (IV) Oxide, Optical Fiber Sensor, Refractive Index, Coating, Agriculture*

# Optimization of Thin Wasted Polystyrene Embedded Multiwall Carbon Nanotubes (MWCNT) Film for Solid Electrolyte of Flexible Dye-Sensitized Solar Cell (DSSC)

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The utilization of organic solvent in a conventional liquid-based electrolyte have led to the solvent's evaporation, hermetic sealing of the cell, hence lack of cell durability. To prevent the fluidity and potential leakage, the composite polymer-based electrolyte has been explored. Hence, the main objective of this study is to develop thin polystyrene embedded multiwall carbon nanotube (MWCNT) film with improving electrochemical properties as electrolyte host for flexible DSSC application. In this study, the MWCNT will be functionalized with carboxyl group using sulfonitric solution. Transmission electron microscope (TEM) were used to evaluate the morphology of MWCNT. Different weight percentage of the functionalized MWCNT were embedded into the polystyrene and their effect on the morphology, and uniformity of the thin polymer films were analysed using field emission electron microscope (FESEM). The electrochemical properties of the prepared polystyrene embedded MWCNT based polymer electrolyte were studied using electrochemical impedance spectroscopy (EIS). The study shows that the optimum loading of MWCNTs in the thin polystyrene embedded MWCNTs film is 0.003 g. These composition exhibits the highest ionic conductivity and the lowest resistance. Further increase in the amount of MWCNTs results in reducing the ionic conductivity due to the percolation network of the MWCNT with the polystyrene.

**Keywords:** *Surface Roughness, Ionic Conductivity, Resistivity, Polymer Electrolyte*

# PAPER ID: 119

# Effect of Polymer Types on Metal Oxide Substrates as an EGFET Sensor based Nitrate Sensing Layers

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In this paper, polyvinyl butyral (PVB) and Polyvinylpyrrolidone (PVP) as nitrate sensing was fabricated on different metal oxide substrates namely tantalum pentoxide (Ta2O5) and indium tin oxide (ITO) respectively. Both PVB and PVP was prepared by mixing 2.0g of PVB/PVP in 20 mL ethanol and deionized (DI) water with ratio 8:2 to form 10 wt%. The prepared solution was stirred for 1 hour at 350 rpm. Then, the prepared solution was deposited on top of Ta2O5 and ITO substrates using spin coating method. The nitrate sensing sensitivity of fabricated samples was tested at three different nitrate concentrations (0, 50, 100 ppm). From the result, it showed that the PVP on ITO substrate recorded highest sensitivity and linearity with 40.9 mV/dec and 0.999, respectively.

**Keywords:** *polyvinyl butyral, polyvinylpyrrolidone, nitrate sensi, spin coating*

# PAPER ID: 121

# Optimization of the Liquid Source $YBa_2Cu_3O_y$ +$ErBa_2Cu_3O_y$ + $Ba_3Cu_5O_8$ in Bulk $YBa_2Cu_3O_y$ Superconductors Grown by Infiltration Growth Process

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$YBa_2Cu_3O_y$ (Y123) superconductors are well known as high-temperature superconductors (HTS) that can be prepared by various types of methods. In this study, Y123 bulk superconductors were fabricated by the infiltration growth process due to the promising way and most established technique consisting of $Y_2BaCuO_5$ (Y211) precursor powders and liquid phases towards the fabrication of bulk $YBa_2Cu_3O_y$ (Y123) superconductor for high field industrial applications. The study of the liquid phase with different ratios of Y123 and Er123 with Y035 were investigated to utilize the superconducting efficiency performance of YBCO in critical current density, $J_c$ at high magnetic fields. It was found that the highest $T_{c\text{-onset}}$ was 91.85 K for sample $Y_1Er_0$. We also reported that the sufficient supply of Y123 into the Y211 preform resulted in uniform distribution of Y211 particles in the Y123 matrix. The formation of smaller-sized Y211 particles of 0.99 ± 0.24 µm for $Y_1Er_0$ samples acts as an effective pinning centre, which had improved the critical current density, $J_c$. Sample $Y_1Er_0$ at 77 K with H//*c*-axis having the highest $J_c$ 54.15 kA/cm$^2$ and 11.45 kA/cm$^2$ in self-field and 2 T, respectively. Nevertheless, appropriate amounts of Er123 used in the liquid source pellet could be proven through the $J_c$ analysis where the $J_c$ values using the $Y_0Er_1$ had deduced the $J_c$ value of the samples. Based on these results, we can optimize the addition of Er123 in the liquid phase, resulting in improved microstructure and high $J_c$ values of the bulk Y123 single grains.

**Keywords:** *Y123 superconductor; infiltration growth process; liquid phase; critical current density*

# PAPER ID: 122

## Comparative Study on Superconducting Properties and Surface Morphology Analysis for $Y_{0.85}K_{0.15}Ba_2Cu_3O_{7-d}$ and $Y0.85Ca_{0.15}Ba_2Cu_3O_{7-d}$ Synthesized via Thermal Treatment Method

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A comprehensive investigation on the comparison of superconducting properties and surface morphology analysis for $YBa_2Cu_3O_{7-d}$ (YBCO) substitution with alkali metals (K and Ca) at Y site was conducted via the simple thermal treatment method. The superconducting properties and surface morphology of the specimens were characterized by using AC susceptibility (ACS), Field Emission Scanning Electron Microscope (FESEM) and Energy Dispersive X-Ray Spectroscopy (EDX). From ACS and FESEM results, the superconducting properties improved after Ca substitution in the YBCO system with higher average grains size compared to that of the pure and K substitutions specimens. Thus, it's Josephson's current, $I_o$ posted the highest value among the three specimens. Hence, we proposed that Ca substituted specimen with better grain growth and compactness surface morphology exhibited higher $I_o$ as indicated better coupling between the grains and thus, stronger Josephson junction. In the other points, we speculated that this may also be due to the increment grain growth of the secondary phase of $BaCuO_2$ that generates and introduced as effective flux pinning site and might attribute to the enhancement $I_o$ or critical current density $J_{cm}$ . This propose ideas were confirmed by EDX result that element Ca seen in the area of the peak with 0.8 weight % and 1.0 atomic %, while K peaks couldn't be detected. Thus, we confirmed that Ca has fully introduced within the grain without changing the structural symmetry while K was decomposed in the sintering process. Moreover, this comparative study highlights the importance of alkali metals, K and Ca substitution in the YBCO system or bulk rare earth based ($REBa_2Cu_3O_y$ (RE = bulk rare earth)) High Temperature superconductors synthesized using thermal treatment method. The future study also will focus on Ca and K addition with optimum sintering temperature via thermal treatment method.

**Keywords:** *Substitution, Superconducting Properties, Josephson's current, Surface Morphology, grain growth*

# PAPER ID: 124

# A Review on The Modification of Hierarchical Zeolite Catalyst, HZSM-5 for Bio-Oil Production Via Catalytic Pyrolysis of Biomass

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The application of catalyst in biomass pyrolysis has become the most promising methods to enhance the quality of bio-oil. Catalyst is used to enhance the poor properties of bio-oil such as high acidity, instability, and high oxygenated compounds. Recently, HZSM-5 catalyst has been studied intensively upon producing aromatic hydrocarbon compounds from biomass. However, there are some limitation on the properties of HZSM-5 microporous structure. This property has affected the effectiveness of the conversion process, product distribution and the lifespan of catalyst. Therefore, there is a wide variety approaches for introducing mesopore into microporous system. This system is known as hierarchical zeolite, a modified zeolite catalyst with improving catalytic properties. One of the approaches is by desilication process using alkaline treatment to increase the mesoporosity on the microporous zeolite structure. To date, studies on the effect of desilication on the hierarchical HZSM-5 towards the formation of aromatic hydrocarbons of bio-oil has not much been studied. Thus, this paper will review the progress of desilication by alkaline treatment towards various factors including Si/Al ratios, alkali solution and concentration, reaction time, and reaction temperature.

# PAPER ID: 128

## First Principle Study of Thermoelectric Properties of La Doped $SrZrO_3$ Perovskite

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Strontium zirconate is a material of great interest due to outstanding mechanical, thermal, chemical and electrical properties. This material has been known for its high dielectric constant, high breakdown strength, low leakage current density and wide bandgap. Strontium zirconate is good candidate for thermoelectric applications due to its nontoxic, inexpensive and environment-friendly nature. In this work, we conducted a first principle study on thermoelectric properties of La doped $SrZrO_3$ with 12.5 % concentration using CASTEP, BoltzTraP and Phono3py packages. The band structure analysis shown that La doped $SrZrO_3$ exhibits semi metallic behaviour. The Seebeck coefficient analysis of La doped $SrZrO_3$ showed that it has n typed carrier but with reduced magnitude due to higher carrier density. The conductivity of La doped $SrZrO_3$ also increased significantly due to higher carrier density, and this reflected in the increases of the electronic thermal conductivity and overall thermal conductivity of La doped compound. The improvement in conductivity also lead to improvement of the figure of merit (ZT) of La doped $SrZrO_3$ to 0.23 at 900 K.

**Keywords:** *First principle study, thermoelectric materials, perovskite.*

# PAPER ID: 129

# Synthesis of Cerium Oxide-Zinc Oxide Heterostructured Photocatalyst For Potential Water Treatment Application

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In this study, a new ZnO based photocatalyst material was synthesised by modifying ZnO nanoparticles with CeO-$_2$ to form CeO-$_2$-ZnO heterostructured photocatalyst via combination of wet-chemical technique and solid phase sintering. The present work was aimed to analyse the morphological changes on ZnO photocatalyst after modification with CeO-$_2$ and to evaluate the effect of different CeO-$_2$-ZnO ration (0.1:100 and 1:100) on the photocatalytic performance of the synthesized $CeO_2$-ZnO heterostructured photocatalyst against model contaminant under UV light irradiation. Microstructure and elemental analyses were performed using FESEM, EDAX and XRD. The photocatalytic performance was evaluated based on the photodegradation test conducted on 10 mg/L methylene blue solution unde UV light irradiation for 120 minutes. The findings indicated that the modification of the ZnO into $CeO_2$-ZnO heterostructured photocatalyst have been successful achieved. The FESEM, XRD and EDAX results confirmed the conversion of raw materials into intended formation of heterostructured morphology. Nodules of Ce rich phase which generally contained $CeO_2$ formed on ZnO grains to create heterojunctions. Photodegradation test on MB dye solution under UV light indicated that $CeO_2$-ZnO heterostructured photocatalyst synthesized in this study exhibited photocatalytic effects under UV light. CZ1 (1:100) exhibited higher photocatalytic performance under UV light compared to CZ0.1 (0.1:100). The use of 2 g/L of CZ1 on 10 mg/l of MB solution and 120 minutes of UV irradiation has resulted in photocatalytic efficiency, R of 88.5%.

**Keywords:** *Photocatalyst, Zinc Oxide, Cerium Oxide, Heterostructure, Water Treatment*

# Dissolution Prediction of β-Succinic Acid in Ethanol Solution using Molecular Dynamic Simulation

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Succinic acid is one of the co-formers that can be used to produce co-crystal. It has two (2) polymorphs; α and β polymorphs, in which β-succinic acid is the stable form. In this study, the morphology of stable β-succinic acid was predicted by applying the COMPASS force field and charges while the dissolution prediction of β-succinic acid in ethanol was investigated using molecular dynamic simulation in Material Studio 7.0. The predicted morphology of β-succinic acid shows elongated hexagonal shape with the largest crystal facet dominated by (020), followed by (111) and the smallest facets of (011) and (110) with the highest attachment energy values of -44.97 and -41.99 kcal/mol respectively. The dissolution prediction of β-succinic acid in ethanol was assessed through mean square displacement (MSD) and diffusion coefficient calculation, while the molecular interactions between solute molecules (β-succinic acid) and solvent molecules (ethanol) was assessed through radial distribution function (RDF). Based on the simulation, the smallest facets tend to dissolve first since the smallest facets located at the edge of the crystal compared to the slowest growing facet.

**Keywords:** *β-Succinic Acid, Morphology, Dynamic Simulation, Mean Square Displacement, Radial Distribution Function.*

# Comparison between Oxide Nanotubes Fabricated on Ti and Ti-Nb alloys: Characterization and Photocatalytic Reduction of Cr (VI)

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Nanotubes (NTs) grown on Ti and its alloy Ti-40Nb have been investigated for the removal of heavy metal ions such as hexavalent chromium, Cr(VI). Alloys were produced in this work by mechanical milling of a mixture of pure titanium (Ti) and pure niobium (Nb). The alloy was characterized. The X-ray diffraction (XRD) patterns confirm Ti-40Nb alloy is composed by both alpha (hcp) and beta (bcc) phases. The alloy was subjected to electrochemical anodization in fluorinated-ethylene glycol electrolyte at 60 V. Surface morphology shows a vertically aligned NTs structure formed on the Ti-40Nb alloy substrates and comparison was made with pure Ti. Oxide formed on both metal surfaces are $TiO_2$ as characterized by XRD and EDX. The average NTs diameter and lengths on the Ti40Nb were significantly larger than that of NTs prepared onto the pure Ti substrate. After annealing, crystallization of the nanotubes was detected. Removal of Cr(VI) on anodized Ti and Ti-40Nb NT oxides were observed and assessed with 100% of 20 ppm Cr(VI) reduced to Cr(III) within 120 minutes of UV irradiation on Ti40Nb. The present of β phase favors the transport of photogenerated electrons, thus being reflected in an increase in the photocatalytic activity.

***Keywords:*** *TiNb, nanotube, alloy, anodization, chromium(VI),*

# Impact of Cosmological Constant in Cosmological Models

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Einstein formulated the equations of general relativity in 1915, when the expansion of the universe has not been discovered, so that the dynamic state of the universe may be occurred was unknown to people. Then for a static solution of his equations he introduced a cosmological term $\Lambda$, named cosmological constant, with his equations. But later Einstein regretted for that, the fact that no reasonable solutions exist representing a static universe, because of he would not had known if the universe is expanding or contracting. There are many dynamic solutions with cosmological constant apart from the static solutions. There are many cosmological models established with cosmological constant like Lemaitre model, De-Sitter model, Eddington-Lemaitre model etc. This paper describes different characteristics of cosmological constant that play an important role in cosmological models. This concept will help to develop a new cosmological model with cosmological constant.

**Keywords:** *Cosmological Constant, Curvature, Repulsive, Gravitational Force, Expansion.*

# Electrochemical Properties of Modified $LaSrCoFeO_3$ Cathode Thin Film on Proton Conductor Ceramics

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Fuel cell researchers are interested in proton ceramics (PCs) such as doped barium zirconate and/or barium cerates oxide, as a next-generation electrolyte for fuel cells. These types of PCs are widely used in Proton Ceramics Solid Oxide Fuel Cell (PC-SOFC) which is typically operates at temperature of 500- 800 °C. At this temperature region, the couple of cathode materials such as $LaSrCoFeO_3$ (LSCF) with PCs such as doped $Ba(Ce,Zr)O_3$ developed high polarization resistance ($R_p$). One of the factors that caused to this effect is the segregation of Sr during sintering process. Thus, in this study, the LSCF film surfaces was modified with a small amount of metal cation $ZrCl_4$ solution to the cathode surface at sub-monolayer coverages via dip-coating method. It was observed, the prepared LSCF on the $BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ (BCZY) substrate showed a significant reduction in $R_p$ value which was 0.232 W $cm^2$ compared to unmodified LSCF thin film.

**Keywords:** *Proton Ceramic Fuel Cell, Solid Oxide Fuel Cell, LSCF, metal cation, polarization resistance*

# 3D Printed Polyamide-Carbon Fibre Composites Filament

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Maintaining interfacial adhesion and bonding between the printing layers appears to be a key difficulty for polyamide-reinforced carbon fibre composites manufactured in filament shapes utilising the fused deposited modelling approach. Understanding its bonding within the layup sequence during the printing process enables for more precise control of good (45 MPa – 70 MPa) flexural strength performance at maximal fibre content (> 20% wt.%), which is ideal for bipolar plates in fuel cells. Our research suggested that the drying process be considered while adjusting the interfacial adhesion between printing layers (5 hours and 20 hours). After 5 hours of drying, the flexural strength of the samples improves by up to 225 percent as compared to the dried samples. When the drying period is raised to 20 hours, however, there are bonding problems between the layup sequences, resulting in an 8% decrease.

**Keywords:** *Fused Deposition Modeling (FDM), PACF, Flexural strength, Taguchi method, Vertical orientation, Horizontal orientation*

# Influence of Soft Phase Thickness on Magnetic Properties of $BaFe_{12}O_{19}/Y_3Fe_5O_{12}$ Film Prepared by a Sol-gel Method

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In the present work, bilayer film consisting of $BaFe_{12}O_{19}$(BaM)/$Y_3Fe_5O_{12}$(YIG) with varying soft and hard phase thickness were prepared on a quartz substrate by a sol-gel method, followed by a spin coating technique. For structural analysis, the X-Ray diffraction revealed the coexistence of both soft and hard phase. The field emission electron microscope showed the hard phase well distributed on top of soft phase layer, and cross-sectional of both layers can be seen clearly. The magnetic properties were studied at room temperature by vibrating sample magnetometer to analyse the influence of soft phase thickness on the magnetic properties of nanocomposite film, and found that magnetic properties of nanocomposite film were strongly affected by a soft phase composition. As the layers getting thinner, the magnetic properties are well improved, however the value of coercivity and magnetization of bilayer film were still low compare to pure hard phase, with 70% reduction in saturation magnetization value as the soft phase thickness reaching 100 nm, and this attributed by dipolar interaction that dominated by soft phase. A stepped-loop at the second quadrant of the hysteresis can also be seen to indicate a non-exchange coupling film.

**Keywords:** *Bilayer film, Exchange interactions, Nanocomposite film*

# Effect of Various Concentrations of Silane Coupling Agent treated Palm Kernel Shell (PKS) powder filled Polyvinyl (chloride) (PVC)/Acrylonitrile Butadiene Rubber (NBR) Compounds

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Effects of various concentrations of APTES silane coupling agent treated Palm Kernel Shell (tPKS) powder filled Polyvinyl (chloride) (PVC)/Acrylonitrile Butadiene rubber (NBR) compounds on the optimum cure time, $T_{c90}$ (min.), mechanical and flame retardant properties had been investigated. As noted, Palm Kernel Shell (PKS) had its limitations such as can cause the poor bonding with rubber matrix due to its polarity and hydrophilicity characters. So, by introducing this APTES coupling agent, it was enhanced the interfacial adhesion between the PKS filler and NBR matrix. The APTES coupling agent concentrations were varied at 1%, 3%, 5% and 7% and the untreated PKS was acted as the controlled sample. The results showed that by increasing the APTES coupling agent in PKS/PVC/NBR compounds, it increased the optimum cure time, tensile strength and hardness. Meanwhile, the elongation at break, swelling index and burning behaviour decreased with increase the concentrations of APTES silane coupling agent in PKS/PVC/NBR compounds. Therefore, the 5% APTES Coupling agent was chosen as the best treatment on PKS filler in PVC/NBR compounds as the optimum treatment since it had the highest properties in all types of testing involved.

**Keywords**: *Silane Coupling; Palm Kernel Shell; polarity; bonding; mechanical properties*

# Investigation of Antimony-doped $TiO_2$ Microspheres Growth Mechanism: The role of Dopant Molarity

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The addition of dopant in the process of synthesizing $TiO_2$ films is intended to modify the crystal growth property, enhance the optical property, to magnify the photo-electrochemical activity of the $TiO_2$ films. Antimony (Sb) is a promising dopant material because it can act as a simple one-electron donor which increases the conductivity as electrons are introduced into the conduction band exudes interesting potential for diverse optoelectronic applications. We report herein, the synthesis of Sb-doped $TiO_2$ films using liquid phase deposition (LPD) and investigations on the influence of dopant molarity on the growth mechanism of the Sb-doped $TiO_2$ microspheres. Morphological features, structural and optical properties were investigated by field-emission scanning electron microscopy, X-ray diffraction and UV-vis-NIR spectroscopy, respectively. EDX analysis confirmed that Ti, O and Sb existed in the samples and Sb dopant causes the peak positions in XRD patterns to shift slightly instead of introducing new phases. The Sb-doped $TiO_2$ microspheres were demonstrated to grow randomly on the ITO substrate and by comparing the samples of a varying concentration we found that 1% Sb-$TiO_2$ is sufficient to produce significant improvement over the light absorption. The presence of Sb is found to enhance $TiO_2$ microsphere growth. The diameter of Sb-doped $TiO_2$ microspheres was observed to be increased with increasing dopant molarity. The large particle size of microspheres will result in a strong light scattering ability and increase an optical absorption path confirmed by the result of UV-Vis absorption and diffused reflectance. The absorption band edge is red-shifted with decreasing optical band gap upon increasing the dopant molarity.

**Keywords**: *Doping, Microstructure, Liquid Phase Deposition, Porous Material, Titanium Dioxide Films*

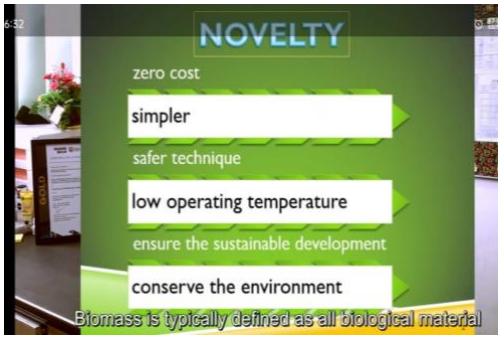
# Materials Technology Challenge 5.0 (MTC 5.0) Project

## Project ID: MTC 1

### Rapid Production of Graphene Oxide Derived from Coconut Front Wastes as Electrode Materials in Supercapacitor

Dr. Nurhafizah Binti Md Disa, Assoc.Prof. Dr. Nurhayati Abdullah



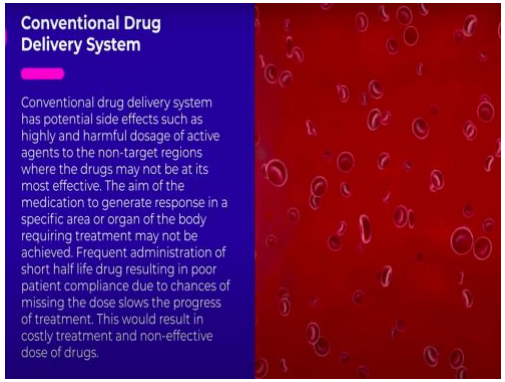


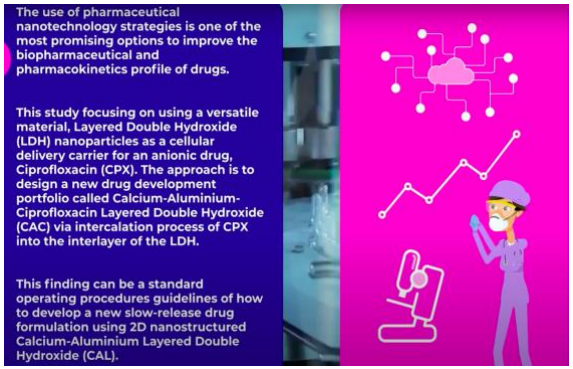


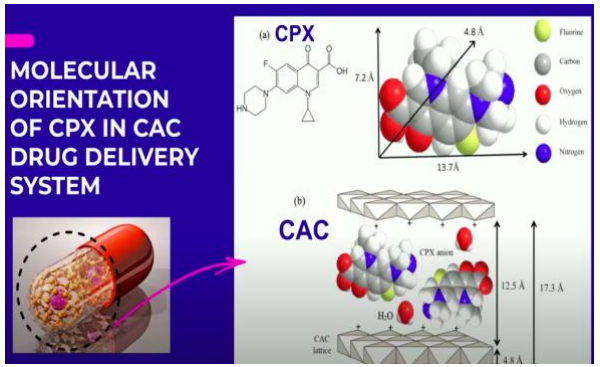

# Project ID: MTC 14

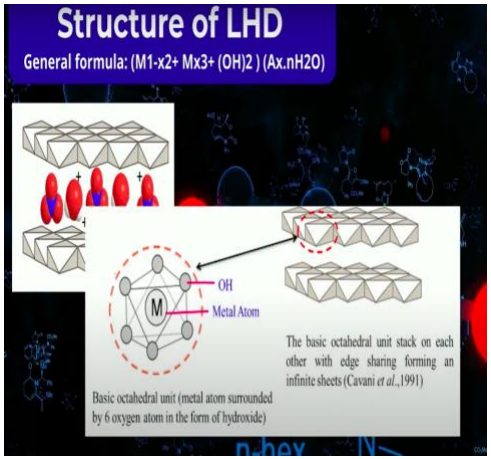
## New Drug Delivery System Using 2D Nanostructured Layered Double Hydroxide

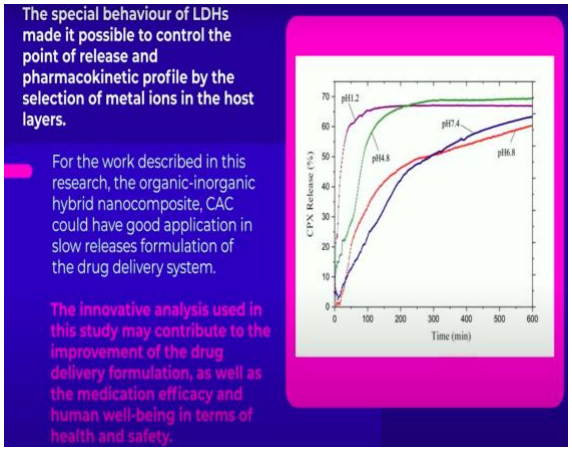
Monica Limau Jadam, Dr. Zaemah Jubri, Assoc Prof Dr. Siti Halimah Sarijo

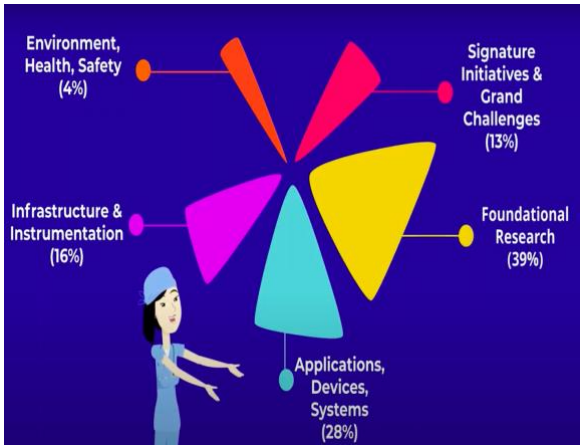


# Project ID: MTC 24

## Optical Properties of Reduced Graphene Oxide-Coated Tellurite Glass for Fiber Optics Technology

Azlina Yahya, Ts. Dr. Muhammad Noorazlan Abd Azis

### INTRODUCTION

The commercial on fiber optics used silicate glasses many years ago however, the problem encountered with silicate glasses is, they produced a high loss and possessed high melting temperature. **Tellurite-based glass** has been introduced over silicate glasses due to its outstanding properties including low melting point, high refractive index, and excellent infrared transmission. Despite, extensive studies on tellurite glasses doped with $Er^{3+}$ ions, there are still lacking in achieving the significant refractive index along with the high-performance glass. Therefore, an initiated study on **new advanced glass coatings** can be adopted to enhance the optical properties and overcome the limitations of current glass materials. The outcome of this research is believed may be contributed to new advancements which point out the novelty needed for further progress in the fiber optics field.

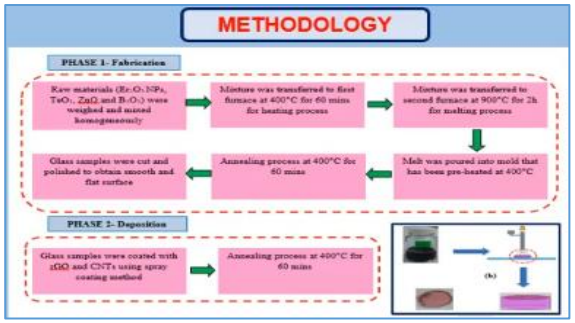
### OBJECTIVES

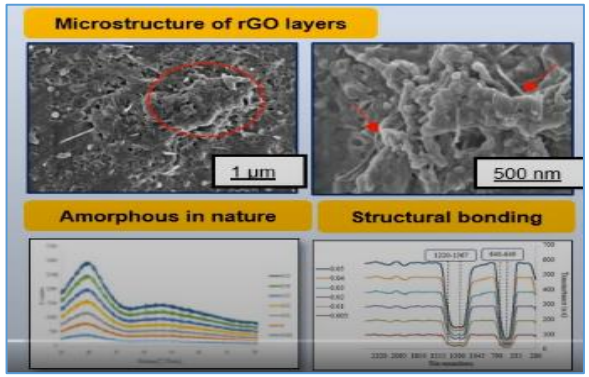
- To investigate the surface morphology and bonding parameters of ZBTEr(NPs)-rGO glasses by using FESEM, XRD and FT-IR.
- To determine the absorption spectra, optical bandgap energy and refractive index of ZBTEr(NPs)-rGO glasses.

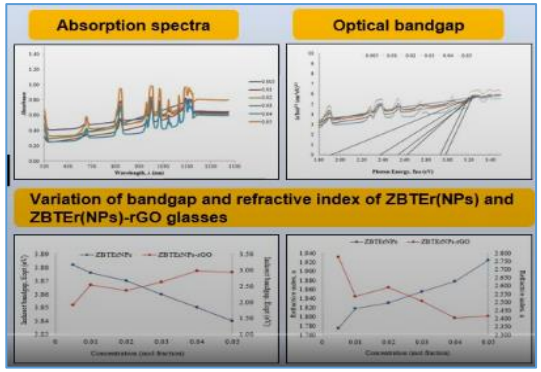
### NOVELTY

- A new study of graphene-based materials onto glass surface via a simple spray coating technique.

### METHODOLOGY




### POTENTIAL APPLICATION/ COMMERCIALIZATION

- For future fiber optics technology

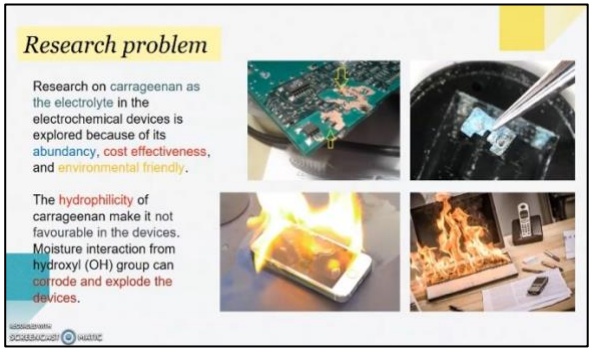
### CONCLUSION

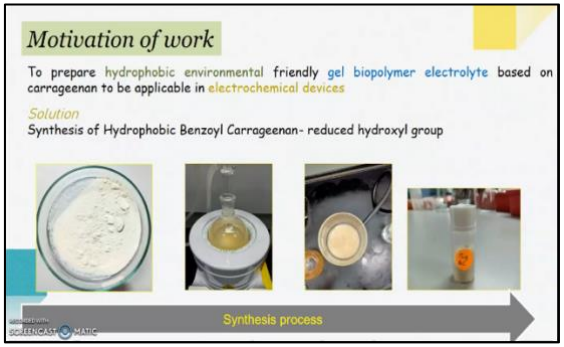
Graphene-based materials such as rGO was deposited onto the tellurite-based glass surface to improve the optical properties of glass materials due to the factor of oxygen functional groups localized in the rGO nanosheets. Hence, this novel research may significantly attribute to **fiber optics**.

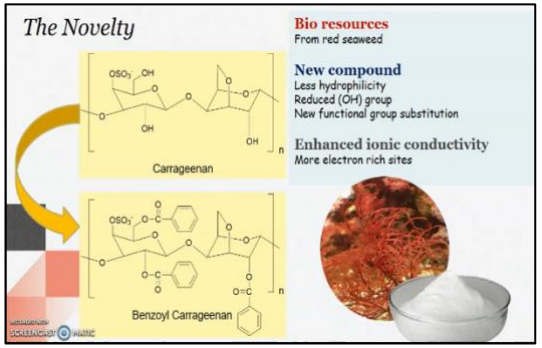
# Project ID: MTC 28

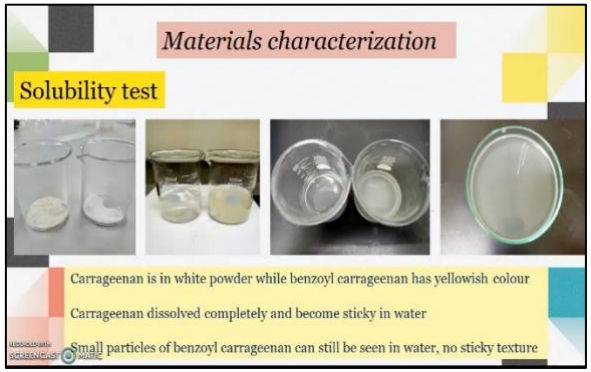
## Hydrophobic Benzoyl Carrageenan

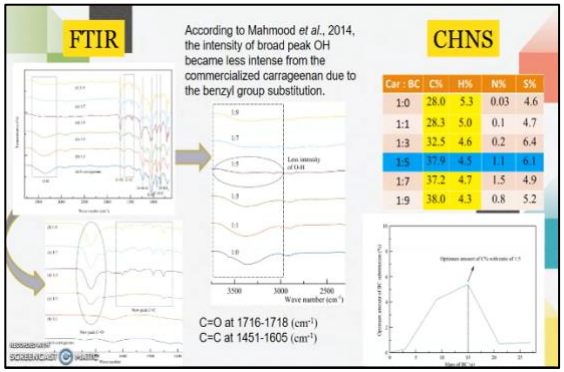
Dr. Intan Juliana Shamsudin, Norsyabila Binti Shrgawi, Dr. Hussein Bin Hanibah, Assoc Prof Dr. Siti Aminah Binti Mohd Noor, Dr. Norherdawati Binti Kasim

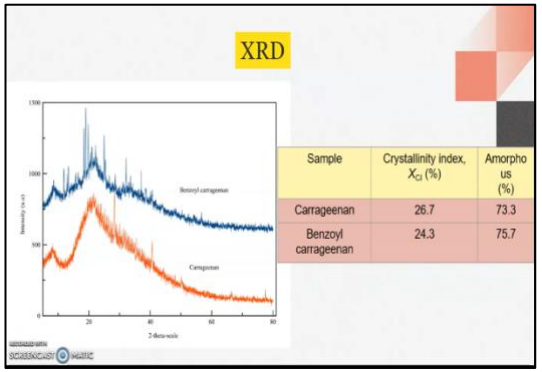


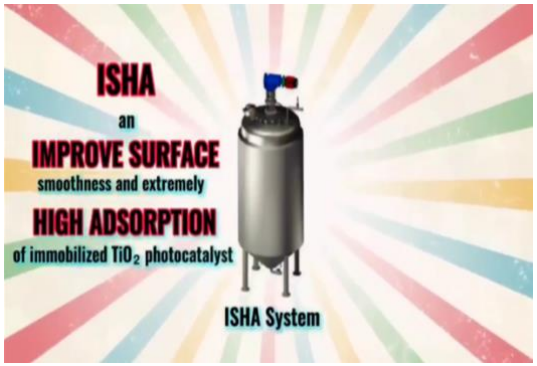



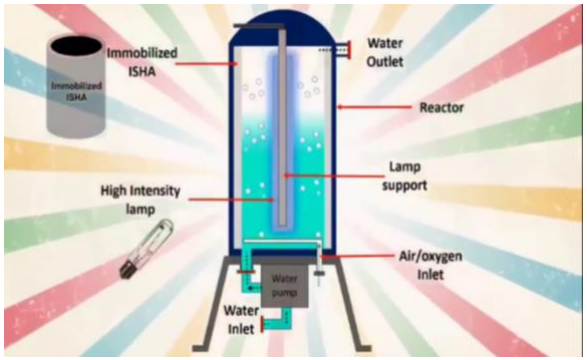



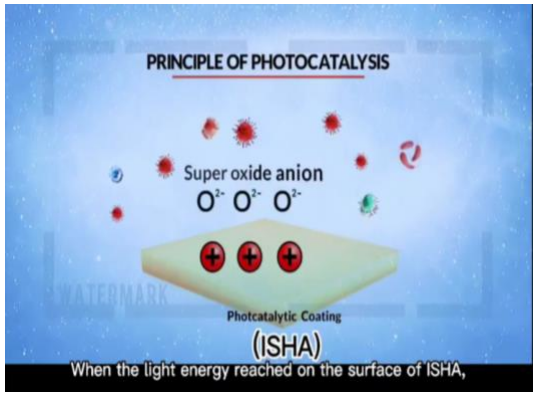
# Project ID: MTC 45

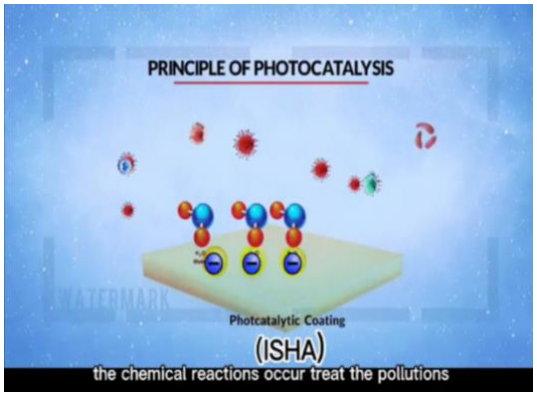
## ISHA- Improve Surface coating and High Adsorption for Wastewater Treatment

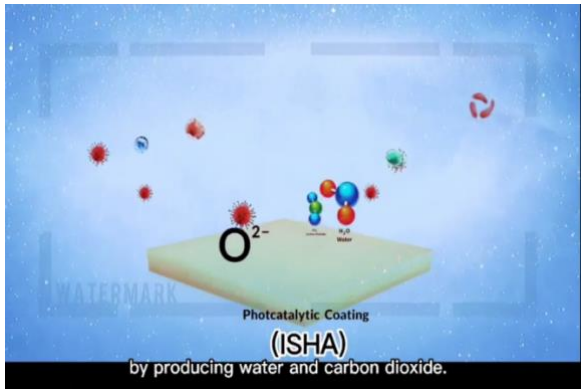
Nur Syazana Binti Nazeri, Dr. Wan Izhan Nawawi Bin Wan Ismail, Muhammad Syahirul Ikhwan Bin Ab Aziz

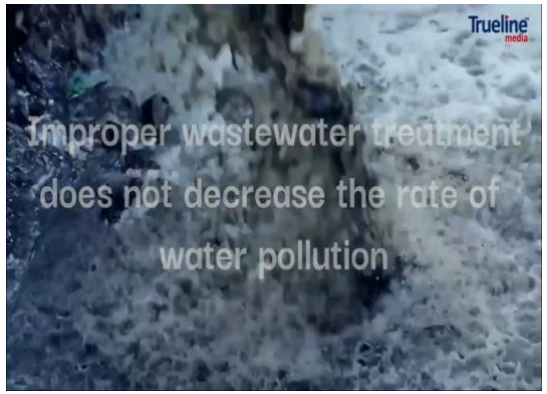



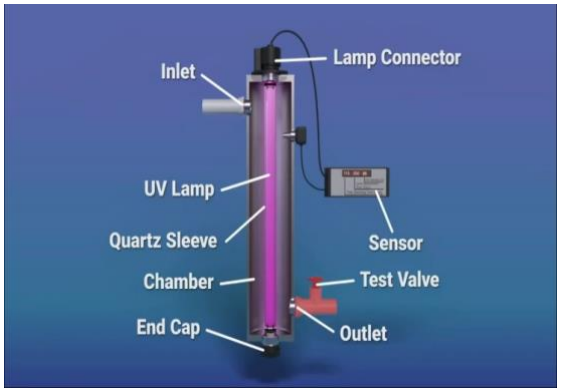



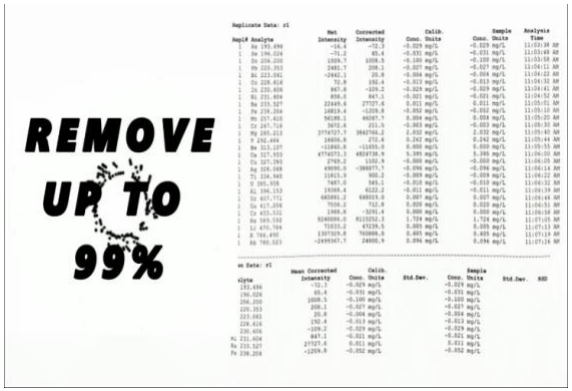
# Project ID: MTC 46

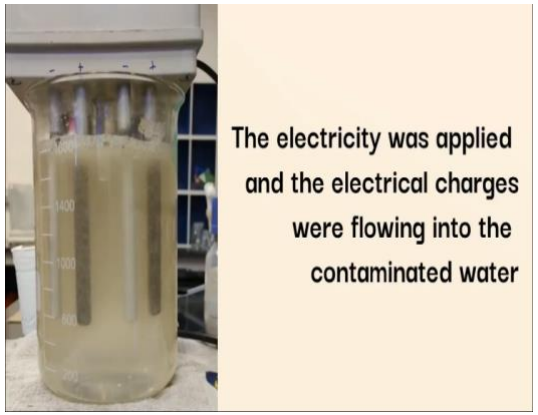
## GET: A Solution for Industrial Wastewater Treatment

Dr. Wan Izhan Nawawi Bin Wan Ismail, Nadiah Sabihah Binti Md Natar, Siti Raihan Binti Hamzah, Muhammad Afiq Bin Rosli, Nureel Imanina Binti Ab Ghani

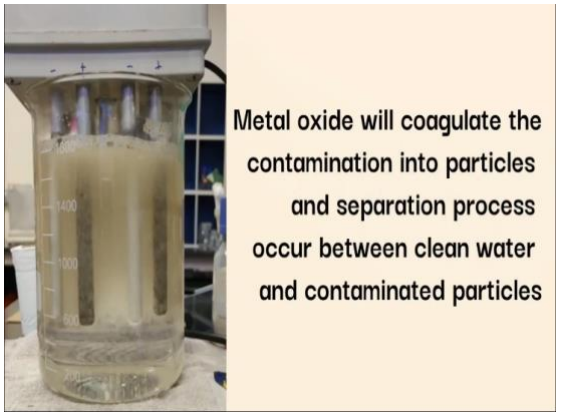


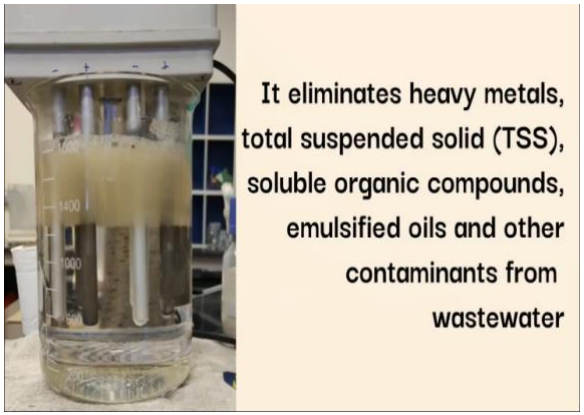



The electricity was applied and the electrical charges were flowing into the contaminated water



Metal oxide will coagulate the contamination into particles and separation process occur between clean water and contaminated particles

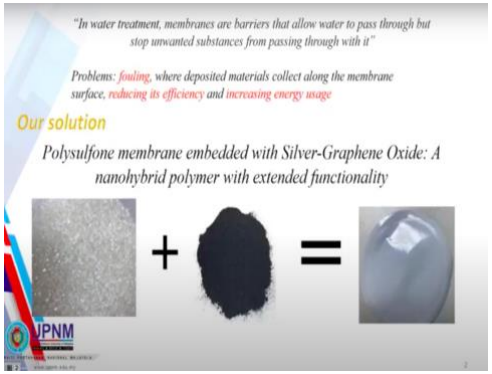


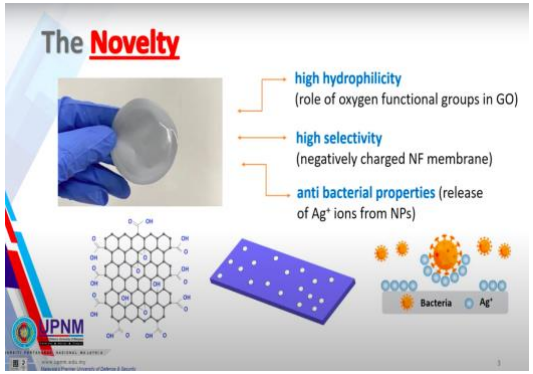
It eliminates heavy metals, total suspended solid (TSS), soluble organic compounds, emulsified oils and other contaminants from wastewater

# Project ID: MTC 68

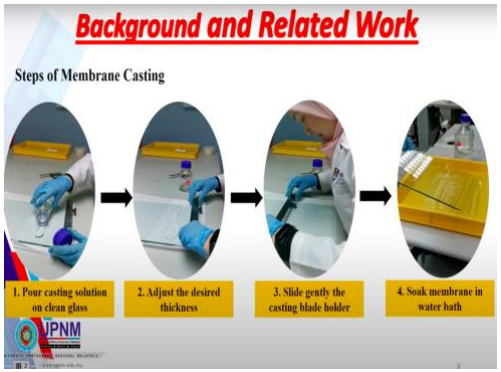
## Nanohybrid Polysulfone/Silver-Graphene Oxide (PSf/Ag-GO) Membranes for Iron Removal in Groundwater

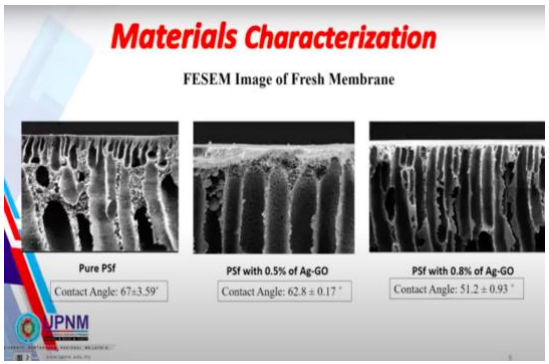
Dr. Norherdawati Binti Kasim, Nur Syahirah Binti Suhalim, Dr. Ebrahim Mahmoudi, Dr. Intan Juliana Binti Shamsudin, Dr. Azua-Laili Binti Jamari

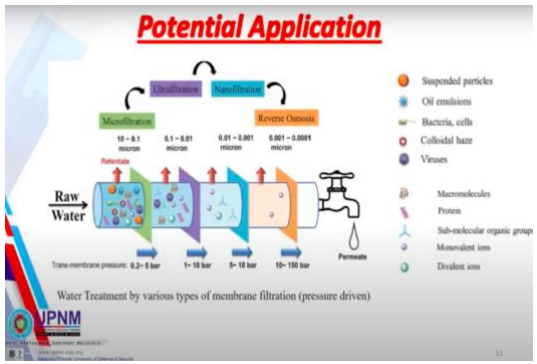






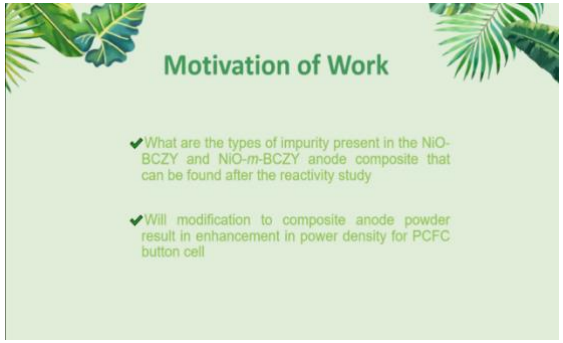



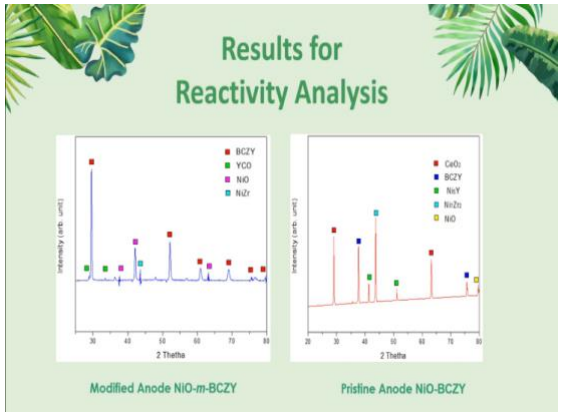
# Project ID: MTC 74

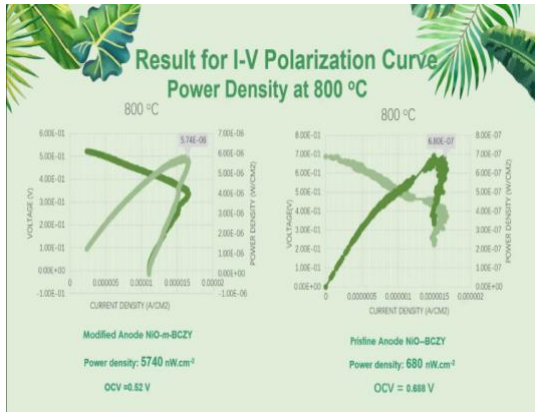
## Development and X-Ray Analyses of NiO-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ and NiO-m-$BaCe_{0.54}Zr_{0.36}Y_{0.1}O_{2.95}$ Composite Anode

Lidyayatty Abdul Malik, Nur Syafkeena Affandi, Muhammad Najwan Nik Mohamad Rosdi, Assoc Prof Dr. Nafisah Osman



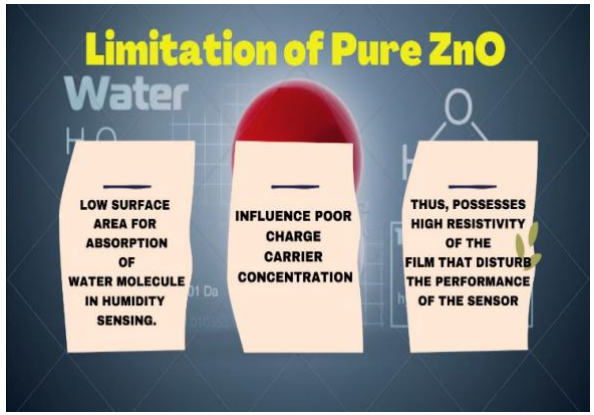



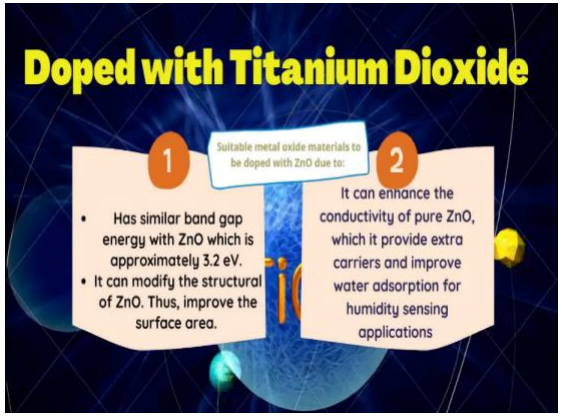



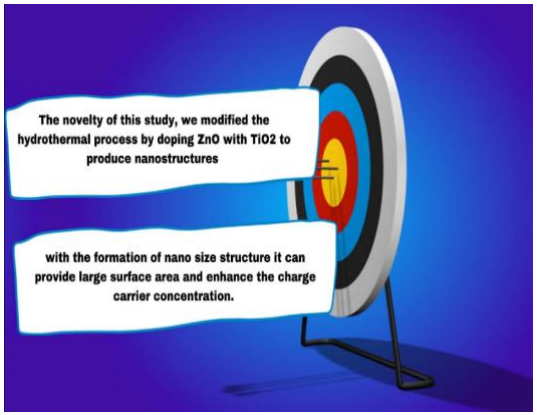
# Project ID: MTC 97

## High Conductive Zinc Oxide: Titanium Dioxide Nanostructures for Humidity Sensor Application

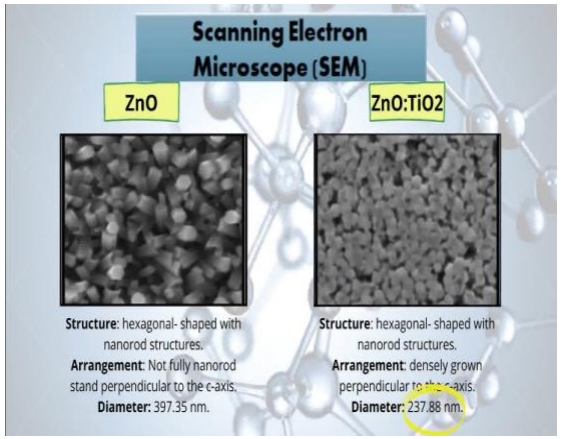
Ts. Dr. Ruziana Binti Mohamed, Myzatul Azlyin Muhamad, Ts. Dr. Mohd Firdaus Malek, Assoc Prof Ir. Dr. Mohamad Hafiz Mamat

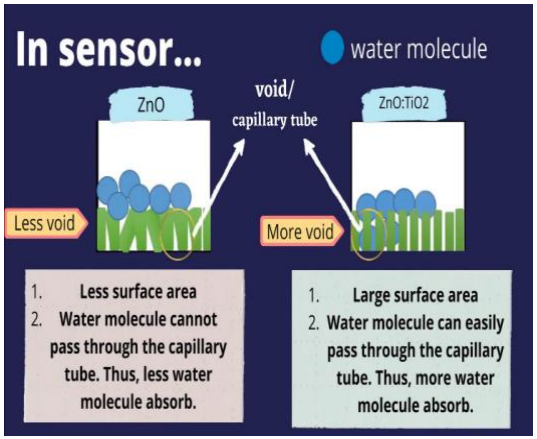




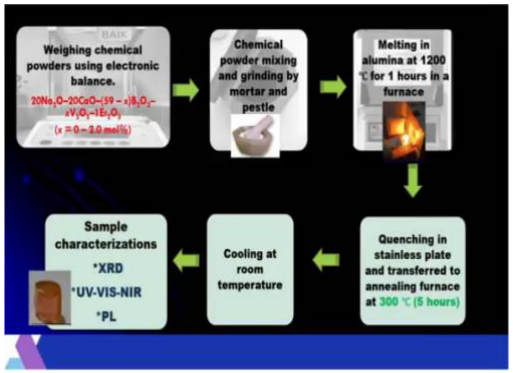


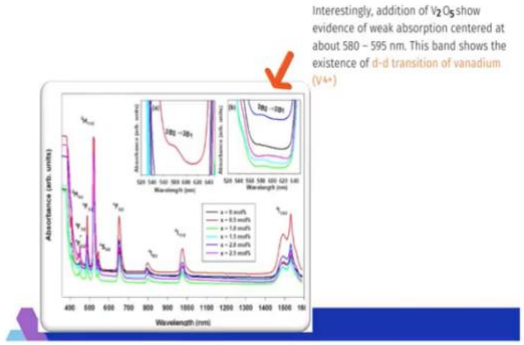



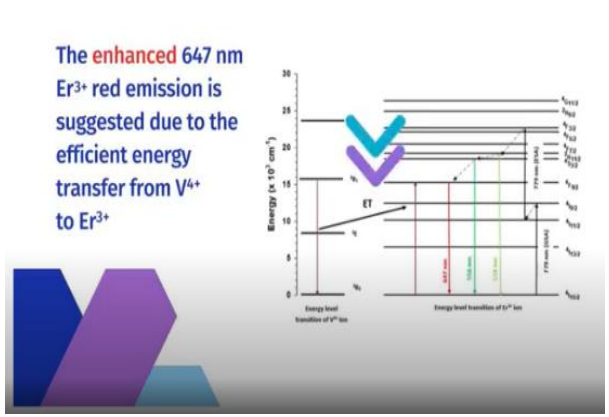
# Project ID: MTC 102

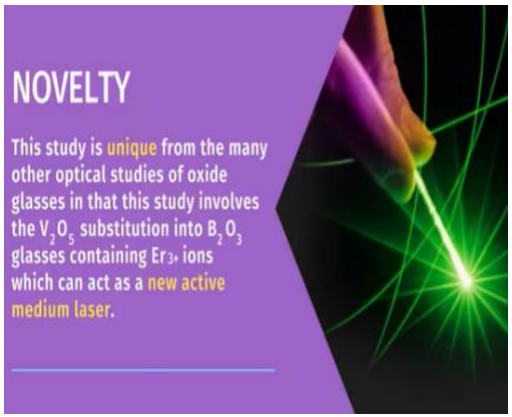
## Up–conversion of $Er^{3+}/V^{4+}$ Co–doped $Na_2O–CaO–B_2O_3$ glasses

Ts. Syafawati Nadiah Binti Mohamed, Prof. Dr. Ahmad Kamal Hayati Bin Yahya, Dr. Ezza Syuhadah Binti Sazali
And Hafizi Bin Lukman

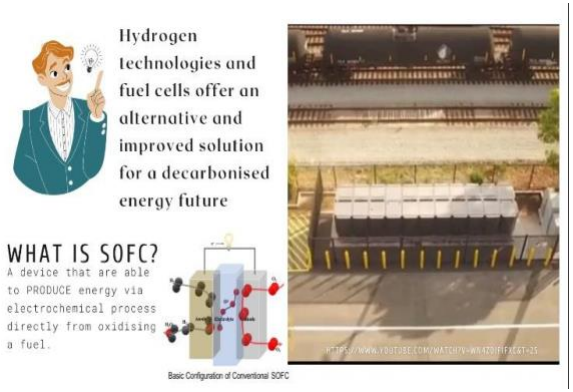



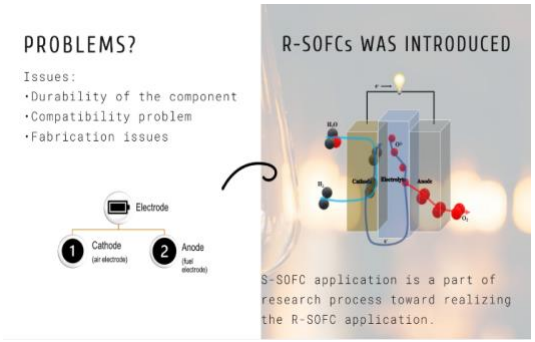




# Project ID: MTC 103

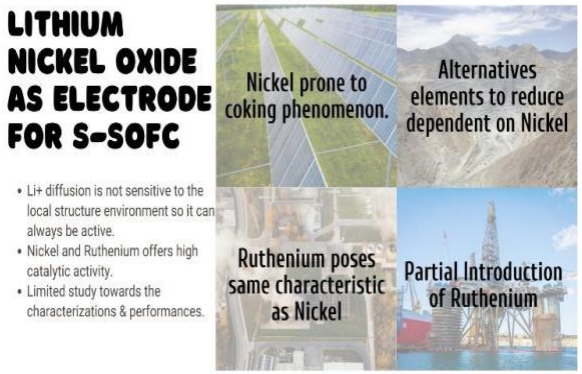
## Lithiated Material Based for Symmetrical SOFC for Future Energy Source

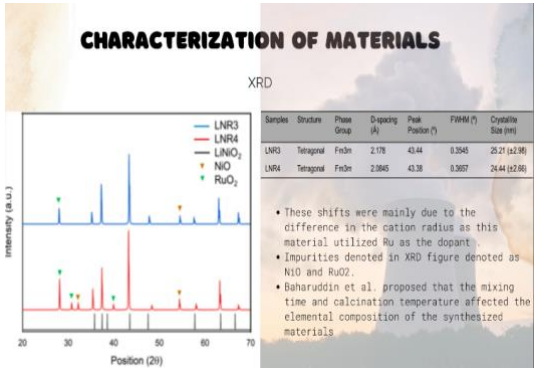
Ts. Azreen Junaida Binti Abd Aziz, Cik Wan Nor Anasuhah Binti Wan Yusoff, Dr. Nurul Akidah Baharuddin

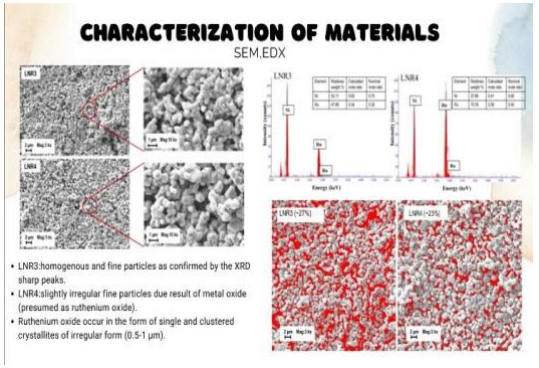






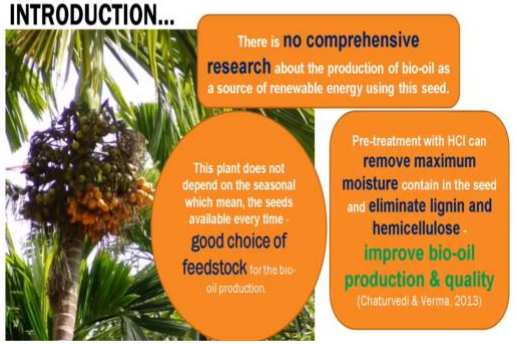



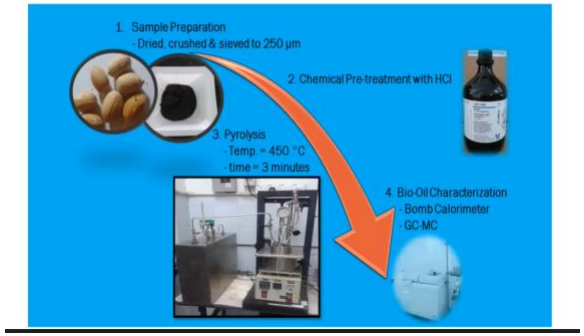



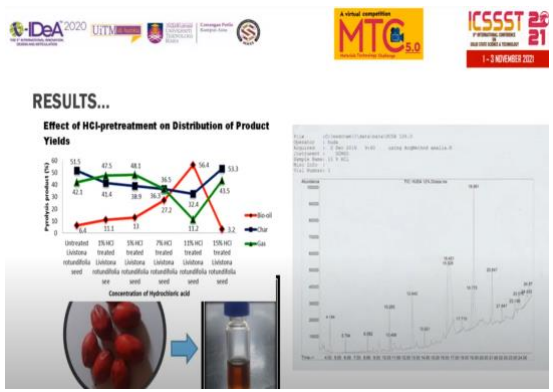
# Project ID: MTC 107

## Bio Oil from HCl-Treated Livistona rotundifolia Seed

Mohd Fauzi Bin Abdullah, Shahira Huda Binti Azman



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