ABSTRACTS

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THE EFFECT OF FILLER LOADING ON THE FLEXURAL AND COMPRESSIVE PROPERTIES OF UNSATURATED AND TREATED CHROME TANNED LEATHER WASTE (CTLW) SHORT FIBRE FILLED UNSATURATED POLYESTER COMPOSITES

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Abstract

The flexural and compressive properties of chrome tanned leather waste (CTLW) short fibre filled unsaturated polyester composite were studied by comparing the performance of untreated (UT) and treated (T) chrome tanned leather waste (CTLW) short fibre filled unsaturated polyester composite as a function of filler loading. The CTLW was manually cut into strips and pulverised two times by passing through the sieve size of 0.25 mm. The pulverised CTLW was treated with 1 wt% concentration of silane coupling agent. Both untreated and treated samples of CTLW short fibre filled unsaturated polyester (UPE) composite was fabricated by using casting technique in the open mould. The sample was prepared based on 0.5 wt%, 1.0 wt%, 1.5 wt%, 2.0 wt%, 2.5 wt% and 3.0 wt% filler loading, initial cured at 70^{o}c for 1 hour and post cured at 90^{o}c for 24 hours. The flexural and compressive properties of the composites samples were studied by using Shimadzu AG-X. From the data obtained, it was found out that the mechanical properties reduce as the amount of CTLW increases. Nevertheless, the treated CTLW values are higher compared to the untreated CTLW. The reasons are because of the reduction of the fibre bundle and clump together due to the treatment effect. Technically, the performances of natural fibre based composites are depending firmly on the interfacial strength of the dissimilar polarity of the composite constituents. The development of CTLW based polymer composite revealed the mechanical properties of the composite are quite impressive and applicable for replacing some composite product.

PARTICLE SIZE DEPENDENCY OF CUBIC MGO TOWARDS ITS ELECTRONIC STRUCTURES, A FIRST PRINCIPLE STUDY

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Abstract

A first principle studies has been done to investigate the effects of magnesium oxide (MgO) particle size and the change in its lattice parameters and electronic structures by using density functional theory (DFT). Two MgO particles were simulated which consist of 8 atoms and 64 atoms respectively and the relaxed structure of the smaller particle shows an expansion in lattice. This agrees with experimental findings and this is the first theoretical results that have been shown to show lattice expansion in simulated small sized crystals. The phenomenon of lattice expansion in smaller sized crystals is believed to be related to the band gap narrowing of MgO nanocrystals as have been found in several experiments. The band width of the conduction band in the calculated band structures and density of states (DOS) were significantly increased as numbers of atoms decreased contributing to the band gap shifts of MgO nanocrystals.

PREPARATION AND CHARACTERIZATION OF EPOXIDIZED 30% POLY(METHYL METHACRYLATE)-GRAFTED NATURAL RUBBER POLYMER ELECTROLYTES FOR ELECTROCHEMICAL DOUBLE LAYER SUPERCAPACITOR

Khuzaimah Nazir

ABSTRACT

This dissertation focuses on the preparation and characterization of epoxidized- 30% poly(methyl methacrylate) grafted natural rubber (EMG30)-salt complexes and plasticized EMG30-salt complexes. In the present study, EMG30 as polymer host, lithium trifluoromethanesulfonate ($LiCF_3SO_3$) as doping salt and ethylene carbonate (EC) as a plasticizer were used in the preparation of solid polymer electrolytes (SPEs) and gel polymer electrolytes (GPEs). The EMG30 was prepared by performic epoxidation method with various time reaction. Proton nuclear magnetic resonance (^{1}HNMR) and Fourier transform infrared spectroscopy (FTIR) spectra confirm a new peak at 2.70-2.71 ppm and 871 cm^{-1} which were assigned to the epoxy group. 54.6, 62.3 and 50.0 mol% of epoxidation content were obtained in EMG30 at 6, 9 and 12 hours of time reactions, respectively. SPEs and GPEs based on EMG30 were prepared by the solution cast technique with different weight percent (wt.%) of $LiCF_3SO_3$ and EC. FTIR spectroscopy studies have shown that coordination of Li^+ ions has occurred on the oxygen (O) atom in the carbonyl (C=O) group and epoxy (C-O-C) group of EMG30. X-ray diffraction (XRD) analysis confirmed amorphous nature of EMG30 samples. Thermogravimetric analysis (TGA) have shown that thermal stability of EMG30 is increased compared to pure MG30. The differential scanning calorimetry (DSC) analysis found the epoxidation reaction has increased the T_g value of EMG30 ($T_g \approx$ - 39.1 °C) due to the richest of polar group. The morphology of the samples has also been investigated using Field-emission scanning electron microscopy (FESEM). The conductivity of the samples was characterized by the impedance spectroscopy in the frequency range between 100 Hz and 1 MHz. The highest ionic conductivity of SPE containing 40 wt.% $LiCF_3SO_3$ in 62.3 mol% EMG30 was 1.10 x 10^{-3} $S.cm^{-1}$, which is two orders of magnitude higher than MG30-$LiCF_3SO_3$ complexes. Further enhancement of ionic conductivity 62.3 mol% EMG30-$LiCF_3SO_3$ obtained with addition of plasticizer into SPE was 4.83 x 10^{-3} $S.cm^{-1}$ at 50 wt.% EC in 62.3 mol% EMG30-$LiCF_3SO_3$. Ionic conductivity for all systems was also studied as a function of temperature from 303 K up to 373 K. The plot of log σ versus $1000/(T-T_o)$ for each sample obey VTF behavior. Transference number characterization supports the ionic conductivity results. The window stability of 62.3 mol% EMG30 based on SPE was observed around 1.8 V versus SS and 3.02 versus Li^+/Li whereas the window stability of GPE was around 2.9 V versus SS and 4.5 V versus Li^+/Li. The highest conducting of SPE and GPE were chosen as an electrolyte in electrochemical double layer capacitor (EDLC). EDLC containing GPE exhibits the most stable performance with higher specific capacitance value (0.470 F g^{-1}) and can maintain its electrochemical stability over 100 cycles of charge and discharge processes. The highest power density (P) and energy density (E) were found to be 7.49 W kg^{-1} and 9.71 Wh kg^{-1}.

FABRICATION OF NIOBIUM-DOPED TITANIUM DIOXIDE NANOTUBES FOR LIGHT EMITTING DIODE APPLICATIONS

NAJWA EZIRA BINTI AHMED AZHAR

The instability of inorganic material is an important issue faced caused by high band gap energy and non-uniform structure due to low surface area. TiO_2 is suitable to be used in LED devices due to higher electron mobility, more stable, less sensitive to oxygen and moisture. The TiO_2 film is easy to grow using various deposition method and various structures. A critical limitation of TiO_2 is non-uniform structure due to low surface area**.** Ultrafine polycrystal oxide with grain size in nanometer range have received much attention because of the relationship observed between properties and microstructure. The TiO_2 nanostructures exhibits high recombination rate of photogenerated conduction band electrons and valence band holes and narrow light-response range that resulting from the wide band gap. The TiO_2 thin film present two drawbacks during process which are low use of solar spectrum and the relatively high electron-hole recombination rate. Many methods have been proposed to resolve this problem including crystal and textural modification of TiO_2 nanostructures. To reduce the band gap various ways have been tested, which one of them is its doping with different metal ions and oxides. This project focuses to study the electrical properties of TiO_2 deposited by electrochemical anodization process. The Nb-doped TiO_2 exhibits an improved the electrical conductivity, making such a compound promising for use a transparent conducting oxide. While attempting electrochemical anodization process, using crystallized TiO_2 layer, the electrical properties of LED will be investigated.

IN SITU TRANSMISSION ELECTRON MICROSCOPE (TEM) FACILITIES FOR FUNDAMENTAL RESEARCH

Mohd Zamri Bin Mohd Yusop (UTM), Masaki Tanemura (NIT)

Abstract

In early 1990's TEM observation works have been started with well-known carbon nanomaterials "carbon nanotubes (CNTs)". Prof. Iijima has introduced the CNTs by TEM images and published in *Nature*. This breakthrough has been leading many researchers essentially to understand CNTs characteristics, thus many potential application have been identified. *In-situ* TEM facility provides an essential way to study nanomaterials directly and individually. Their formations, structural and electrical properties would precisely observed with this cutting-edge facility. The physics of the growth mechanism also directly can be observed thus it will give details information about nanomaterials characteristics. Recently, *in situ* TEM works play a very important role in the nanotechnology. This is because nanosize materials such graphene can only be observed by this method. *In situ* TEM means real time experimental works and observation inside TEM chamber without external exposure. It is the advantage of in situ TEM works that all of the observation results give high details about the measurement such as nanoscale observation, structural change, chemical reaction, etc. The latest TEM facilities also provide video capture systems, thus all the experimental works can be recorded and observable in real elapsed time from the video files.

DESIGN AND CHEMICAL EXPLORATION OF FUSED LACTONE-LACTAM MOIETY AS AN ADVANCED INTERMEDIATE TOWARDS POTENTIAL BIOACTIVE MOLECULES

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Abstract

Lactone-lactam compound plays a significant role in our lives. Realizing or not, they actually encompass in many ways especially in our daily health maintenance. β-lactams, the powerful antibiotics has been used in worldwide to help fight against infections caused by bacteria. Meanwhile the L-Ascorbic acid, also known as vitamin C, is one of the most famous lactone-based compound that must be obtained from the dietary source for normal cellular function. Furthermore, fused lactone-lactam ring moieties such as the lactasystin derivatives are the bioactive molecules which has been recognized to have such biological importance and now become a tools for future potential drug design as well as important targets for cancer chemotherapy. Thus, an approach towards the synthesis of fused lactone-lactam from chiral *D*-alanine methyl ester hydrochloride is hereby designed and described. The synthetic steps include various chemical exploration, functional group interconversions, and the key step of lactonization with many different reagents as well aldol condensation with different aldehyde are also highlighted.

A SIMPLIFIED NANOTECHNOLOGY PLATFORM ESTABLISHED IN THE AVERAGE SCIENCE LABORATORY FOR LEARNING FROM THE BASIC TO THE STATE OF ART OF THE SCIENCE AND TECHNOLOGY

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Abstract

The importance of the semiconductor device has been increasing by the appliance of the new application such as automobile, IoT, etc. To educate the student as the future engineer and scientist who can make unique and valuable idea, the deep understanding about the fundamental of the device physic is one of the most important subjects. For achieving this purpose, the simplified device and its fabrication platform, simplified nanotechnology platform established in the average science laboratory is strongly expected at educational organizations. Therefore, the simplified fabrication methods using general apparatus in the average science laboratory is proposed. The fabrication processes of the simplified p-n junction under normal air environment condition were successfully demonstrated. In addition, the feasibility of the metal-oxide-semiconductor (MOS) and bipolar transistor were also confirmed. In this presentation, the summary of these research results, the program to learn the state of art of the device fabrication using the electron beam (EB) direct writing lithography and the simplified process will be explained. Furthermore, the result of the simplified EB resist resolution using sensitive curve of the resist and a simulation result of the mobility of the carrier in the strained silicon are also explained.

KEMAPANAN DAN PEMBANGUNAN BAHAN LIGNOSELULOSA UNTUK PRODUK TAMBAHAN NILAI (SUSTAINABILITY AND DEVELOPMENT OF LIGNOCELLULOSE MATERIALS FOR VALUE ADDED PRODUCTS PROCESSING OF RAW MATERIALS

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Abstrak

Lignoselulosa merupakan singkatan nama kepada bahan yang mengandungi lignin, selulosa dan hemiselulosa. Ketiga-tiga kimia konstituen ini banyak terdapat dalam serat di dalam tumbuh-tumbuhan termasuk dari batang, dahan, ranting, urat daun, pelepah, tandan buah, sabut buah, tangkai dan lain lain. Selulosa merupakan polimer asli yang terbina dari rantaian glukosa yang mempunyai rantaian lurus yang panjang. Kandungan selulosa di dalam tumbuhan mempunyai peratusan yang berbeza dari jenis spesis tumbuhan yang berbeza atau spesis yang sama. Pengekstrakan selulosa dan lignin dari tumbuhan boleh dilakukan secara mekanikal dan kimia. Di antara pemprosesan yang biasa dilakukan adalah pempulpaan secara kimia atau mekanik atau separa kimia/mekanik, letupan stim dan pengekstrakan secara perlunturan. Selulosa asli atau dikenali sebagai selulosa I atau alpha-selulosa yang dieskstrak dari tumbuhan melalui proses pempulpaan akan terhasil dalam bentuk gentian-gentian fibril terlerai. Fibril ini terbentuk dari beberapa jaringan makrofibril dan makrofibril ini terbentuk dari beberapa jaringan mikrofibril dan mikrofibril terbina dari beberapa jaringan selulosa yang tersusun atau secara rawak. Setiap unit glukosa di dalam selulosa mempunyai 3 kumpulan hidroksida yang berupaya bertindakbalas melalui proses esterifikasi atau eterifikasi membentuk terbitan selulosa. Terbitan selulosa lebih mudah larut dalam banyak pelarut biasa dan boleh digunakan untuk menghasilkan pelbagai bahan yang mempunyai sifat-sifat yang tertentu. Manakala, selulosa I, agak sukar dilarutkan dalam banyak pelarut biasa. Selulosa I boleh dilarutkan di dalam beberapa tertentu seperti pelarut ionik, cardoxen, alkali/urea dan lain-lain membentuk larutan selulosa. Selulosa boleh dijana semula dari larutan selulosa melalui proses penggumpal membentuk selulosa terjana semula atau selulosa II.

EVALUATION OF MUSCLE OXYGEN CONSUMPTION AT REGIONAL LEVEL OF FATIGUE USING FUNCTIONAL NEAR INFRARED SPECTROSCOPY

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Abstract

Functional Infrared Spectroscopy (fNIRS) is a non-invasive modality which has been widely used to investigate hemodynamics response in human tissues layer. The objective of this paper is to measure the muscle oxygenation states at three assessment of muscular fatigue's level in human using fNIRS. The experiment was carried out on 27 sedentary healthy volunteers. The participants were performed isometric activity into three level of fatigue condition using handgrip contraction that based on 1RM calculation. These signals could also be used to evaluate the muscle oxygen consumption (MvO2) of regional muscle of fatigue. We found strong agreement between the response of oxygenated hemoglobin myoglobin ($p=0.013$) and deoxygenated hemoglobin myoglobin ($p=0.003$) which produce a p-value ($p<0.05$) measured by fNIRS. The result showed that, after all three levels of exercises, desaturated MvO2 seems to occur after region 30% level of exercise. Then, desaturated MvO2 was maintained until 50% level of exercise based on a slight different found between 30% and 50% exercise. Thus, this may help to estimate fatigue's level of human based on the light absorption property in tissues.

URANIUM ENRICHMENT RATIO USING GAMMA-SPECTROMETRY

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Abstract

Uranium, considered as rare earth element, present naturally in three radioactive isotopes, ^{238}U, ^{235}U and ^{234}U. Typically the respective isotopic abundances are 99.27%, 0.72% and 0.0054%. Being fissile, only ^{235}U is useful as fuel for energy generation or nuclear bomb. However, only enriched uranium where $^{235}U/^{238}U$ percentage ratio of masses >3% are useful for sustainable energy generation. Therefore, an efficient, fast and accurate measurement of the ratio is needed to assess the feasibility of uranium to be mined, its impact to the environment, as well as to reconstruct the geochemical histories of an area, and also detecting illicit transportation of fissile materials. This presentation describes a simple mathematical approach coupled to Gamma-ray Spectrometry where the enrichment ratio of uranium based on their masses can be obtained through the activity ratio of the two isotopes. Application of the approach on soil samples from Peninsular Malaysia show enrichment ranging from 0.549% to 0.748%. On average these values are in agreement to the typical natural enrichment ratio is 0.7204%. Besides soil samples, this approach could also be applied for other purposes to various type of samples having diverse enrichment ratios.

DEPOSITION OF NANOSTRUCTURED BORON DOPED AMORPHOUS CARBON BY BIAS-CVD USING PALM OIL PRECURSOR

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Abstract

The nanostructured boron doped amorphous carbon (a-C:B) thin films was successfully deposited by bias-assisted chemical vapor deposition using palm oil ($C_{67}H_{127}O_8$) precursor. Current-voltage (I-V) measurement (Bukoh Keiki), thickness profilometry, field-emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy (EDS), Raman spectroscopy, atomic force microscopy (AFM), ultraviolet-visible-near-infrared (UV-vis-NIR) spectroscopy, and solar simulator were conducted for investigate carbon thin film and solar cell devices, respectively. In this study, two deposition parameters were carried out; the substrate deposition temperatures (200ºC- 350ºC), and negative bias (0 V to -50 V). Based on this investigation, it can be found that, the a-C:B thin film deposited at different substrate temperatures (200ºC to 350ºC) and negative biases (0 V to -50 V) formed ohmic contact with gold. The conductivity of boron doped of a-C thin films was strongly influenced by substrate temperature, and negative bias under deposition condition. The conductivity of a-C:B thin films achieved approximately around 10^{-4} to10^{-7} S.cm^{-1}. The FESEM images revealed the minimum measured particles of a-C:B thin film were approximately 28.1 nm at 350oC and -20 V. High transmittance spectra (>80%) in the visible wavelength region of boron doped a-C:B thin film with absorption coefficient, α between 10^4 to 10^5 cm^{-1}. The estimated optical band gap is ~2.05 to 1.92 eV decreased as substrate temperature increased and doping with boron. The lowest estimated optical band gap of a-C:B films is approximately around 1.90 eV deposited at different negative biases. For the first time the carbon solar cell from palm oil precursor with the configuration of Au/n-Si/p-C/Au achieved conversion efficiency (η) of 0.1302%. Moreover, the highest η of Au/n-Si/p-C:B/Au achieved is ~1.543% at 350ºC and -20 V using grid method. Although the conversion efficiency is considerably low, but Au/n-Si/a-C:B/Au (~1.543%) fabricated by negative bias-CVD using carbon source of palm oil was considered new in this area. It is hope that, the use of palm oil precursors gave reasonable yield for carbon based solar cell in the near future.

FABRICATION OF NANO-COMPOSITED ZnO/TiO_2 BASED DYE-SENSITIZED SOLAR CELLS

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Abstract

The following research illustrates for the first time development of aligned ZnO nanorod on Sn-doped ZnO films by using sonicated sol-gel immersion methods for dye-sensitized solar cells and the fabricated DSSCs show the improvement of photovoltaic properties and than from a novel photoanode of nano-composited aligned ZnO nanorod/TiO_2:Nb a significant improvement on photovoltaic properties was obtained. The Sn-doped ZnO films were used as a seed layer for nanorod growth, where the Sn-doped ZnO films at 2 at.% shows the best of electrical and optical properties. As a result, the aligned ZnO nanorod with relatively high aspect ratio was grown on ITO-coated glass at 2 at.% Sn-doped ZnO films using sonicated sol-gel immersion methods. The resulting of ZnO nanorod length and diameter were around 1.8μm and 120nm, respectively. Since the absorption of dye is dependent to aspect ratio or surface area ZnO nanorod and therefore the fabricated DSSCs shows improvement of energy conversion efficiency 0.6% as compared to the fabricated DSSCs using aligned ZnO nanorod on undoped ZnO film, ZnO nanorod on 1 at.% Sn-doped ZnO film and ZnO nanorod on 3 at.% Sn-doped ZnO film were 0.11%, 0.25%, and 0.21%, respectively. Besides that, the surface area of aligned ZnO nanorod was increased by varying the solution concentration parameter. It was found that by using 0.03M Zinc acetate solution the aspect ratio of ZnO nanorod was higher as compared to 0.05M. Therefore, the fabricated DSSCs using 0.03M ZnO nanorod shows the improvement of efficiency to ~1%. The aligned ZnO nanorod with better aspect ratio and larger surface area was efficiently for dye absorption and light harvesting that contributed to the improvement of DSSCs. Meanwhile, the presence of TiO_2 nanoparticles on top of ZnO nanorods might increase the internal surface area of photoanode that absorbed more dye molecules and resulting of increasing the photocurrent density 8.59 mA/cm^2 as well as energy conversion efficiency of 2.39%. Furthermore, the improvement of DSSCs for nano-composited aligned ZnO nanorod/ TiO_2:Nb was closely related to the improvement of electrical properties of TiO_2 nanoparticle from Nb-doped TiO_2 at 5 at.%. The Nb-doped TiO_2 at 5 at.% shows higher of electrical properties that contributes better of electron transport properties. A novel photoanode of nano-composited aligned ZnO nanorod/TiO_2 with Nb-doped TiO_2 at 5.% shows the significant improvement of photocurrent density and energy conversion efficiency of 18.15 mA/cm^2 and 5.38%, respectively. The enhancement of energy conversion efficiency of the nano-composited aligned ZnO Nanorod/TiO_2:Nb-5 at.% DSSCs can be due to the enhanced electron-injection

efficiency caused by the positive shift in V_{fb} which help increase J_{sc} and reduce the charge recombination.

Keywords: Dye-sensitized solar cell; ZnO nanorod; Sn-doped ZnO; Nb-doped TiO_2; ZnO nanorod/TiO_2:Nb

SYNTHESIS AND CHARACTERIZATION OF TIO2 NANOWIRES BY HYDROTHERMAL METHOD

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Abstract

TiO_2 nanowires are an emerging class of TiO_2 nanostructures. TiO_2 nanowires in the form of powder are successfully synthesized using hydrothermal method. The effects of various parameter and Si doping on the structural properties of nanowires are investigated. The effect of post annealing temperature from 400 °C to 900 °C was studied. From FESEM images, it was discovered that the nanowires maintain it structures up to 500 °C, while annealing at 600 °C resulted in the breakage of nanowires into smaller particles. XRD spectra showed these nanowires underwent further transformation from the anatase to the rutile phase with simultaneously recrystallized to rod-like structures at annealing temperature of 900 °C. The morphology and structural properties of hydrothermally synthesized TiO_2 nanowires are temperature-depended. By using customized autoclave, we found that the suitable synthesis temperature is about 150 °C. The XRD result and Raman spectroscopy revealed that TiO_2 nanowires annealed at 500 °C synthesized at 150 °C for 6 hours showed highest crystallinity with anatase phase. The shorter synthesis time of 6 hours compared to existing synthesis method is a novel processing of TiO_2 nanowires. From XRD and Raman spectra revealed that the structural properties of nanowires are significantly affected by the volume of precursor solution in autoclave, the concentration of precursor solution and the sodium hydroxide solution concentration. The effect of Si doping on the synthesized nanowires was observed. The incorporation of Si into matrix TiO_2 promotes the formation of rutile rather than anatase phase TiO_2 as showed in XRD pattern. The Si doped TiO_2 nanowires exhibited lower band gap compared to undoped TiO_2 nanowires.

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Abstract

This dissertation focuses on the preparation and characterization of epoxidized- 30% poly(methyl methacrylate) grafted natural rubber (EMG30)-salt complexes and plasticized EMG30-salt complexes. In the present study, EMG30 as polymer host, lithium trifluoromethanesulfonate ($LiCF_3SO_3$) as doping salt and ethylene carbonate (EC) as a plasticizer were used in the preparation of solid polymer electrolytes (SPEs) and gel polymer electrolytes (GPEs). The EMG30 was prepared by performic epoxidation method with various time reaction. Proton nuclear magnetic resonance (^{1}HNMR) and Fourier transform infrared spectroscopy (FTIR) spectra confirm a new peak at 2.70-2.71 ppm and 871 cm^{-1} which were assigned to the epoxy group. 54.6, 62.3 and 50.0 mol% of epoxidation content were obtained in EMG30 at 6, 9 and 12 hours of time reactions, respectively. SPEs and GPEs based on EMG30 were prepared by the solution cast technique with different weight percent (wt.%) of $LiCF_3SO_3$ and EC. FTIR spectroscopy studies have shown that coordination of Li^+ ions has occurred on the oxygen (O) atom in the carbonyl (C=O) group and epoxy (C-O-C) group of EMG30. X-ray diffraction (XRD) analysis confirmed amorphous nature of EMG30 samples. Thermogravimetric analysis (TGA) have shown that thermal stability of EMG30 is increased compared to pure MG30. The differential scanning calorimetry (DSC) analysis found the epoxidation reaction has increased the T_g value of EMG30 ($T_g \approx$ - 39.1 °C) due to the richest of polar group. The morphology of the samples has also been investigated using Field-emission scanning electron microscopy (FESEM). The conductivity of the samples was characterized by the impedance spectroscopy in the frequency range between 100 Hz and 1 MHz. The highest ionic conductivity of SPE containing 40 wt.% $LiCF_3SO_3$ in 62.3 mol% EMG30 was 1.10 x 10^{-3} $S.cm^{-1}$, which is two orders of magnitude higher than MG30-$LiCF_3SO_3$ complexes. Further enhancement of ionic conductivity 62.3 mol% EMG30-$LiCF_3SO_3$ obtained with addition of plasticizer into SPE was 4.83 x 10^{-3} $S.cm^{-1}$ at 50 wt.% EC in 62.3 mol% EMG30-$LiCF_3SO_3$. Ionic conductivity for all systems was also studied as a function of temperature from 303 K up to 373 K. The plot of log σ versus $1000/(T-T_o)$ for each sample obey VTF behavior. Transference number characterization supports the ionic conductivity results. The window stability of 62.3 mol% EMG30 based on SPE was observed around 1.8 V versus SS and 3.02 versus Li^+/Li whereas the window stability of GPE was around 2.9 V versus SS and 4.5 V versus Li^+/Li. The highest conducting of SPE and GPE were chosen as an electrolyte in electrochemical double layer capacitor (EDLC). EDLC containing GPE exhibits the most stable performance with higher specific capacitance value (0.470 F g^{-1}) and can maintain its electrochemical stability over 100 cycles of charge and discharge processes. The highest power density (P) and energy density (E) were found to be 7.49 W kg^{-1} and 9.71 Wh kg^{-1}.

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The instability of inorganic material is an important issue faced caused by high band gap energy and non-uniform structure due to low surface area. TiO_2 is suitable to be used in LED devices due to higher electron mobility, more stable, less sensitive to oxygen and moisture. The TiO_2 film is easy to grow using various deposition method and various structures. A critical limitation of TiO_2 is non-uniform structure due to low surface area**.** Ultrafine polycrystal oxide with grain size in nanometer range have received much attention because of the relationship observed between properties and microstructure. The TiO_2 nanostructures exhibits high recombination rate of photogenerated conduction band electrons and valence band holes and narrow light-response range that resulting from the wide band gap. The TiO_2 thin film present two drawbacks during process which are low use of solar spectrum and the relatively high electron-hole recombination rate. Many methods have been proposed to resolve this problem including crystal and textural modification of TiO_2 nanostructures. To reduce the band gap various ways have been tested, which one of them is its doping with different metal ions and oxides. This project focuses to study the electrical properties of TiO_2 deposited by electrochemical anodization process. The Nb-doped TiO_2 exhibits an improved the electrical conductivity, making such a compound promising for use a transparent conducting oxide. While attempting electrochemical anodization process, using crystallized TiO_2 layer, the electrical properties of LED will be investigated.

WASTE COOKING PALM OIL AS A GREEN CARBON SOURCE FOR GROWTH OF GRAPHENE SYNTHESIS ON NI SUBSTRATE AT DIFFERENT DEPOSITION TEMPERATURES

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Abstract

The synthesis of graphene by double thermal chemical vapor deposition using waste cooking palm oil (WCPO) as a natural carbon source has been investigated. The WCPO was placed in the first furnace (precursor furnace) whereas nickel was placed in the second furnace (deposition furnace). The deposition temperatures varied from 850 °C to 1100 °C by 50 °C increments. FESEM images at optimum temperature (1000 °C) display hexagonal shapes since the graphene layers were formed after precipitation of the carbon. Meanwhile, AFM the results show great potential for imaging and probing the 2D local resistance of graphene interconnection. Meanwhile, the interlayer distance, number of layers, crystalline size and impurity composition were compared by simple XRD pattern. UV-Vis results reveal the presence of graphene layer on Ni at the sudden jump peak prominent peak of at 230 nm. Sample at 1000 °C demonstrated an optimum reflectance in the entire visible light region. An obvious and significant peak with high intensity was notably detected at wavelength of 230 nm. Raman results reveal that the sample synthesis at deposition temperature 1000 °C is high 2 D-peak respect to other samples, which indicates high-quality formation of graphene.

METAL IONS: THERAPEUTIC OR TOXIC

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Abstract

A healthy lifestlye today would include the usage of a variety of supplements based on metal ions. A good example would be selenium, a semi-metal thought to be toxic initially was discovered later to be essential for health. What we witness today is that more and more metal ions are becoming essential for good health and well-being mainly due to the numerous work conducted in the area of bioinorganic chemistry. Walk into any pharmacy and you will be met by a multitude of supplements containing various metal ions. There are two major ways how metal ions may impact upon the biochemistry of biological systems. Firstly, is the role metal ions play in essential biochemical processes such as transportation of dioxygen. Secondly, metal ions are introduced to biological systems as diagnostic and for therapeutic purposes. Organotin(IV) complexes have been cited in numerous studies as compounds which can show biological activity. The organotin complexes with ligands containing O, S and N, donor atoms have shown strong cytotoxicity towards tumour cell lines. We had worked on the synthesis, characterization and biological activity studies of organotin(IV) complexes with a host of different ligands such as catechol, dithiocarbamic acids, hydroxamic acids and thiosemicarbazones. This work which has covered a span of 20 odd years has resulted in the syntheses of more than 150 new compounds. The organotin(IV) complexes displayed a variety of geometries dependent on the ligands utilised. What was also interesting is that the organotin(IV) complexes could undergo structural changes when in solution. Thus, the solid state structures of organotin(IV) complexes obtained from X-ray crystallography is not strictly the structure that may be responsible for the biological activity shown. Inadvertently it is a bit naive to think that a simple correlation exists between structure and biological activity. However, some general trends were observed. The organotin(IV) complexes were found to be generally more active biologically compared to the free ligands. We also concurred that the dibutyltin(IV) complexes were most active biologically. It was interesting to note that some of the organotin(IV) complexes were very active towards cancer cells but had moderate toxicity towards normal cells. It is apparent that these complexes are showing selectivity towards cancer cells.

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Abstract

The synthesis of graphene by double thermal chemical vapor deposition using waste cooking palm oil (WCPO) as a natural carbon source has been investigated. The WCPO was placed in the first furnace (precursor furnace) whereas nickel was placed in the second furnace (deposition furnace). The deposition temperatures varied from 850 °C to 1100 °C by 50 °C increments. FESEM images at optimum temperature (1000 °C) display hexagonal shapes since the graphene layers were formed after precipitation of the carbon. Meanwhile, AFM the results show great potential for imaging and probing the 2D local resistance of graphene interconnection. Meanwhile, the interlayer distance, number of layers, crystalline size and impurity composition were compared by simple XRD pattern. UV-Vis results reveal the presence of graphene layer on Ni at the sudden jump peak prominent peak of at 230 nm. Sample at 1000 °C demonstrated an optimum reflectance in the entire visible light region. An obvious and significant peak with high intensity was notably detected at wavelength of 230 nm. Raman results reveal that the sample synthesis at deposition temperature 1000 °C is high 2 D-peak respect to other samples, which indicates high-quality formation of graphene.

Keywords—graphene; waste; palm oil; nickel; temperature

HEMICELLULOSE: MAJOR RESOURCES, PROPERTIES AND APPLICATIONS

Dr Sabiha (FSG)

Based on renewable resources, environmentally friendly biodegradable polymers provide sustainable alternatives to conventional synthetic polymers to produce materials intended for a large variety of applications. Lignocellulosic biomass such as agricultural and forestry residues provides a low-cost and uniquely sustainable resource for conversion of hemicellulose to various products that can reduce greenhouse gas emissions, enhance energy, dispose of problematic solid waste, and improve air quality. Hemicellulose a natural polymer, is the second most abundant in lignocellulosic biomass next to cellulose and it contains amorphous and highly branched short sugar chains. This biopolymer is categorized as biodegradable and non-toxic polymer with low molecular weight compared to cellulose and therefore their utilization to produce various value-added products is a reasonable option. Many methods have been used to extract hemicellulose such as alkaline extraction, acid hydrolysis, autohydrolysis, steam explosion and microwave treatment. The choice of the processes depends on the properties and final application of the recovered hemicelluloses. The extraction of hemicelluloses from lignocellulosic biomass is an interesting alternative way to convert this waste into value-added products for chemical, food, and pharmaceutical industries.

UTILIZATION OF BUTYL RECLAIMED RUBBER (BRR) FILLED WITH BLACK AND NON-BLACK FILLER SYSTEMS IN DEVELOPING SUSTAINABLE PRODUCTS

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Excessive disposal of used rubber based products caused a huge abundance of rubber waste as rubber is difficult to be decomposed or degraded. This brings a major negative impact to the environment. The current footwear market also has to face a challenge in improving casual shoe comfort, being shock absorption and abrasion resistant. These properties are among of the most significant properties for the comfort of a footwear. In this study, BRR800 was the BRR investigated. Since reclaimed rubber is not entirely 100% rubber as reclaimed rubber is in fact a mixture of rubber, carbon black, oil, zinc oxide, stearic acid and other compounding ingredients used in the original compounds, the reclaimed rubber content in each system was fixed at 161 parts per hundred (pphr). Each mixture was mixed using a two-roll mill. The fillers used in this study were carbon black and calcium carbonate. This research aimed to elucidate the effect of black and non-black filler systems on the cure characteristics and mechanical properties of butyl reclaimed rubber (BRR). Not only that, this is to utilize reclaimed rubber in order to put them to good use, producing other sorts of application at a cheaper price without diminishing its properties, which in this study, it is for footwear application and this is such a huge advantage to the current society. The Mooney viscosity, cure characteristics, crosslink density, and mechanical properties, such as hardness, abrasion resistance, compression set, tear strength, rebound resilience and the tensile properties of the vulcanizates were investigated. The results showed that the Mooney viscosity of BRR800 filled with carbon black increased effectively and had a faster curing time and higher crosslink density than BRR filled with calcium carbonate. In addition, except for compression set and elongation at break, the mechanical properties of BRR800 with a black filler system were higher than those of BRR800 with a non-black filler system. This shows that reclaimed rubber has the potential to be used in various applications, not just to make shoe soles.

Keywords: Butyl reclaimed rubber; Carbon black; Calcium carbonate; Cure characteristics; Mechanical properties; Sustainable

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Abstract

A healthy lifestlye today would include the usage of a variety of supplements based on metal ions. A good example would be selenium, a semi-metal thought to be toxic initially was discovered later to be essential for health. What we witness today is that more and more metal ions are becoming essential for good health and well-being mainly due to the numerous work conducted in the area of bioinorganic chemistry. Walk into any pharmacy and you will be met by a multitude of supplements containing various metal ions. There are two major ways how metal ions may impact upon the biochemistry of biological systems. Firstly, is the role metal ions play in essential biochemical processes such as transportation of dioxygen. Secondly, metal ions are introduced to biological systems as diagnostic and for therapeutic purposes. Organotin(IV) complexes have been cited in numerous studies as compounds which can show biological activity. The organotin complexes with ligands containing O, S and N, donor atoms have shown strong cytotoxicity towards tumour cell lines. We had worked on the synthesis, characterization and biological activity studies of organotin(IV) complexes with a host of different ligands such as catechol, dithiocarbamic acids, hydroxamic acids and thiosemicarbazones. This work which has covered a span of 20 odd years has resulted in the syntheses of more than 150 new compounds. The organotin(IV) complexes displayed a variety of geometries dependent on the ligands utilised. What was also interesting is that the organotin(IV) complexes could undergo structural changes when in solution. Thus, the solid state structures of organotin(IV) complexes obtained from X-ray crystallography is not strictly the structure that may be responsible for the biological activity shown. Inadvertently it is a bit naive to think that a simple correlation exists between structure and biological activity. However, some general trends were observed. The organotin(IV) complexes were found to be generally more active biologically compared to the free ligands. We also concurred that the dibutyltin(IV) complexes were most active biologically. It was interesting to note that some of the organotin(IV) complexes were very active towards cancer cells but had moderate toxicity towards normal cells. It is apparent that these complexes are showing selectivity towards cancer cells.

THE ROLES OF NANOTECHNOLOGY IN THE FUNDAMENTAL ISSUE OF SOLAR CELL FABRICATION

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ABSTRACT

Solar cell is an optoelectronic device that converts the sunlight (photon) energy into the electrical energy in photovoltaic energy conversion. The photovoltaic energy conversion device consists of a semiconductor layer for absorption of photon energy to produce electron-hole pairs and a junction between p-type semiconductor and n-type semiconductor (p-n junction) for charge carrier separation. The comprehension of p-n junction is needed to improve the solar cell conversion efficiency as well as the consuming energy and manufacturing cost for the solar cell fabrication. The basic properties of semiconductor material and the principle of p-n junction solar cell are critical fundamental issue in the solar cell fabrication. This presentation is focus on the roles of nanotechnology in the fundamental issue and basic semiconductor physics, which is necessary in the operation of p-n junction solar cell and also describe the basic principles of p-n junction solar cell. Then, the fundamental phenomenon also will be reviewed.

Keywords: Deposition process; Nano-material; Doping process; P-N Junction

INFLUENCE OF SULFUR (S), PEROXIDE (S) AND MIXED-SULFUR/PEROXIDE (M-S/P) VULCANIZATION ON MECHANICAL AND DYNAMIC PROPERTIES OF VULCANIZED RECLAIMED RUBBERS

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ABSTRACT

The mechanical and dynamic mechanical thermal analysis (DMTA) of reclaimed rubbers (Natural Reclaimed Rubber, Tire Reclaimed Rubber, and Butyl Reclaimed Rubber) with different vulcanization systems (s, p and m-s/p) was reported in this article. Vulcanization is process of converting plastic region of rubber into elastic three dimensions of rubber structures. It is important process to vulcanize the rubber as it will affect the properties of the rubber. Sulfur and peroxide vulcanization systems remain the most popular and frequently used. The tear strength, resilience, compression set and dynamic mechanical analysis were studied to observe the effect of different vulcanization systems towards mechanical and DMTA properties of reclaimed rubbers. The resulted showed that TRR cured with sulfur vulcanization gave the highest tear strength (28 kN/m) compared to other types of vulcanization. While BRR cured with peroxide vulcanization shows the highest compression set (62%) compared to BRR with m-s/p (61%) and TRR vulcanized with sulfur also indicates the highest resilience (47%). For DMTA, the results revealed that the shear storage modulus (E'), shear loss modulus (E''), and tan (δ) all reflect the vulcanization process.

Keywords: rubber; reclaimed rubbers; mechanical properties; dynamic mechanical analysis; vulcanization.

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Abstract: The synthesis of graphene by double thermal chemical vapor deposition using waste cooking palm oil (WCPO) as a natural carbon source has been investigated. The WCPO was placed in the first furnace (precursor furnace) whereas nickel was placed in the second furnace (deposition furnace). The deposition temperatures varied from 850 °C to 1100 °C by 50 °C increments. FESEM images at optimum temperature (1000 °C) display hexagonal shapes since the graphene layers were formed after precipitation of the carbon. Meanwhile, AFM the results show great potential for imaging and probing the 2D local resistance of graphene interconnection. Meanwhile, the interlayer distance, number of layers, crystalline size and impurity composition were compared by simple XRD pattern. UV-Vis results reveal the presence of graphene layer on Ni at the sudden jump peak prominent peak of at 230 nm. Sample at 1000 °C demonstrated an optimum reflectance in the entire visible light region. An obvious and significant peak with high intensity was notably detected at wavelength of 230 nm. Raman results reveal that the sample synthesis at deposition temperature 1000 °C is high 2 D-peak respect to other samples, which indicates high-quality formation of graphene.

Keywords—graphene; waste; palm oil; nickel; temperature

DYE SENSITIZED SOLAR CELLS

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ABSTRACT

Solar energy is the most abundant environment friendly renewable energy available on earth. Most of the developing countries are in the sun-belt and therefore well-placed to exploit solar energy. Photovoltaic conversion using solar cells is the convenient way to use solar energy. Conventional solar cells are mainly Si based. The usage of Si cells is not widespread because the production cost is relatively high. New generation solar cells such as multi-gap tandem cells, dye-sensitized cells, perovskite cells, and etc have been reported as alternatives to Si cells. Among the new generation solar cells, we focused on dye-sensitized solar cells (DSSCs). Most of the high efficient energy conversion DSSC systems are based on liquid electrolytes. However, problems associated with liquid electrolytes are leakage, flammability, electrode corrosion and other electrochemical stability issues. Replacing liquid electrolyte with a film of solid polymer electrolyte (SPE) will overcome these drawbacks, but, SPE has lower conductivity and poor electrolyte-electrode contact. To overcome the shortcomings of liquid electrolyte and SPE, quasi-solid-state (QSS) electrolyte is introduced. “Quasi” or “semi”-solid state electrolyte has both the cohesive properties of solid and the diffusive transport properties of liquids. QSS electrolyte is prepared by incorporating polymer or inorganic fillers (gelling agent) into a liquid electrolyte. This talk aims to introduce and provide the necessary background for researchers to explore into the R&D of DSSCs. The talk will begin with the state of the art of various photovoltaic solar technologies with particular attention on DSSCs, and then discuss the basic principles of DSSCs followed by fabrication and characterization techniques for DSSCs. Performance of DSSCs based on liquid- and quasi-solid-state electrolytes will be compared and discussed. Challenges in the R&D of DSSCs and suggestions to improve the performance will also be presented.

Keywords: Solar Cell; DSSC; Solar Energy

SELECTED RECENT TOPICS IN RADIO ASTRONOMY

PM Dr Zamri Zainal Abidin

Abstract

This talk will introduce a simple version of the fundamentals and history of radio astronomy. Current research at the Radio Cosmology Lab in University of Malaya will be presented. Topics that will be covered are including radio astronomical research of radio quiet zone, dark matter, stellar formation, galaxy and clusters evolutions and solar radio physics for space weather. The talk will also look at the prospect of the short and long terms future of radio astronomy research in Malaysia.

OVERVIEW ON PEROVSKITE SOLAR CELLS: FABRICATION OF ZINC OXIDE - BASED PEROVSKITE SOLAR CELLS

Dr. Mohd Firdaus Malek

The rapid development of organometal halide perovskite solar cells (PSCs) has led to reports of power conversion efficiencies of over 20%. TiO2 is the most commonly used material for the electron transport layer in PSCs. ZnO is an excellent inorganic semiconductor material owing to its large surface area, easy synthesis, direct electron pathways, large variety of synthesizable nanostructures, and low cost of fabrication. It can potentially replace TiO_2 as the electron transport layer material (ETM) in high efficiency perovskite solar cells based on flexible substrates.). Due to the different diffusion lengths of holes and electrons, electron transporting materials (ETMs) used in PSCs play a critical role in PSCs performance. However, the number of reported high performance PSCs using ZnO nanostructures is still limited.

SYNTHESIS AND CHARACTERIZATION OF SILVER-DOPED NANO ZINC OXIDE ON TITANIUM DIOXIDE SEEDED SUBSTRATE: POTENTIAL APPLICATION AS UV SENSOR

SITI ZULAIKHA BINTI UMBAIDILAH

ABSTRACT

ZnO-based UV Sensor have been investigated widely and it is realized that the performance of this device depends on the dimension, morphology and the structure of ZnO. One of the efforts that lead to the surface modification of ZnO is by introducing dopant in ZnO which it is expected to improve certain properties of ZnO and hence enhancing the performance of UV Sensor. In this work, metal-doped ZnO were grown on TiO2 seed layer by using a spin-coating technique for the deposition of TiO2 seed layer and the solution-immersion method for the growth of metal-doped ZnO. The effectiveness of TiO2 as a seed layer were investigated and it proved that the presence of TiO2 as a seed layer revealed a smaller diameter size of nanorods with high absorption properties of ZnO compared with pure ZnO. Then, the preparation towards the optimization of metal-doped ZnO nanorods on TiO2 seed layer also were studied. The properties of ZnO nanorods on TiO2 as a seed layer (ZTO) was successfully improved by introducing different types of metal dopants. All metal dopant showed a good potential to be used as dopant due to the size reduction of nanorods which contribute to high absorption properties of ZnO compared to non-doped sample. But, because of Ag dopant produces the highest absorption with a smallest size of nanorods, Ag might be the better dopant to produce a good optical property in UV region. The detailed study on the optimized Ag-doped ZnO thin films on the TiO2 seed layer (AgZTO) was successfully carried out by varying the parameters. It was found that 1.5 at.% of Ag^{+}, 0.08M precursor concentration and 500°C thermal annealing temperature was the optimum growth condition for AgZTO nanorods. On the other hand, the optimized AgZTO was further utilised for the preparation of highly conducting thin films in order to estimate the feasibility of Ag dopant in enhancing the performance of UV sensor. The comparison studies between ZTO and AgZTO under controlled parameter; 1.5 at.% of Ag dopant, 0.08M precursor concentration and 500 ºC thermal annealing temperature were successfully investigated. The results showed an excellent optical property of Ag1.5ZTO0.08 compared with ZTO0.08. The presence of Ag dopant in ZnO lead to the improvement of light absorption properties and high value of IUV/IVis which 90.4% higher than ZTO0.08. These samples were also tested using I-V measurement system and the result proved that the conductivity of Ag1.5ZTO0.08 were increased about 90.6% compared with ZTO0.08. As Ag dopant was introduced to ZnO, the intensity of UV emission and conductivity of the sample increased and hence demonstrated for high performance of UV sensor.

CHALLENGES TOWARDS SYNTHESIZING NANO-STRUCTURES OF ZNO BY AQUEOUS SOLUTION METHOD – A RETROSPECT

ASSOCIATE PROF. DR. ZURAIDA KHUSAIMI

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Abstract

A retrospect of the challenges faced towards synthesizing Zinc Oxide (ZnO) nanostructures by aqueous solution method is presented. Nanotechnologies have been engaged in this research in which ZnO nanostructures were controllably grown in nanoscale by bottom-up approach. Stabiliser was used to reduce rapid precipitation and agglomeration of ZnO particles and aid formation of nanometer range particles. The growth of rod, branched rod, flower like, hexagonal flakes and wire structures was evident where parameters such as ageing time, acidity and alkalinity solution environment have been varied. The objective in large was to optimise the preparation of ZnO nanostructures by cost-effective solution-immersion method towards desirable template for further growth of ZnO nanostructures by mist-atomiser method. Probing the structural, surface morphology of these samples has led to the evidence that supports the presence of nanocrystallites in the shape of nanorods. The preparation of ZnO nanorods templates with active room-temperature photoluminescence (PL) emission in the visible region (400-800 nm) with semi-conducting properties suitable for electronic devices application has been successfully prepared. Novel chemical equations involving precursor zinc nitrate hexahydrate and stabiliser, HMTA in the presence of water have been suggested to rationalise the formation of ZnO nanorods. Growth mechanism of the nanorods through basal growth with the aid of gold-seeded on Si substrate has been suggested to bring about the growth of aligned ZnO nanorods, whereas non-basal growth has been proposed for non-aligned and flower-shaped ZnO structures.