Decomposition Profiles of Silver Nanoplates under Oxidative Environments using Hydrogen Peroxide

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Silver nanoparticles (AgNPs) have been widely used nowadays due to its unique properties and potential applications. Silver nanoplates (AgNPls) are a good example of two-dimensional nanostructures which exhibit an extreme degree of anisotropy due to the shape and thus unique features in their localized surface plasmon resonances (LSPR). Changing in the size, shape, and morphology of AgNPls can all be manipulated their LSPR properties representing in the shifted color of the colloid solution. The phenomenon can be used for a variety of applications in chemical/biological sensing and imaging. In this study, a decomposition mechanism of AgNPls under oxidative environments induced by hydrogen peroxide (H$_2$O$_2$) was demonstrated. The decomposition profiles of AgNPls were studied using various concentrations of H$_2$O$_2$ and monitored by UV-vis absorption spectrometry technique to determine the optimize detection time. After incubating AgNPls with H$_2$O$_2$, the color has shifted from red to pink, orange, and yellow due to the concentration of the added H$_2$O$_2$. The intensity of LSPR monitored by UV-vis shows that the in-plane dipole, related to the plate size of AgNPls ($\lambda_{max} = 502$ nm ), is decreased and blue-shifted at high concentration of the added H$_2$O$_2$. Moreover, the intensity of LSPR at out-of-plane quadrupole, related to aspect ratio of the lateral size and thickness ($\lambda_{max} = 340$ nm ), is decreased and red-shifted. These observations indicate that the conversion of AgNPls starts at the edges of plate to the smaller irregular disk but the thickness is unchanged when the H$_2$O$_2$ were added. The plate decomposition is visually observed via a color change and TEM images. The plots between the $\Delta\lambda$ of in-plane dipole and log of [H$_2$O$_2$] are linearly related indicated that the decomposion mechanism of AgNPls might be used as a naked eye sensor for evaluating the concentration of H$_2$O$_2$.

![Figure 1](image-url)

**Keywords** Silver Nanoplates; Hydrogen Peroxide; Decomposition; Sensor
Multicomponent Nanocomposites of CoO-CoO$_2$-Graphene and Their Electrode Performance for Lithium Ion Batteries

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Mesoporous nanocomposites of CoO-CoO$_2$-graphene are synthesized via an electrostatically-derived self-assembly of exfoliated layered CoO$_2$ nanosheets with negative surface charge and surface-modified reduced graphene oxide (rG-O) nanosheets with positive surface charge, which is followed by heat-treatment in reduced atmosphere. The heat-treatment at elevated temperatures under H$_2$/Ar atmosphere causes a phase transformation from layered CoO$_2$ to rocksalt-type CoO confirmed by powder X-ray diffraction. The control of heating condition makes possible the tailoring of the ratio of CoO and CoO$_2$. Electron microscopic results reveal that, in the heat-treated nanocomposites, both of CoO$_2$ nanosheets and CoO nanoparticles are immobilized on the surface of rG-O nanosheets with the formation of porous stacking structure. The incorporation of layered CoO$_2$ nanosheets increases the surface area of CoO-rG-O nanocomposites via the optimization of mesoporous structure defined by BET analysis. A strong coupling of nanocrystalline cobalt oxides and rG-O gives rise to a prominent enhancement of electrical conductivity. The resulting multicomponent CoO-CoO$_2$-rG-O nanocomposites display large discharge capacity with excellent cyclability and good rate characteristics. The present findings clearly demonstrate that a controlled phase transformation from CoO$_2$ to CoO is effective in optimizing the electrode performance of cobalt oxide-graphene nanocomposites.

**Keywords** Mesoporous nanocomposites; Cobalt oxide graphene electrode; Lithium ion batteries
Photocatalytic Degradation of Methyl Orange on a Magnetically Separable CoFe$_2$O$_4$/TiO$_2$ Nanocomposite

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The cobalt ferrite/titanium dioxide (CoFe$_2$O$_4$/TiO$_2$) nanocomposite photocatalysts were successfully synthesized by combination of the modified sol-gel and hydrothermal methods with different mole ratios of CoFe$_2$O$_4$ to TiO$_2$. All nanocomposite samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Brunauer, Emmett and Teller (BET), and vibrating sample magnetometry (VSM). The XRD results showed the phase structure of TiO$_2$ presented in mixed crystalline phases between anatase and rutile structures. Meanwhile, CoFe$_2$O$_4$ showed cubic spinel structure. The TEM image showed that the obtained nanocomposite was spherical particles with diameter in the range of 10–40 nm. BET results shows specific surface area of nanocomposite was found in the range of 142–180 m$^2$/g. The photocatalytic activity was studied by using methyl orange as model of the dye under solar light irradiation. Results clearly showed that nanocomposite in the mole ratio of 0.2CoFe$_2$O$_4$/0.8TiO$_2$ exhibited high photocatalytic activity. The recoverable ability of 0.2CoFe$_2$O$_4$/0.8TiO$_2$ nanocomposite was also studied the degradation of methyl orange by external magnetic field.

Keywords CoFe$_2$O$_4$; Degradation; Nanocomposite; Photocatalyst; TiO$_2$
Fabrication and Photocatalytic Activities of Novel BiFeO$_3$/Bi$_2$WO$_6$ Composites for Rhodamine B Decolorization

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The novel BiFeO$_3$/Bi$_2$WO$_6$ composites were successfully synthesized by coupling co-precipitation with hydrothermal methods. The physichemical properties of composite samples were investigated by X-ray diffraction (XRD) for crystal structure and crystallinity. The morphology and particle size were examined by transmission electron microscopy (TEM). The XRD results of BiFeO$_3$/Bi$_2$WO$_6$ composite samples showed orthorhombic structure. The morphologies of BiFeO$_3$/Bi$_2$WO$_6$ composites consisted of granular-like and plate-like shapes. The Brunauer Emmett and Teller (BET) adsorption-desorption of nitrogen gas for specific surface area determination at the temperature of liquid nitrogen was performed on all samples. UV-vis diffuse reflectance spectroscopy (UV-vis DRS) was used to identify the light absorption range and band gap energy of all samples. Magnetic properties were studied by vibrating sample magnetometer (VSM). Photocatalytic activities of BiFeO$_3$/Bi$_2$WO$_6$ composite samples were evaluated by photodecolorization of rhodamine B (RhB) under visible light irradiation. Results clearly show that BiFeO$_3$:Bi$_2$WO$_6$ composite in 0.4:0.6 mole ratio exhibited the highest photocatalytic performance.

Keywords BiFeO$_3$; Bi$_2$WO$_6$; Composite; Fabrication; Photocatalytic activity
Graphene/polyaniline Nanocomposite-based Biosensor for Cholesterol Determination

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Graphene (G)/ polyaniline (PANI) nanocomposites are prepared and used for electrode modification by electrospraying fabrication for the detection of hydrogen peroxide (H\textsubscript{2}O\textsubscript{2}) and cholesterol. The morphology of G/PANI nanocomposite modified electrode is characterized by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The electrochemical behavior of G/PANI modified electrode is characterized by using cyclic voltammetry (CV) of ferri/ferrocyanide redox couple. The results show that the peak current response is substantially increased indicating the enhanced sensitivity of electrode. Furthermore, the peak potential difference ($\Delta$Ep) on G/PANI modified electrode is decreased compared to an unmodified electrode, which mean the electron transfer kinetic is faster on this electrode. The factor affecting the performance of modified electrode is carefully evaluated and optimized. Furthermore, the covalent immobilization of cholesterol oxidase (ChOx) on G/PANI electrode using glutaraldehyde as a cross-linker is prepared for amperometric detection of cholesterol. The electrochemical performance of the modified electrode in the detection of cholesterol is evaluated and optimized. Eventually, the ChOx/G/PANI modified electrode is successfully applied for the detection of H\textsubscript{2}O\textsubscript{2} and cholesterol in phosphate buffer saline (PBS) at a pH of 7.0. All of these results will be presented.

Keywords Graphene (G); Polyaniline (PANI); Electrospraying; Cholesterol oxidase; Cholesterol
Urchin-Like Gold Micro/Nanostructures (ULGMNSs) with Exceptionally High SERS

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In this report, a novel route for synthesizing complex gold micro/nanostructures using hydrogen peroxide (HP) as the sole reducing agent is developed. Raspberry-like gold micro/nanostructures (RLGMNSs) were generated by the reduction/stabilization of HP. The development of complex gold micro/nanostructures could be accomplished with the presence of silver ions. As the concentration of silver ion was increased, the gold microstructures evolved from RLGRMSs to urchin-like gold micro/nanostructures (ULGMNSs) with nano-needles. At an extremely high concentration of silver ions ([Ag⁺]:[Au³⁺], 4:1), the gold microspheres were obtained. The surface of ULGMNSs is covered with nanoneedles with 50 – 100 nm in length and 0.2 to 0.8 μm in diameter. Silver ions play an impotent role on formation and growth of the nanoneedles. The time-dependent observations of the growth mechanism (measuring by SEM) suggest that the added silver ions disrupt the dendrite growth of gold nanostructure by adsorption on the surface of existing hexagonal gold nanoplates. The adsorption induces the formation and growth of nanoneedles by promoting the crystal growth along <211> direction. The obtained ULGMNSs express exceptionally high surface enhanced Raman scattering (SERS) enhancement. The nanoneedles on the surface of ULGMNSs facilitated the formation of the hot spots. A nanomolar concentration of R6G could be determined using SERS spectroscopy.

Keywords Complex gold nanostructures; Silver ion; Hydrogen peroxide; SERS
Bacterial Cellulose/hydroxyapatite Nanocomposites Loaded with Bone Morphogenetic Protein-2 for Bone Formation Applications

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In the present work, a bacterial cellulose (BC)/hydroxyapatite (HAp) nanocomposite was prepared by a biomimetic mineralization approach for bone tissue engineering applications. Bacterial cellulose was produced by Acetobacter xylinum. HAp was grown in vitro along the nanofiber BC network via soaking in a calcium chloride solution followed by a sodium phosphate dibasic solution. Scanning electron microscopy (SEM) images revealed that HAp particles in the nanoscale (200 – 300 nm) homogeneously deposited on the surface of BC. Human BMP-2 (rhBMP-2) protein, the best known biologic agent for bone formation, was in-house recombinantly expressed in the soluble form in E. coli and then loaded to the BC-HAp nanocomposite by soaking in different concentration solutions (0 – 5,000 ng/ml). In vitro osteogenic potentials of rhBMP-2 in the BC-Hap nanocomposites were evaluated using C2C12 myoblast cell line for 14 day. Alamar Blue assay was exploited to quantitatively monitor cell proliferation, while cell differentiation was assessed by examining levels of alkaline phosphatase (ALP) activity. As expected, the BMP-2 unloaded BC-HAp nanocomposite exhibited reasonable cell growth and differentiation due to the osteoconductive properties of HAp. The data showed that loading of the rhBMP-2 could significantly enhance C2C12 cell proliferation and differentiation in the concentration dependent fashion. The loading solution concentrations of 1000 ng/mL and more could increase ALP activities by almost 2-fold for the entire period of incubation. The morphology of the C2C12 cells adhered onto the BMP-2 loaded BC-Hap substrates was visualized with the SEM. The adhered cells on all tested surfaces exhibited a well-spread morphology with long stress fibers running in many different directions. This work preliminarily demonstrates a promising potential for utilization of the BC-HAp nanocomposite as a carrier of rhBMP-2.

Keywords Bacterial cellulose; Hydroxyapatite; Nanocomposite; BMP-2
Enhanced Mechanical, Thermal and Electrical Properties of Highly Filled Graphene-Polybenzoxazine Composites

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Graphene is reported to possess superior electrical conductivity, high thermal conductivity, outstanding mechanical properties and excellent electronic transport properties. This research emphasized on the development of graphene filled composites based on polybenzoxazine particularly at high graphene loading (0-60 wt%) and investigated mechanical, thermal and electrical properties of the obtained composites. All composites were prepared using a compression molder at temperature of 200 °C and pressure of 15 MPa for 3 hours. In the present work, the flexural modulus of graphene filled polybenzoxazine was found to substantially increase with increasing graphene content. At the maximum content of 60 wt% of graphene, the modulus of the graphene composite is enhanced by 236% compared to that of the neat polybenzoxazine. Meanwhile, the flexural strength of the composite tends to decrease with increasing graphene loading. However, the obtained flexural strength of the composite i.e. 42 MPa, remains much higher than the DOE target value for an application as a bipolar plate material (>25 MPa). The thermal resistance of the composite reveals a remarkable improvement with increasing graphene content. At the maximum graphene content of 60 wt%, the temperature at 5% weight loss of composite was increased by 26 °C and residue of the graphene based composite was increased to 74%. In addition, the electrical conductivity exhibits a dramatic increase with increasing the graphene content from 0 to 60 wt% which was attributed to the formation of conductive pathways of the graphene particles in the polybenzoxazine matrix. Other essential properties of these highly filled composites including gas permeability and thermal conductivity are also being evaluated for potential use as a bipolar plate for proton exchange membrane fuel cell.

Keywords Highly filled system, Polybenzoxazine, Graphene, Thermal properties, Mechanical properties.
The Study of Pd-Ni-Sn Electrocatalytic Compositions for Use in Direct Ethanol Fuel Cells

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Palladium is one of the promising platinum replacing catalysts which was synthesized in different compositions for use in direct ethanol fuel cells (DEFCs). The sodium borohydride reduction method was used to prepare different Pd-Ni-Sn electrocatalystic compositions impregnated on carbon black (Vulcan XC72-R) powder. The Ni and/or Sn were used as the promoted metals for the Pd-based electrocatalyst in order to increase catalytic stability and electro-oxidation reaction (EOR). The metal weight ratio of the as-prepared catalysts were 20%Pd, 20%Pd20%Ni/C, 20%Pd20%Sn/C, 20%Pd15%Ni5%Sn/C, 20%Pd10%Ni10%Sn/C and 20%Pd5%Ni15%Sn/C. The X-ray diffraction (XRD) results showed the presence of Ni(OH)₂ peak and SnO₂ peak with respect to the Ni content and Sn content catalysts respectively. The plane (2 2 0) was used to calculate the crystalline size due to its clearly appearance on the XRD patterns. It was found that the crystalline size was in a range of 4.5 and 8.1 nm for all catalyst compositions. The energy dispersive spectrometry (EDS) was employed to verify the ratio of metal loadings for all catalyst samples. The scanning electron microscopy (SEM) demonstrated that the surface morphology was uniform for all catalysts. The current density of ethanol oxidation was investigated using the cyclic voltammetry (CV) in 1 M ethanol/KOH mixture at room temperature. It was found that the 20%Pd10%Ni10%Sn/C ternary catalytic system exhibited the corresponding current density of approximately 146 mA/cm² which was higher than those of the binary catalytic systems and the 20%Pd catalysts.

**Keywords** Sodium borohydride; Direct ethanol fuel cell; Ethanol electro-oxidation reaction; Palladium-base catalysts
Nanotechnology Assuring Food Safety and Security in The Global Food Supply Chain

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From the farm to your table nanotechnology plays an important role in protecting the global food supply chain. Nanomaterials are used in food processing and packaging as well as sensors and tracers. But technologies such as nanoparticles, can also be used as weapons in targeting rapid detection and prevention of pathogen contamination. Colloidal particles in the size range 10-100 nm are considered nanoparticles. A nanometer - nm is one-billionth of a meter. Nanotechnology generally inhabits the region of 0.1 nm. In intelligent packaging smart nanoparticle coating sniff out gases that are emitted by deteriorating food. This will trigger a color change on the label, at the same time the label could indicate that the fruit is ripe or the remaining shelf life of the product. Radio Frequency Identification (RFID) labels are replacing barcodes and can gather information over the lifespan of the product. Nanoparticles can also help to stabilize foods and enhance the nutritional properties. This paper looks at the role of nanotechnology in assuring the safety and security of the global food supply chain of both perishable and shelf-stable foods. As well as the potential of tampering and unethical behavior in food supply chain management and nanotechnology.

**Keywords** Nanotechnology, Food processing, Food supply chain, Packaging, RFID
Synthesis and Characterization of $\text{SO}_4^{2-}/\text{ZrO}_2-\text{La}_2\text{O}_3$

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La$_2$O$_3$ obtained from decomposition of monazite ore by alkali process, was used to prepare SO$_4^{2-}$/ZrO$_2$-La$_2$O$_3$ catalyst. In this study SO$_4^{2-}$/ZrO$_2$ loaded with La$_2$O$_3$ was synthesized by impregnation method. This catalyst is expected to be better than SO$_4^{2-}$/ZrO$_2$ without loading the La$_2$O$_3$. The effect of loading amount of La$_2$O$_3$ (5%, 10% and 20%) on structural properties of synthesized powder was investigated. The catalyst powders were characterized by X-ray powder diffraction (XRD), X-ray fluorescent (XRF), Nitrogen adsorption isotherm (BET) and Scanning electron microscope (SEM). It was found that specific surface area of SO$_4^{2-}$/ZrO$_2$-La$_2$O$_3$ decreased with the increasing of loading amount of La$_2$O$_3$. The obtained catalyst was used to catalyze simultaneous transesterification and esterification of palm oil and myristic acid with methanol to produce biodiesel.

Keywords Synthesis; Characterization; Sulfated zirconia; Lanthanum oxide
Thermoelectric properties of double substituted LaCoO$_3$

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Due to its high Seebeck coefficient, LaCoO$_3$ and related materials have been studied as potential candidates for thermoelectric applications. In this work, we present a strategy to improve thermoelectric properties of LaCoO$_3$ by double substitution with Sr and Mg giving La$_{1-x}$Sr$_x$Co$_{1-y}$Mg$_y$O$_3$ with $x$, $y = 0$, 0.025, 0.05, 0.1, and 0.2. All samples were prepared by citrate sol gel method and characterized by powder X-ray diffraction. Quantum Design Physical Properties Measurement System (PPMS) was used to measure thermoelectric properties of the sintered pellets. Effects of Sr and Mg substitutions were investigated separately. Replacing small amount of La with Sr increases electronic conductivity of the samples but reduce their Seebeck coefficient. On the other hand, Mg substitution increases Seebeck coefficient of the compounds but decrease electronic conductivity. However, when both substitutions were simultaneously used, the two effects combine and the overall properties are improved as both electronic conductivity and Seebeck coefficient are increased. In addition, double substitution also decreases lattice part of thermal conductivity of the samples which further improve their thermoelectric efficiency. Among all samples studied in this work, the samples with small amount of double substitution, La$_{0.975}$Sr$_{0.025}$Co$_{0.0975}$Mg$_{0.025}$O$_3$, give the best ZT of 0.029 at 298K.

Keywords Thermoelectrics, Oxides, Electrical properties
Improvement of Engineering Properties of Fired Clay Bricks Using Glass Cullet as an Additive

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This study was conducted to evaluate the effect of glass cullet on some physical and mechanical properties of fired clay brick. Afterwards, in order to get comparable results, different ratios of the glass cullet (0, 5, 10, 15 and 20% by weight) were added to the raw-brick clay. The results indicated that the densification of specimens occurred at the firing temperature between 900-1100 °C. Increasing the firing temperature could decrease porosity and increase density and compressive strength of specimens. Conclusively, the results revealed that glass cullet could be regarded as a potential addition to raw materials used in the manufacturing of fired clay bricks.

Keywords Porosity; Fired clay bricks; Glass cullet; Compressive strength
Electrochemically Fabrication of Poly(3-aminobenzoic acid)/MWNTs composite thin film

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In this study, the carboxylated polyaniline, poly(3-aminobenzoic acid), and multi-walled carbon nanotubes (PABA/MWCNTs) composite thin films were fabricated by electropolymerization of 3-aminobenzoic acid (ABA)/MWCNTs in 0.5 M H₂SO₄ using cyclic voltammetry (CV) with potential range of 0 V to 1.1 V for 5 cycles at scan rate of 20 mV/s on indium tin oxide (ITO)-coated glass substrate. A various concentrations of MWCNTs in 50 mM ABA solution with various sonication times were employed. The composite thin films were then characterized by CV, UV-vis absorption spectroscopy and atomic force microscopy (AFM). The effect of MWCNTs on PABA thin films can be observed from the different CV traces. Moreover, the AFM images indicated that different roughness can be seen for different concentrations of MWCNTs.

Keywords Electropolymerization; composite thin film; poly(3-aminobenzoic acid); multi-walled carbon nanotubes; cyclic voltammetry
Isolation of Nanocellulose Fibres from Oil Palm Trunk Fibres by Steam Explosion and High-Intensity Ultrasonication

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Nanocellulose fibres were isolated from oil palm trunk fibres by steam explosion and high-intensity ultrasonication. The chemical composition of raw oil palm trunk fibres consists of α-cellulose 40.4%, hemicellulose 22.9%, lignin 18.7%, extractives 5.7%, and moisture 12.5% of dry weight. Dried oil palm trunk fibres were prehydrolysis treated with sodium hydroxide solution followed by oxidizing or bleaching with calcium hypochlorite solution. The isolation of nanocellulose fibres was performed by using high-intensity ultrasonication (20 kHz at 800-1200 W) and steam explosion at pressure 15 lb incorporating with oxalic acid hydrolysis. After bleaching, the chemical compositions of cellulose fibres such as α-cellulose, hemicellulose, lignin, extractives and moisture content were 93.9-94.7%, 0.5-0.7%, 0.4-0.7%, 0.1-0.3%, and 4.2-4.6% of dry weight, respectively. It was found that the optimum condition for hydrolysis the oil palm trunk fibres was hydrolysis with 2% wt sodium hydroxide solution. The isolation of nanocellulose fibres by using high-intensity ultrasonication gave higher percentage yield of nanocellulose fibres than steam explosion process. The isolated nanocellulose fibres from both processes were similar in the structure.

Keywords Nanocellulose; Oil palm trunk fibres; Steam explosion; High-intensity ultrasonication
Degradation of Silk Dyes over ZnO Thin Films under UV-light Irradiation

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Zinc oxide (ZnO) thin films have been successfully deposited on glass substrates by using dip coating method. The thin films were characterized by X-ray diffraction, atomic force microscopy, ultraviolet–visible spectroscopy and photoluminescence spectroscopy. Their photocatalytic activities were investigated by the decomposition of malachite green and silk dyes (pink, green, purple, red and blue) under UV-light illumination. The initial concentrations of malachite green and silk dyes decreased during the UV-light illumination time. It was found that the degradation rate of the malachite green standard dye was higher than the silk dyes. The decolorizations of the silk dyes were strongly dependent on the additives.

Keywords ZnO; film; photocatalysis; dye
Enzymatic Functions Under High Temperature!

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Enzymes are generally unstable under extreme conditions. In this study, we show a unique phenomenon for the regulation and preservation of enzymatic activity of lysozyme and ribonuclease A (RNase A) using a cationic smart copolymer, poly(N,N-diethylaminoethyl methacrylate)-graft-poly(ethylene glycol) (PEAMA-g-PEG), even after the serious heat treatment. PEAMA-g-PEG suppressed the enzymatic activity of lysozyme owing to capping of the active site of lysozyme, which involved an electrostatic interaction between the negatively charged active site of lysozyme and the positively charged amine moiety of PEAMA-g-PEG at neutral pH despite the fact that both are positively charged. The inhibited enzymatic activity was recovered upon the addition of poly(acrylic acid) to the lysozyme/PEAMA-g-PEG complex even after the heat treatment. Recently, we found that PEAMA-g-PEG prevents heat inactivation of RNase A, which has a positively charged active site opposite to that of lysozyme. Interestingly, after treatment at 98 ºC for 10 min, the enzymatic activity of RNase A complexed with PEAMA-g-PEG was maintained at up to 75% of the level of the native RNase A whereas PEG was not able to prevent the heat induced irreversible inactivation of RNase A. Circular dichroism (CD) spectral analysis revealed that heat-induced irreversible inactivation was largely suppressed when enzymes was heated with PEAMA-g-PEG. These findings suggest that the heat resistance of enzymes is improved by the external addition of PEAMA-g-PEG.

Keywords: Lysozyme, RNase A, Enzymatic activity, PEAMA-g-PEG.
Study on Preparation of Poly(ε-caprolactone)/Poly(lactic acid) blend 3-D Scaffolds by Multi-nozzle Extrusion Deposition Machine (MED)

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Poly(ε-caprolactone) possesses good flexibility and fast biodegradability, while poly(lactic acid) is rather rigid, but fragile and relatively degrades more slowly. In this study, poly(ε-caprolactone) (PCL) and poly(lactic acid) (PLA) were blended at different weight ratios to yield a material with the most desired mechanical and biological properties for cartilage tissue engineering application. The blended materials were fabricated into 3-D scaffolds by a multi-nozzle extrusion deposition (MED). MED is one of additive processing techniques that fabricate materials into 3D scaffolds using computer aided design (CAD) data. The geometry, pore size and pore distribution of the resulting scaffolds can be readily controlled. Surface morphology, compressive strength, and biocompatibility of the fabricated scaffolds were determined using scanning electron microscopy (SEM), compressive testing machine, and cytotoxicity test, respectively.

Keyword: multi-nozzle extrusion deposition (MED) technique; 3D scaffold; poly (ε-caprolactone); poly (lactic acid)
The Effects of Silica and Polyurethane Binder on Self-cleaning Properties of TiO\textsubscript{2}-finished Cotton Fabrics

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This work investigated the development of self-cleaning cotton textiles using TiO\textsubscript{2} nanoparticles. The aim was to add value to textile products and to conserve the environment by reducing laundering frequency. It is known that TiO\textsubscript{2} is a photocatalyst capable of decomposing organic stains. In this study, cotton fabrics were finished with TiO\textsubscript{2} by a pad-dry-cure technique. TiO\textsubscript{2}-coated samples showed positive results with all four model stains: direct dye (C.I. Direct Blue 199), coffee, tomato sauce, and soft drink. When adding fumed silica (Aerosil200) to the TiO\textsubscript{2} coating, the finished fabric was less photocatalytically active for the decomposition of direct dye under artificial sunlight. A polyurethane binder (Evo Fin PUS) did not significantly affect stain decomposition but improved wash fastness. The crease recovery of the sample coated with 2% TiO\textsubscript{2}/2% polyurethane binder was superior to the untreated cotton.

Keywords Cotton; Polyurethane binder; Self-cleaning textile; Textile finishing; Titanium dioxide
Functionalized Carbon Nanotubes as Pt Catalyst Supports for use in Direct Ethanol Fuel Cells

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The improvement of catalyst surface to amplify surface area and expand efficient catalytic reaction for fuel cell purpose is our interest. Carbon nanotubes (CNTs) supports were functionalized by acid solutions (e.g., nitric acid, acetic acid, hydrochloric acid) to promote oxygen-containing functional groups, and then further electrodeposits the Pt metal nanoparticles for catalyst preparation. FT-IR spectra results show the formation of hydroxyl (-OH), carboxylic (-COOH) and ketone (-C=O) functional groups, at region 3420, 1735, 1643 and 1022 cm⁻¹ respectively. The results represent that the CNTs support surfaces were found to be richer oxygen-containing functional groups after acid treatment. In addition, cyclic voltammetry (CV) and chronoamperometry measurements were used to investigate the prepared catalyst performance at room temperature. It was found that the significant improvement in current density was obtained. Therefore, the collaboration between the Pt metal nanoparticles and oxygenated groups on the functionalized CNTs supports significantly enhanced the ethanol electrooxidation performance.

Key words: Fuel Cells; Electrodeposition; Cyclic voltammetry; Functionalized carbon
Synthesis and Characterization of a novel CeO$_2$/Bi$_2$WO$_6$ Heterojunction Photocatalyst with Enhanced Photocatalytic Activity

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The CeO$_2$, Bi$_2$WO$_6$ and CeO$_2$/Bi$_2$WO$_6$ photocatalysts were synthesized by coupling with hydrothermal and homogeneous precipitation methods. All samples were characterized in order to obtain the correlation between structure and photocatalytic properties by X-ray diffraction (XRD), transmission electron microscopy (TEM), BET specific surface area ($S_{BET}$) and UV-vis diffuse reflectance spectrophotometry (UV-vis DRS). The XRD results indicated that CeO$_2$ retain the cubic structure, while Bi$_2$WO$_6$ presented as orthorhombic structure. Photocatalytic activities of all photocatalyst samples were examined by studying the degradation of rhodamine-B under solar light irradiation. The results clearly showed that CeO$_2$/Bi$_2$WO$_6$ sample exhibited remarkably higher activity than pure CeO$_2$ and Bi$_2$WO$_6$.

**Keywords** Characterization; Heterojunction; Metal oxide; Photocatalytic activity; Synthesis
Highly Visible-Light-Induced Photocatalytic Activity of Methylene Blue using Novel InVO₄/BiVO₄ Composites

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The novel visible-light-driven photocatalyst InVO₄/BiVO₄ composites were successfully prepared by hydrothermal technique. The physical properties of the as-prepared samples were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), UV–vis diffuse reflectance spectroscopy (UV–vis DRS) and Brunauer, Emmett and Teller (BET). The absorption spectrum of all shifted to the visible region, suggesting the potential application of this material as a superior visible-light driven photocatalyst. Photocatalytic activities of all samples were examined by studying the degradation of methylene blue (MB) in aqueous solution under visible light irradiation. The results indicated that InVO₄/BiVO₄ photocatalysts showed higher photocatalytic activity than pure InVO₄ and BiVO₄.

Keywords BiVO₄; Composites; InVO₄; Photocatalytic activity
Ag/AgCl Photocatalytic Activity on Orange G Dye under Visible Light Irradiation

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Ag/AgCl was obtained from AgCl which was synthesized by the ion-exchange reaction with some metallic Ag nanoparticles on its surface. Its sizes were in the range 1-1.5 μm. The XRD diffraction patterns were matched with the cubic phase of AgCl crystal with some weak signals of metallic Ag. Ag nanoparticles were also detected by Transmission Electron Microscope (TEM). Another evidence of the presence of metallic Ag nanoparticles (on the AgCl surface) was the absorption in the UV-vis spectrum around 500 and 600 nm which was attributed to the surface plasmon resonance (SPR) effect. The product showed higher photocatalytic degradation efficiency of Orange G dye under visible light irradiation than commercial AgCl, simple AgCl, and Degussa P25 TiO2. AgCl crystals prepared with different conditions had no metallic Ag nanoparticles on the AgCl surface and showed lower photocatalytic activity.

Keywords Ag nanoparticles; SPR effect; recombination rate
Dehydration of D-xylose into Furfural Catalyzed by MWCNTs in Aqueous System

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Biomass conversion into biochemical continues to grow in importance. Furfural, derived from xylose in biomass, is one of the most essential chemicals that can be used as a building block for many industrial applications including polymers, fuels, pharmaceuticals and cosmetics. In the present work, multi-walled carbon nanotubes (MWCNTs) were proposed as a catalyst for biomass conversion in aqueous system due to their thermal and physicochemical property. The catalytic activity of MWCNTs was evaluated using xylose conversion into furfurals. The conversion of xylose increased significantly from 34% to 80% in the presence of MWCNTs while the furfural yield increased from 20% to 35%. The functional groups of MWCNTs were studied using Fourier transform infrared (FTIR). The FTIR result indicated the presence of the carboxylic groups, which is expected to play a role for enhancing the catalytic activity. Furthermore, the effect of chloride ions on furfural formation was carried out by adding 0.5 M NaCl. The addition of NaCl to the reaction system of MWCNTs-catalyzed xylose dehydration gave rise to higher furfural yield of 42%. The result suggested the potential contribution of the salt species in the sugar conversion and chemistry.

Keywords multi-walled carbon nanotubes; xylose; furfural; carboxylic groups; NaCl
Preparation and Characterization of Porous Carbon Materials from Bagasse by Hydrothermal Carbonization Process

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Hydrothermal carbonization process (HTC) is an one-pot thermochemical conversion process that would be viable means of solid waste management and could produce condensed functional materials for high value applications. In the present study, porous carbons from bagasse (BG) were produced via low temperature hydrothermal carbonization at 230 °C for 24 hours by using two strategies : (a) mixing weight ratio of BG : deionized water of 1:10 (HC-BT230), and (b) mixing weight ratio of BG : deionized water : citric acid of 1:10:0.02 (HC-BCT230). After HTC, the percentage yields of HC-BT230 and HC-BCT230 were 40% and 38%, respectively. Structure and surface chemical properties of the porous carbons were characterized using specific surface area analysis (BET), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR) and elemental analysis (C, H, N, O). The carbon contents of obtained products were 59.82 wt% and 65.12 wt% for HC-BT230 and HC-BCT230, respectively. In comparison with the raw bagasse which had a very low BET surface area of 1.66 m²/g, both the materials obtained after HTC possessed the increased BET surface areas of 27.33 m²/g (HC-BT230) and 20.47 m²/g (HC-BCT230). In addition, SEM analysis presents the existence of rough surface with the round-shaped particles attached to the surface, which provides additional macroporosity.

Keywords Bagasse; Hydrothermal carbonization (HTC); Porous carbon; Surface chemistry
Electrospun Graphene/Polyaniline Modified Carbon Electrode for Heavy Metal Detection

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The high surface area of graphene/polyaniline (G/PANI) fibers modified carbon electrode was prepared by electrospinning for the detection of heavy metals (e.g. Cd²⁺ and Pb²⁺). The parameters affecting the morphology of electrospun G/PANI fibers, such as type of carrier polymer, type of organic solvent, and concentration of carrier polymer were investigated and optimized. The results showed that type of organic solvent is the most important factors controlling the morphology of electrospun fibers. The morphology of the high surface area fibers was characterized by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The electrical conductivity of the high surface area fibers modified electrode was much higher than the unmodified carbon electrode, indicating the potentially high electrochemical sensitivity of electrospun G/PANI electrode. Along with anodic stripping voltammetry, this system was successfully applied for sensitive determination of Cd²⁺ and Pb²⁺.

Keywords Graphene; Polyaniline; Electrospinning; Anodic stripping voltammetry; Heavy metal
The olivine structure of LiNiPO$_4$ was synthesized via a new precursor LiNiPO$_4$$\cdot$2H$_2$O using a simple wet chemical reaction at low temperature (50 °C). This material can be used as a next generation high capacity cathode material for Li-ion batteries. The completed crystalline LiNiPO$_4$ was obtained from the calcination of the hydrate at 800 °C. The hydrate precursor and the calcined product were characterized by TG/DTG/DTA, FTIR, XRD and AAS/AES techniques. The non-isothermal decomposition kinetics of the dehydration process of the hydrate precursor was studied using TG/DTG/DTA data at different heating rates. The activation energy $E$ and the pre-exponential factor $A$ were determined using the selected KAS method. Additionally, the iterative method was used to evaluate the exact value of $E$. The most probable mechanism function ($g(\alpha)$) was determined from the Coast-Redfern and the conversional multi-rate equations. The isokinetic temperature ($T_i$) was evaluated from the spectroscopic data and was used to estimate the thermodynamic functions of activated complex using the Eyring equation.

Keywords LiNiPO$_4$$\cdot$2H$_2$O; Olivine structure of LiNiPO$_4$; Kinetics study; Thermodynamic functions of activated complex
Synthesis, Characterization, Non- Isothermal Kinetic and Thermodynamic Studies of the Formation of LiCoPO₄ from NH₄CoPO₄·H₂O Precursor

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Ammonium cobalt phosphate monohydrate (NH₄CoPO₄·H₂O) was synthesized by precipitating method. Then Olivine-like LiCoPO₄ was prepared from the NH₄CoPO₄·H₂O precursor and Li₂CO₃ by solid-state reaction. The non-isothermal decomposition of the solid solution (NH₄CoPO₄·H₂O precursor and Li₂CO₃) were found to decompose in four steps in the sequence of co-elimination (deammoniation and dehydration), dehydration, polycondensation and decarbonization processes. The thermal final product was found to be LiCoPO₄ according to the characterization by Thermalgravimetric / Differential thermalgravimetric / Differential thermal analysis (TG/DTG/DTA), Fourier transform infrared spectroscopy (FTIR), Atomic absorption spectroscopy / Atomic emission spectroscopy (AAS / AES) and X-ray powder diffraction (XRD). The morphologies of the studied compounds were investigated by Scanning electron microscopy (SEM). The kinetic parameters of the thermal decomposition (activation energy Eₐ and pre-exponential factor A) of this solid solution under non-isothermal conditions were studied by Ozawa-Flynn-Wall (OFW) and Kissinger-Akahira-Sunose (KAS) as well as the iterative methods (exact values of Eₐ). The calculated Eₐ values of title solid solution are very close to each other. The Coats-Redfern equation and kinetic compensation effects (KCEs) were successfully applied to confirm the activation energy and the probable mechanism functions g(α) of the thermal decomposition, which found to be the third order (F₃), three-quarters order (F₃/4), third order (F₃) and Valensi eq. (D₂) for the first, second, third and final decomposition steps, respectively. The thermodynamic functions of the transition state complexes (activated complexes) (ΔH°, ΔS°, ΔG°) calculated from the kinetic parameters from OFW method agree with that from the KAS method.

Keywords: NH₄CoPO₄·H₂O; LiCoPO₄; Solid-state reaction; Non-isothermal kinetics
Facile Synthesis of CdS in Montmorillonite, Supporting by Al$^{3+}$ Cation Dopant and Enhancing Its Optical Properties

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Intercalation of organic or inorganic guest species in layered clay minerals such as montmorillonite (MMT) is a way of producing nanohybrid materials, which gain increasing interest in development of advanced functional materials. Cadmium sulfide (CdS) is a promising material for many applications. Synthesis of high-quality CdS nanomaterials is very important for understanding their properties and potential uses. In this study, CdS nanoparticles were synthesized on montmorillonite and the effect of the addition of Al$^{3+}$ ion on the products’ properties were investigated.

After the ion exchange reaction between the aqueous solution of aluminium chloride (AlCl$_3$.6H$_2$O) and the aqueous suspension of montmorillonite, the aqueous solution of cadmium chloride (CdCl$_2$) was added and the mixture was stirred for 3 h at room temperature. The ratios of Cd:Al were 3:1, 1:1 and 1:3. After the reaction, the resulting solids (Al$_{1-x}$Cd$_x$S-MMT) were mixed with the aqueous solution of Na$_2$S and heated at 200°C.

The heated products exhibited the expansion of the interlayer space by 0.57 nm for CdS-MMT, Al$_1$Cd$_2$S-MMT and Al$_1$Cd$_3$S-MMT, and 0.55 nm for Al$_3$Cd$_3$S-MMT. The XRD patterns of all products did not show any reflections due to the other species, indicating the intercalation of CdS and Al$^{3+}$ ion in montmorillonite. The Al$^{3+}$ ion doped products (Al$_{1-x}$Cd$_x$S-MMT) showed significant differences in the visible absorption spectra. The absorption onsets were blue-shifted as increasing the amount of Al$^{3+}$ ion, supporting the formation of smaller size CdS in montmorillonite. Meanwhile, the photoluminescence intensities of Al$_{1-x}$Cd$_x$S-MMT were higher than that of pure CdS and CdS-MMT, attributing to the increase of recombination of electron and hole.

Keywords CdS; Al$^{3+}$ Ion; Hybrid Material; Montmorillonite
Properties Enhancement of Cotton Fabrics treated with Inorganic Coatings Based on Sol-Gel Processes for Urease Immobilization

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Cotton was sol-gel treated with metal alkoxide precursors, tetraethylorthotitanate, TEOT, in order to get inorganic phases able to improve the thermal stability of the fabric, without changing its mechanical features. It was found that cotton fabric with TEOT coating has $T_{\text{onset}}$ of 340°C whereas $T_{\text{onset}}$ of pure cotton fabrics is 320°C. In the terms of mechanical property and tensile strength, it was observed that the tensile strengths of both pure cotton and TEOT coated cotton fabrics are similar. We also report the immobilization of urease on TEOT coated cotton fabrics. It was shown that the proper conditions for the highest percentage (90.09%) of urease immobilization were 20 min of sonicate time and treated temperature at 50°C within 60 min. In addition, the thermal stability of urease immobilized on TEOT-coated fabrics is significantly increased. The efficiency of the immobilization was investigated by examining the relative enzymatic activity of immobilized compared with free urease. The results show that immobilized and soluble urease have a half-life of 32 and 26 days, respectively. Furthermore, Scanning electron microscopy and energy disperse spectrometry were used to characterize cotton fabrics that pointed to the enzyme entrapment with sol-gel matrices of TEOT.

Keywords Cotton fabrics; Sol-gel process; Tetraethylorthotitanate; Immobilized enzyme
DNPH-coated Electrospun Fibrous Nylon6 Membrane for Determination of Aldehydes in Water

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Electrospun fibrous Nylon6 membrane was prepared and used as adsorbent for solid phase extraction (SPE) in disk format. The fibrous Nylon6 SPE disk had lower back pressure than a silica-based packing SPE and then gave a high flow rate for a large volume of low-concentration sample. Moreover, the fibrous Nylon6 membrane was coated with 2,4-dinitrophenylhydrazine (DNPH) for derivatization, preconcentration and extraction of aldehydes in one step. The DNPH-derivative was then analyzed by high-performance liquid chromatographic (HPLC). Parameters for DNPH coating, such as concentration of DNPH and coating time, and extraction of aldehydes, such as type and volume of elution solvents, were optimized. The most important parameter affecting this extraction technique was concentration of DNPH that used for membrane coating. The proposed SPE disk was also applied for determination of aldehydes in real water sample.

Keywords Electrospun fibrous Nylon6 membrane; DNPH; Derivatization; Aldehydes; Solid-phase extraction
Synthesis and Characterization of Cu-Zn Nanoparticles by Submerged Arc Discharge Method

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Brass nanoparticles were synthesized by submerged arc discharge of brass rod (Cu 90%wt/Zn 10%wt) in the ambient atmospheric pressure. Three types of dielectric liquid including deionized water, ethanol and ethylene glycol were used in arc-submerged nanoparticle synthesis system. The particle size, microstructure and morphology of nanoparticles obtained were characterized via transmission electron microscopy (TEM), Scanning electron microscope (SEM) and X-ray diffraction (XRD), respectively. The XRD patterns show that the nanoparticles synthesized consist of Cu-Zn (brass) and zinc oxide. Zinc oxide was formed by oxygen free radicals during decomposition of the dielectric liquids used. The nanoparticles synthesized were spherical with size ranging from 10 nm to 40 nm. L-ascorbic acid and sodium borohydride was then used to reduce zinc oxide. The brass nanoparticles obtained were used to prepare a conductive ink. The conductive ink formulated was screen printed on polyethylene terephthalate (PET) substrate. The patterns printed were heated at 100°C under air flow and baked at 150°C under 2% H₂-N₂ mixed gas. The resistivities of the patterns obtained were then measured.

Keywords Copper-zinc alloy nanoparticles; Submerged arc discharge; Conductive ink
Effect of Triethanolamine in Ethylene Glycol Based Lubricant for Corrosion Protection on Cobalt-iron Alloys

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Hard disk drive (HDD) is currently used for storing data in not only computers but also other electronic appliance devices. Among HDD components, read-write head (called slider) is designed to write data onto magnetic media as well as read the data back from media. In operation, the slider will perform reading and writing while flying above media at the height of 12 nm. To maintain this flying height across the different radius of the media, air bearing design, read and writer elements will be lapped and polished to meet designed surface roughness, surface topography, as well as magnetic property which is a challenge for lapping and polishing because slider consists of multi materials such as Al₂O₃-TiC (AlTiC) for slider body, nickel-iron (NiFe) for shield, cobalt-iron (CoFe) for writer, nickel-manganese (NiMn), tantalum (Ta) and copper (Cu) for reader. To achieve this requirement, triethanolamine (TEA) is one of the additives added to the lubricant to control surface morphology and corrosion protection on CoFe. The aim of this study was to determine the effect of TEA on corrosion of CoFe. The corrosion was studied by analytical technique; electrochemical technique and by physical technique; scanning electron microscopy (SEM). The results presented the effect of pure ethylene glycol lubricant compared which three different concentration of TEA was added in ethylene glycol based lubricant on the lapping process. Adding of TEA in lubricant affected to decrease corrosion occurring. On the other hand, corrosion rate increased with increasing the concentration of TEA.

Keywords Corrosion; Cobalt-Iron; Corrosion inhibitor; Corrosion rate
Synthesis of Three Dimensionally Ordered Macroporous (3DOM) Hydroxyapatite (HAp) and Iron Substituted Three Dimensionally Ordered Macroporous Hydroxyapatite (3DOM Fe-HAp)

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Three dimensionally ordered macroporous (3DOM) hydroxyapatite (HAp) and iron substituted 3DOM HAp was successfully synthesized by sol-gel method using PMMA colloidal crystal arrays. The highest HAp phase of 77.0% was found in the 3DOM HAp after aging time of 10 hours where the maxima of 78.4% HAp were obtained in the synthesized 3DOM Fe-HAp after aging time of 8 hours. Compared with the 3DOM HAp, the colour of the 3DOM Fe-HAp was changed from white to brown with an iridescent phenomenon as a result of three dimensionally ordered structure of the HAp. The 3DOM HAp and the 3DOM Fe-HAp were characterized using X-ray diffraction spectrometry (XRD), Fourier transformed-infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM).

Keywords Hydroxyapatite; Three-dimensionally ordered macrporous (3DOM); sol-gel; Iron
Synthesis and Characterization of Cu-Zn Nanoparticles through Microwave-assisted Polyol Co-reduction Process

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Copper nanoparticles have attracted much attention because of its huge potential for replacing expensive nano silver inks utilized in conductive printing with low cost. Many methods have been used for synthesizing metal nanoparticles. A major problem in utilizing copper nanoparticles is their inherent tendency to oxidize in ambient conditions. Thus, another interesting approach to stabilize the copper nanoparticles is to use copper alloy nanoparticles. However, only a few works has been studied on the synthesis and characterization of copper-zinc alloy. Polyol process is a convenient and environment friendly technique to produce nanoparticles. It uses a non-aqueous liquid (polyol) as a solvent and reducing agent. The use of a non-aqueous solvent has an advantage of minimizing surface oxidation and agglomeration. Moreover, Polyol mediated nanoparticles synthesis allows flexibility controlling the size and shape of nanoparticles. In this work, copper-zinc alloy nanoparticles were synthesized through the microwave-assisted polyol co-reduction process at concentrations 0.1 M and 0.05 M. The molar ratio was fixed at 5:1. The particle sizes, microstructure and morphology of nanoparticles were obtained via X-ray diffraction (XRD), Scanning electron microscope with Energy-dispersive X-ray spectroscopy (SEM/EDX) and Transmission electron microscopy (TEM). The results confirmed the formation of bimetallic copper-zinc alloy. Crystallite size at 0.1 M different concentration were investigated with size 40, 58, 62 and 55 nm, respectively and crystallite size at different concentration at 0.05 M were 62, 72, 53 and 46 nm, respectively.

Keywords Copper-zinc alloy nanoparticles; Co-reduction; Polyol process; Conductive ink
Multi-Enzyme for One Step Bio-Desizing and Bio-Stoning of Denim Fabric

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After weaving denim fabric, it is necessary to remove sizes (starch) and dyes (indigo dye and/or sulfur dye) from the fabric via desizing and stone-washing processes respectively. The purpose of desizing is to improve fabric wettability and that of stone-washing is to decrease fabric color strength. In general, these two processes are separately conducted using different chemicals and/or enzymes, leading to time and energy consuming. In this research, we proposed to produce a multi-enzyme containing high activity of amylase (for desizing) and cellulase (for stone-washing) from Aspergillus sp. and to use this multi-enzyme for one-step desizing and stone-washing. Thick denim fabric supplied from the industry was bio-desized and bio-stone washed (biostoning) in a washing machine using various concentrations (5-100%) of our multi-enzyme and a fabric to stone ratio of 1:24, at pH 5, 60°C for 1-5 hours. For comparison, a commercial mixed-enzyme between amylase and cellulase (Denimax Core 1380s) was also used on the same fabric for one-step process. Treated fabrics were tested for size residue (desizing efficiency), water absorbency, color strength (dye removal efficiency) and other physical properties. Results indicated that the one-step process using our multi-enzyme could be done successfully with 5% concentration of enzyme at 2-hour time, while the process using commercial mixed enzyme needed a longer time of 4 hours for the best outcome. The desizing efficiency using our multi-enzyme process was approximately 91% while it was 82% when using commercial mixed enzyme process. Treated fabrics were softer than untreated one, contained very low content of starch size, and provided good water absorbency property. Color strength of treated fabric was 3-4 units lower than the untreated fabric.

Keywords Desizing; Biostoning; Denim; Multi-enzyme; Aspergillus sp.
Facile Preparation of Monodisperse Carbon Beads

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Monodisperse carbon beads were successfully prepared via sol-gel polycondensation of resorcinol with formaldehyde using the syringe injection method. This process was followed by solvent exchange, hot drying and carbonization in a nitrogen atmosphere. Monodisperse carbon could be obtained by injection. Particle size of carbon was dependent on the size of needle, injection rate and flow rate of circulating pump. The results indicated the potential for controlling the size distribution of carbon beads with different parameters. Carbon beads were characterized by particle size analyzer, scanning electron microscopy and nitrogen sorption measurement. This method could also be applied to the synthesis of monodisperse beads of other organic or inorganic materials. It is possible to scale-up the apparatus for the mass production in the near future.

Keywords RF; Monodisperse; Carbon Beads; Syringe Injection
Morphology and Mechanical Property of Anodic Aluminium Oxide by Chemical Etching Solution

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Anodic aluminum oxide (AAO) templates were successfully fabricated by using a two step anodization process. Morphology of anodic aluminum oxide templates depend on various process parameters. The chemical etching treatment had a highly impact on the morphological features of the AAO templates. In this research we aimed to study effect of chemical etching (Nitric acid, Phosphoric acid and Chromic acid). We found that etching solution of phosphoric acid fail to remove the anodic aluminum oxides from the first step anodization. The addition of chromic acid can be remove anodic aluminum oxide and improve the AAO pore features. Field Emission Scanning Electron Microscope (FE-SEM) and Micro Hardness Tester were used to characterize the morphology and the mechanical property of AAO templates, respectively. In addition, the relationship between AAO templates and chemical etching is further discussed and established.

Keywords Anodization; Chemical Etching; Nitric Acid; Phosphoric Acid; Chromic Acid
Efficient Solution-Processed Non-Doped Green Emitters Based on Bis(fluorenyl)benzothiadiazole End-Capped with Carbazole Dendrons for Organic Light-Emitting Diodes

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Organic light-emitting diode (OLED) is the electrically driven emission of light from organic materials. Nowadays, OLEDs have attracted enormous attention from the scientific community due to their high technological potential for the next generation of full-color-flat-panel displays. Trends of OLED studies are mainly focused on device fabrication techniques and material development. In terms of material development, the device performances can be upgraded by finding out materials emitting pure blue, green, and red colors with excellent emission efficiency and high stability for OLED displays. In this work, new green emissive materials, bis(fluorenyl)-benzothiadiazole end-capped with carbazole dendrimers, were successfully designed and synthesized with 55–70% yields. PL spectra in solid state (neat film) of the materials showed featureless emission bands in the green region (λ_em = 528–540 nm) and exhibited slight blue-shifts (~1–14 nm) of emission maxima relative to their solution spectra, suggesting that intermolecular π–π interactions in the solid state of the fluorescent core are well averted by the bulky molecular structure of these end-capping carbazole dendrons. Moreover, high thermal (T_g up to 364 °C) and electrochemical stability (multiple CV scans displayed identical CV curves), and great potential as solution processed non-doped green emitters for OLEDs were obtained from these materials. A stable pure green light-emission with CIE coordinates of (0.27, 0.62) and high luminance efficiency (up to 10.01 cd/A) was achieved from a non-doped OLED using these materials as emissive layers with the structure of indium tin oxide glass substrate/PEDOT:PSS/green emitters (50 nm)/bathocuproine (30 nm)/LiF (0.5 nm)/Al (150 nm).

Keywords Organic light-emitting diode; non-doped emitter; benzothiadiazole; dendrimer
Creating Reactive Surface of Glass Using Hydrofluoric Acid

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Materials coated on a glass surface normally quickly wear off over time due to the chemical inertness of glass causing weak binding between them. Increase in a silanol (Si–OH) group on the glass surface can create the strong binding. Furthermore, in many optical applications, the clarity of glass is an important factor. The main objective of the research was to convert a normal glass to a glass with higher reactive surface, while the etched glass was still highly transparent.

In this research, we have studied the conditions for creating a quantity of the silanol groups using a hydrofluoric acid (HF) etching process. Additionally, the transparency of the glass must be maintained. First the glass samples were cleaned using various solutions. Then, the cleaned glasses were etched using various HF concentrations (1.0 – 10.0 mM) and etching durations (1 - 5 hours). The etched glasses were tested their clarity using a visible spectrophotometer, and the increase in the silanol group was inspected by measuring contact angles and diffused reflectance infrared spectroscopy. The results showed all un-etched and etched glasses were transparent with about 90-92% transmittance. Furthermore, the quantity of silanol on the glass surface is influenced by the HF concentration, the etching duration, and surprisingly the cleaning solution.

\textbf{Keywords} glass surface; cleaning solution; Hydrofluoric Acid; etching process; contact angle; silanol
Electrical Parts from Polypropylene-Bagasse Fiber Composites

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Waste electrical parts are increased every year due to the rise of consumption of electrical appliance. The commonly plastic for production of electrical parts is Polypropylene. This aim of this research is to mix bagasse fiber, a by-product of the sugar industry, with PP to produce electrical parts. The ratio of bagasse fiber was set up from 5 to 15 wt% respectively. The effect of coupling agent to the PP/bagasse fiber composites on the adhesion between matrix and fiber are investigated. The mechanical properties were evaluated by means of tensile (ASTM D638), 3-point bending (ASTM D790) and impact testing (ASTM D256). The results showed that the flexural modulus improved with adding bagasse fiber content and the addition of maleic anhydride grafted Polypropylene (MA-g-PP) also improved the tensile strength, the flexural strength and the flexural modulus. Aspect ratio of bagasse fiber did not improve the mechanical properties significantly. The results of the thermal properties indicated that the addition of MA-g-PP, bagasse fiber content and aspect ratio of bagasse fiber decreased crystalline in polymer chains. SEM micrograph showed good dispersion of bagasse fiber at 10wt% and good adhesion between matrix and fiber with MA-g-PP mixed in composites. The agglomerates of bagasse fiber were evidently distributed in PP composites with 15wt% bagasse fiber.

Keywords Polypropylene; Bagasse fiber; Maleic anhydride grafted Polypropylene; Mechanical properties
Physical-Chemical Characteristics of Chitosan-Carboxymethyl Cellulose Edible Films

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Edible films from chitosan and carboxymethyl cellulose (CMC) were fabricated and characterized for application in Halal food industries. We investigated the effects of carboxymethyl cellulose and plasticizer contents on chitosan-based films. The films were prepared from 1.00% (w/v) of chitosan, CMC % at (0.25 and 0.50 % w/v) and sorbitol at (0 - 0.20 % w/v). The best competitive films, composed of 1.00 % chitosan, 0.25 % CMC and without plasticizer had water vapor permeability of $2.5 \times 10^{-10}$ g-m/m²-s-Pa, tensile strength of 0.65 MPa and elongation at break of 101.60 %. The modified film had a glass transition temperature ($T_g$) in the range of -0.4 to 4.0°C. Color of the modified films measured with L*a*b* system was not significantly different. The films were slightly yellow and had minimal odor. The modified films are currently tested for their efficacies in extending storage life of Thai fruits.

Keywords: chitosan; carboxymethyl cellulose; edible film
Production of PHBV-Bagasse Composites

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PHBV is biodegradable aliphatic polyester produced by a wide range of microorganisms, members of Polyhydroxyalkanoate (PHAs) family. This research aims to study composites properties of biodegradable polymer of Poly (hydroxybutylate-co-hydroxyvalerate) (PHBV) filled with Bagasse. The composites were prepared by the melt mixing method. A different compositions base on PHBV/Bagasse were investigated according to the following weight ratio, i.e. 100/0, 95/5, 90/10, 80/20 and 70/30 wt%. The effect of Bagasse loading and surface modification on morphology, mechanical properties, thermal properties and rheology behavior of PHBV/Bagasse composites were studied. The results showed that the composites exhibit pseudoplastic behavior as the shear stress and extrudate swell increased with increasing shear rate while shear viscosity decreased. The heat of fusion (related to crystallinity) of semicrystalline PHBV biopolymer and also the melting point was decreased, particularly in low Bagasse loading biocomposites. The mechanical properties results indicated high elastic modulus and flexural strength with tensile strength and elongation at break. The SEM analysis results showed a good dispersion of Bagasse in the matrix, However, detrimental Bagasse agglomeration was clearly observed to take place for sample with Bagasse loading exceeding 20%. The surface modification of Bagasse was carried out using silane coupling agent (Si69 and APS) and benzoic acid highlighting the effect of functionalization on the interfacial adhesion between PHBV and Bagasse. These results were also further confirmed by FTIR spectroscopy and SEM-EDS.

Keywords PHBV; Bagasse; Biodegradable
The Corrosion Inhibition Efficiency of *Piper Sarmentosum* Extract for Mild Steel in Cooling System

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The present article describes the inhibition efficiency of *Piper Sarmentosum* extract on the corrosion behaviour of mild steel in make-up water used for cooling system. The effects of extract concentrations (4.0 g·L\(^{-1}\), 5.0 g·L\(^{-1}\) and 6.0 g·L\(^{-1}\)) and temperatures (35ºC, 45ºC and 55ºC) were investigated using weight loss measurements and SEM. The *Piper Sarmentosum* extract showed a promising result as a green corrosion inhibitor. The result showed the best inhibition efficiency of 82.37% corresponding to the corrosion rate of 2.38 mpy with the extract concentration of 6.0 g·L\(^{-1}\). The inhibition efficiency of the extract increased with an increase in extract concentration. However, it decreased with an increasing temperature suggesting the adsorption of the extract on the mild steel surface via a physisorption process. An activation energy of corrosion process increased from 15.97 J·mol\(^{-1}\) to 55.80 J·mol\(^{-1}\) when adding 6.0 g·L\(^{-1}\) extract. With the extract, the corroded area dramatically reduced. SEM showed that corrosion morphology was uniform corrosion.

**Keywords:** Corrosion inhibitor; Natural Extract; Mild steel; Corrosion
Electrical and Mechanical Properties of Polypropylene/Ethylene Propylene Rubber/Carbon Black Composites

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Carbon black (CB) is widely used as a reinforcing filler (to improve dimensional stability), an electrically conductive filler, an ultraviolet light stabilizer, an antioxidant (to prolong the lifetime of rubber), and a pigment. CB based polymer nanocomposites typically exhibit percolation-type conductive behaviour. In this work, electrically conductive composites were prepared from polymer blends of polypropylene (PP) and ethylene propylene rubber (EPR) with CB as conductive filler (PP/EPR/CB). PP/EPR mixtures at the volume ratios between 100/0 to 50/50 were blended with CB as conductive filler ranging from 0 to 30 wt% by melt mixing in an internal mixer at 200 °C for 10 min, followed by compression moulding at the same temperature. The PP/EPR blends were found to have lower percolation threshold and surface resistivity than carbon black filled PP likely due to “double percolation” phenomenon in the systems. The percolation threshold of the obtained PP/EPR/CB composites was initially observed at the minimum content of 5 wt% of CB. To achieve the surface resistivity of less than $10^6 \text{Ω/square}$, the CB content in the blend can be reduced at least 50% compared to the composite using neat PP as a matrix. Mechanical properties, including tensile strength, tensile modulus and elongation at break of the conductive composites were evaluated. The tensile modulus of the CB filled composites increased with increasing CB content. The tensile strength and elongation at break values for all composites decreased slightly with the CB content. These conductive composites show properties that meet applications such as conductive materials for electronics packages.

Keywords: Electrical properties; Mechanical properties; Carbon black; Percolation threshold
Mechanical Properties of Surface modified Pineapple Leaf Fiber and Poly(Lactic Acid) Composites

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In this work, the mechanical properties of pineapple leaf fiber (PALF)/poly(lactic acid) (PLA) composites were studied. Pineapple leaf fibers were treated with 4 %wt sodium hydroxide solution followed by silane. There are three types of silane solutions with different functional groups used for fiber treatment; γ-(aminopropyl) trimethoxy silane (APS), γ-methacrylate propyl trimethoxy (silane A174) and bis[3-(triethoxysilyl)propyl] tetrasulfide (Si69). The mechanical properties of the composites were determined using tensile and impact testing, while the fractured surfaces were investigated by scanning electron microscope (SEM). The results showed that the tensile strength at break of PLA is 56 MPa and increased when higher loading of the fiber was used (5 % < 10 % < 20 %wt). The tensile strength of all silane treated PALF/PLA composites was lower than PLA, whereas its impact strength was similar to PLA. The untreated PALF/PLA composite containing 5 %wt of PALF shows the highest impact strength compared with PLA and all the other composites. In the case of the three different silanes, the fiber composite treated with silane A174 showed the best impact strength. The SEM images showed that the PALF fibers in the composite treated with silane were much more strongly attached to the matrix than the untreated samples, which were observed to be ‘loose’. This indicates greater adhesion between PLA and PALF with the silane treatment.

Keywords Pineapple leaf fiber (PALF); Mechanical properties; Fiber surface treatment
Synthesis and Characterization of a Mixed Phase of Anatase TiO\textsubscript{2} and TiO\textsubscript{2}(B) by Low Pressure Chemical Vapour Deposition (LPCVD) for High Photocatalytic Activity

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This project is concerned with preparing a dual phase of anatase TiO\textsubscript{2} and TiO\textsubscript{2}(B) thin film synthesized using Low Pressure Chemical Vapour Deposition (LPCVD). This is the first report of these materials being produced by CVD in the literature and we have developed a mechanism for TiO\textsubscript{2}(B) formation. Titanium isopropropoxide and N\textsubscript{2} gas were used as the precursor and carrier gas respectively. The effects of reaction temperature, carrier gas flow rate and deposited area were studied. TiO\textsubscript{2} thin films with nano-sized TiO\textsubscript{2} particles were obtained under suitable conditions and SEM, TEM, powder XRD, Raman and UV-Vis DR spectroscopy were employed to characterize the phase and physical appearance of synthesized materials. Results show that a dual phase (TiO\textsubscript{2}(B) and anatase) thin film nanopowder was successfully prepared by LPCVD with needle- and polygonal plate-shape crystallites respectively. The optimal LPCVD condition for preparing this mixed phase of TiO\textsubscript{2} was 600°C with a 1 L/min N\textsubscript{2} flow rate. It has been reported in the literature that the mixed phase TiO\textsubscript{2}(B) and anatase prepared by hydrothermal synthesis using both anatase or P25 precursors has enhanced photocatalytic activity for the chemical degradation of methyl orange, sulforderomine B and nitrate ion. In parallel studies, we have also hydrothermally synthesised the mixed phase materials from a titanium isopropropoxide precursor and are in the process of testing this materials for the water splitting reaction if we confirm this photocatalytic enhancement for this new dual phase materials we intend to also test the mixed phase thin film materials produced by LPCVD to observe whether we see a similar enhancement.

Keywords TiO\textsubscript{2}(B); Dual phase TiO\textsubscript{2}; Low Pressure Chemical Vapour Deposition; Photocatalyst
Low Temperature Synthesis of Nanocrystalline Hydroxyapatite from Cockle Shells by Wet Chemical Method

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Nanocrystalline Hydroxyapatite bioceramic powder, which is similar in composition and crystal structure of natural bone were synthesized from Cockleshells by wet chemical precipitation method at low temperature. Powder synthesis was co-precipitated with Ammonium dihydrogen phosphate (NH$_4$H$_2$PO$_4$) and calcium oxide which derived from Cockle shells (more than 95% purity) by magnetic stirrer at 40-60°C/8 hours, adjusts pH to 7 by HNO$_3$ solution. The powders were calcined at 700°C/2 hours. The crystalline morphology were analyzed by powder X-ray diffraction (XRD) was determined to be hydroxyapatite (HA; Ca$_{10}$(PO$_4$)$_6$(OH)$_2$). Chemical compositions were observed CaO and P$_2$O$_5$ which analyzed by X-ray fluorescent (XRF) and Scanning Electron Microscopy (SEM) with Energy Dispersive X-Ray Analysis (EDX). Furrier transformed infrared (FT-IR) was presented of bands at 1048-1090; 961; 571-601 cm$^{-1}$ which correspond to PO$_4^{3-}$ functional groups of HA, density 3.167 g/cm$^3$. Particle characteristics were measured average particle size, surface area and product yield of the process are 76.18 nm, 220.30 m$^2$/g and 92.47%, respectively.

Keywords Synthetic hydroxyapatite; Calcium phosphate; Cockle shells; Bioceramic
Influence of Graphene-polyaniline Additive on the Performance of Gel Valve-regulated Lead-acid Battery

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In this work, graphene-polyaniline (GP-PANI) composite was successfully prepared and used as a novel additive on the gel electrolyte of absorptive glass mat valve-regulated lead-acid (AGM VRLA) battery. Gelled electrolyte in the presence of GP-PANI additives, containing fumed silica and concentrated sulfuric acid, was prepared by mixing with high stirring rate of homogenizer at room temperature. The electrochemical behavior and performance of AGM VRLA battery were tested by using electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), conductivity, and galvanostatic charge-discharge method. In addition, the morphology of battery plates was characterized by scanning electron microscope (SEM). Various GP-PANI concentrations between 5 and 60 mg/L added into the gelled electrolyte were optimized. The EIS results show that only 20 mg/L of GP-PANI composite provided the lowest charge transfer resistance corresponding to the discharge capacity of battery. Moreover, the 12V GEL-AGM-VRLA battery contained with optimal fumed silica content and concentration of GP-PANI provided higher discharge capacity than the conventional GEL-AGM-VRLA battery in the absence of GP-PANI additive.

Keywords gelled electrolyte, graphene-polyaniline composite, VRLA battery
Preparation of Microfibril Cellulose from Coconut Fiber by Chemical Treatment

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Microfibril cellulose was successfully prepared by chemically treated brown coconut fiber. First step, coconut fiber was treated with H2O2 solution at 90°C for removing waxy and lignin on the surface. Second step, the treated fiber was sonicated for 1 hour for improving the separated cellulose form large bundle of coir fiber. Finally, the treated coconut fiber was treated with NaOH solution at 90°C producing the separated single cellulose. The effect of these treatments on the microstructure and surface functional group of fibers was studied using scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier-transformed infrared spectroscopy (FT-IR), respectively. SEM results showed that the chemical treatment could be removed the residual waxy, hemicelluloses and lignin on the surface of coconut fiber and separated into microfibril cellulose. The microfibril cellulose with diameter as 10 µm was successfully obtained. The XRD results showed that the crystallinity of cellulose increased when treated with chemicals. The FT-IR results confirmed the reduction of impurities content on the surface by chemical treatment.

Keywords Coconut fiber; Lignocellulostic material; Cellulose; Chemical treatment
Synthesis and Characterization of ZSM-5 Zeolites from Natural Kaolin under Different SiO$_2$/Al$_2$O$_3$ Mole ratios

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ZSM-5 zeolites were synthesized from natural kaolin, Lampang province, Thailand, via hydrothermal process. The kaolin contains silica and alumina sources for zeolites synthesis. After milling and sieving kaolin, the pretreatment was calcined at 700 °C for 3 h and followed digestion with 3 M HCl. The chemical composition of SiO$_2$ and Al$_2$O$_3$ analyzed by X-ray fluorescence spectrometry (XRF) were 72.74 %wt and 21.22 %wt, respectively. In preparation of ZSM-5 zeolites, the SiO$_2$/Al$_2$O$_3$ mole ratios were adjusted to 30, 50, 70 and 100 by adding Na$_2$SiO$_3$ solution. Additionally, the tetrapropylammonium bromide (TPA-Br) was used as a templating agent by added into the mixture and adjusted gel pH to 11 with 0.5 M H$_2$SO$_4$. The optimum conditions of ZSM-5 zeolite synthesis for hydrothermal process were used at 170 °C and reaction time for 24 h. After that, the synthesized products for ion-exchange process were refluxed with 1 M (NH$_4$)$_2$SO$_4$ at 90 °C for 2 h and then calcined at 550 °C for 3 h. Subsequently, the ZSM-5 zeolites were characterized by x-ray diffraction spectrometry (XRD), fourier transform infrared spectrometry (FT-IR), scanning electron microscope (SEM) and brunauer-emmett-teller (BET) surface area analysis.

Keywords ZSM-5 zeolites; Natural kaolin; Pretreatment; Hydrothermal process
Bis(3-N-butylcarbazolyl)cyanoterephthalidene for green organic light emitting diodes (OLEDs)

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A new green electroluminescence dopant material, bis(3-N-butylcarbazolyl)cyanoterephthalidene, was synthesized by the Knoevenagel condensation reaction and used in organic light emitting diodes (OLEDs). The OLEDs device was fabricated by the vacuum deposition under high vacuum conditions. The OLEDs structure was composed of ITO/MoO$_2$/α-NPD/bis(3-N-butylcarbazolyl)cyanoterephthalidene doped CBP/Balq/LiF/Al. The photophysical properties of the device have been investigated. The turn-on voltage and maximum external quantum efficiency (EQE) were 12 V and 1.28 %, respectively. The device fabricated by multilayer OLEDs exhibited the green electroluminescence at 493 and 522 nm.

Keywords Green organic light emitting diodes; Carbazole; Electroluminescence
High Purity Calcium Oxide Extraction from Eggshells for Nanobioceramic Powder Synthesis

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Eggshells, which a natural source of calcium carbonate (CaCO₃) and can be produced calcium phosphate bioceramic powders like hydroxyapatite (HA; Ca₁₀(PO₄)₆(OH)₂) and tricalcium phosphate (TCP; Ca₃(PO₄)₂). In this research, calcium oxide can be prepared from eggshells, with more than 97% purity. As eggshells were used as material must have heavy metal level within ASTM’s implant materials standard and have high calcium. After organic matters in eggshells was eliminated organic matter with 15% v/v of H₂O₂. Oxidation reaction in shuttle kiln was the method to extracted calcium oxide (CaO) at 850, 900 and 950 °C. Oxides were analyzed by X-ray Diffraction and X-ray fluorescence. Differential thermal analysis and thermal gravimetric analysis used for predicted thermal state of the eggshells that affected on mineral composition. The results showed that the eggshells of crystalline calcium carbonate (calcite). The firing temperature of 900 °C under oxidation atmosphere was found to be the suitable conditions in this research that appear high-purity calcium oxide phase with more than 97% purity.

Keywords Bioceramic; Calcium phosphate; Calcium oxide; Eggshells
Fabrication of 3D Scaffold from Poly(2-hydroxyethyl methacrylate)/gelatin Core-Shell Particles as Scaffold: Effect of Freezing Temperature and Shell Crosslinker

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The fabrication of 3-dimensional scaffold from core-shell particles is a new approach to produce the materials potentially useful for tissue engineering application. Poly (2-hydroxyethyl methacrylate)/gelatin core-shell particles were prepared via an emulsifier-free emulsion polymerization by using tert-butyl hydroperoxide (TBHP) as a co-initiator and MBA as a core crosslinker. The obtained core-shell particles had diameter around 450-600 nm and showed the net positive surface charge about 8-9 mV. The particle had a spherical shape and well-defined core-shell morphology where PHEMA core was coated with gelatin shell. The prepared PHEMA/gelatin core-shell particles were then used to fabricate a scaffold by lyophilization at temperature of -20 and -50 °C. The porous morphology of the obtained scaffold was observed by scanning electron microscope (SEM), which showed the mean pore sizes as 50 and 45 µm at -20 and -50 °C, respectively. Moreover, the scaffold was crosslinked through the gelatin shell by using glutaraldehyde (0.1% wt/wt). It was found that the pore size increased to 104 and 85 µm at the two temperatures, respectively. Furthermore, the shell-crosslinked scaffolds could maintain their dimensional structure without observable disintegrate in Phosphate buffer saline (PBS).

Keywords PHEMA/gelatin core-shell particles; Scaffold; Gelatin; PHEMA
Development of Molecularly Imprinted Polyaniline-Graphene Nanocomposite Electrodes for Detection of Dopamine

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By molecular imprinting, introducing highly selective molecular-scale porosity/cavities into conducting polymer films on superior graphene electrochemical platforms can provide better sensing performances. This study presents the development of molecularly imprinted polyaniline (MIPANI)-graphene (GP) nanocomposite electrodes for determination of dopamine (DA) which was employed as template molecule because of its popularity and electroactivity. DA-MIPANI electrodes was fabricated by electrochemical polymerisation of aniline monomer with presence of DA on the GP platform and then DA was further removed from the PANI film by overoxidation process using a cyclic voltammetry with a scan potential range from -0.90 to +0.90 V. Consequently, the resultant PANI film has the specifically molecular recognition sites for rebinding DA during electroanalysis. To obtain the best MIPANI-GP electrode, the synthetic parameters such as monomer, acid and DA template molecule concentrations, GP content, and electropolymerisation time were optimised. Effects of pH, temperature, and interferents on device performances of the MIPANI-based electrochemical sensors were also studied. The detection efficiency of the imprinted and non-imprinted PANI films was assessed by a differential pulse voltammetry (DPV). It was found that the current response showed two linear ranges of 1.0 nM-0.10 µM ($R^2 = 0.9953$) and 0.10 µM-400 µM ($R^2 = 0.9986$), respectively. As compared to performances of non-imprinted sensors, the DA-imprinted film provided higher sensitivity (improved 48% (227.80 µA.cm².µM) for the low concentration range and improved 74% (3.81 µA.cm².µM) for the higher concentration range, respectively), higher specificity, higher selectivity, and lower limit of detection (240 pM, n = 3), indicating good film recognition to DA. After 7 days, the MIPANI-GP electrode retained 95% of initial current response due to DA oxidation process when stored at 4 °C and 85% for 30 days, indicating a good stability. From the finding, the device could be further developed to other highly sensitive, selective and stable nonenzymatic sensors.

Keywords Molecular imprinting; Polyaniline; Graphene; Electrochemical sensor; Dopamine
Superhydrophobic Film from Surface Imprinting of Natural Materials

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A soft-lithographic imprinting approach to fabricate super-hydrophobic surfaces has been developed. In this work, biomaterials from the leaves of lotus (*nelumbo nucifera*) and golden shower (*cassia fistula*) were used as templates for polydimethylsiloxane (PDMS) imprinting. The surface of lotus and golden shower leaves were fabricated on a glass slide by pressing the imprinted PDMS on another pre-polymer system following by polymerization process. A number of polymeric system used to produce the mimicked plant leaves are polystyrene (PS), polystyrene-methylmethacrylate (PS/MMA), polyurethane (PU), and polymethylmethacrylate (PMMA). The SEM images of the imprinted surfaces polymer confirm a reproduced microstructures of the original plant leaves where a large amount of the characteristic papillary microstructures and the best polymeric system is polystyrene system. The polymer films can perform a so-called “lotus-leave” effect comparing to the non-imprinting system.

**Keyword** superhydrophobic; imprinted polymer; PDMS; PS; PS/MMA; PU; PMMA; SEM
Synthesis of Thermoresponsive Chitosan-functionalized Poly(N-isopropylacrylamide)-Based Microgels

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The thermoresponsive chitosan-functionalized core-shell microgels were prepared by emulsifier-free emulsion polymerization induced by tert-butyl hydroperoxide. The shell of the resulting microgels was chitosan and the cores composed of poly(N-isopropylacrylamide) (PNIPAM), poly(N-isopropylacrylamide)-co-poly(methyl methacrylate) (PNIPAM-co-PMMA) and poly(N-isopropylacrylamide)-co-poly(2-hydroxyethyl methacrylate) (PNIPAM-co-PHEMA), which were cross-linked with N,N'-methylene-bis-acrylamide (MBA). The monomer feed composition (NIPAM:MMA and NIPAM:HEMA ratio) was varied as 1.0:0, 0.8:0.2, 0.7:0.3, 0.6:0.4 and 0.5:0.5 by weight for the polymerization. Then, monomer conversion, particle size, zeta-potential and LCST of the formed microgels were characterized. It was found that the monomer conversion of PNIPAM-co-PMMA composition decreased from 83% to 51% when the amount of MMA increased. In addition, the monomer conversion of PNIPAM-co-PHEMA composition was occurred in the range of 67-91 %. The particle size of the microgels was found to be varied with the monomer feed composition. The zeta-potential of the microgels was about 40 mV, stemming from the positive charge of chitosan on the microgels surface. The P(NIPAM)/CS microgels showed the sharpest LCST value of 32 °C, while P(NIPAM-co-PMMA)/CS and P(NIPAM-co-PHEMA)/CS microgels at 0.8:0.2 feed composition had the sharp ranges of LCST at 31-37°C and 34-37°C, respectively. FTIR spectra can be used to confirm the presence of PNIPAM-co-PMMA or PNIPAM-co-PHEMA incorporated in their corresponding microgels. TGA thermogram presented the weight fraction of each component in the microgels. These core-shell microgels could be potentially used as thermoresponsive drug delivery carriers.

Keywords Thermoresponsive polymer; Lower critical solution temperature (LCST); Microgel
Silver Nanoparticles In Different Molecular Weight Of Chitosan By Gamma Radiation For Controlling Chili Anthracnose

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This study aimed to prepare silver nanoparticles by gamma radiation using different molecular weight of chitosan as a stabilizer. The different molecular weight of chitosan was also prepared in solid state in air at room temperature by gamma radiation. Particle size, zeta potential and surface plasmon of silver nanoparticles in relation to different irradiation doses, molecular weight and concentrations of chitosan were analyzed. The efficiency of silver nanoparticles against Colletotrichum gloeosporioides (C. gloeosporioides) causing chili anthracnose was assessed in different silver concentration. The result showed that molecular weight of chitosan decreased with increasing radiation dose. The apparent size of silver nanoparticles increased with increasing concentration. The mean diameters of silver nanoparticles have average size of 30-170 nm depending on chitosan concentration. Aggregation of silver nanoparticles was occurred when the chitosan concentration was below 0.8%. The application of 50 ppm of silver nanoparticles incorporated with potato dextrose agar (PDA) produced inhibition of the growth of C. gloeosporioides in comparison to the control in vitro. The antifungal activity increased with increasing the silver nanoparticle concentration.

Keywords Silver nanoparticles; Chitosan; Gamma radiation; Chili anthracnose
Study of Silver Nanoparticles-Loaded Calcium Alginate Microbeads Embedded in Gelatin Scaffolds for Drug Delivery Applications

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Silver nanoparticles-loaded calcium alginate microbeads embedded in gelatin scaffolds were developed for drug delivery applications. Calcium alginate microbeads incorporated with silver nanoparticles were prepared by emulsification/internal gelation process. The silver ions (Ag⁺) in alginate solution reduced to silver nanoparticle (AgNPs) were obtained by UV irradiation technique. The size and morphology of the microbeads were investigated using Optical Microscopy (OM) and Scanning Electron Microscopy (SEM). Polymeric scaffolds were fabricated from 5%w/w of gelatin solution and crosslinked with 3%w/w of genipin (based on the weight of gelatin). The AgNPs-loaded alginate microbeads embedded in gelatin scaffolds were fabricated by freeze drying method. The characterization of these scaffolds for their morphology was observed by SEM. Moreover, these scaffolds were investigated for their water swelling and weight loss behavior in the phosphate buffer solution (PBS) at 37 ºC for 1, 3, 5 and 7 day. Lastly, the release of Ag⁺ from these scaffolds was carried out by total immersion method in PBS at 37 ºC.

Keywords Silver nanoparticles; Calcium alginate microbeads; Emulsification; Gelatin scaffolds
Reinvestigation of Tricyclic Acyclovir: Characterization of a ‘Proton-wire’ Model

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The crystal structure of a dihydrate of the title compound, 3-[(2-hydroxyethoxy)methyl]-6-methyl-3H-imidazo[1,2-a]-purin-9(5H)-one, C11H13N5O3·2H2O, has been reinvestigated. The asymmetric unit contains two molecules of tricyclic acyclovir and four molecules of water. The structure consists of a three-dimensional network of strong hydrogen bonds that integrates all of the components. While the crystal structure and the formation of an (H2O)₈ solvent water molecule cluster through a disordered strong hydrogen bond [O···O = 2.807 (3) Å] between two water molecules across an inversion center had been described previously [Suwinska, Golankiewicz & Zielenkiewicz (2001). Acta Cryst. C57, 767–769], but the disorder was incompletely modelled. In this work the disorder model is extended and includes disorder of one tricyclic acyclovir hydroxy group across another inversion center [O···O = 2.644 (4) Å]. The resulting infinite O–H···O hydrogen-bonded water–hydroxy chains, analogous to the ‘proton wires’ invoked in a Grotthuss mechanism as found in the membrane protein gramicidin A, are discussed and an unusual disorder model involving infinite concerted chains of O–H···O hydrogen bonds is provided. Exploration of the H-atom disorder model allowed identification of a proton-wire structure that had been missed by the earlier investigators. As such structures are relatively rare in the literature, new examples of this important phenomenon may be helpful in understanding proton transport processes across membranes.

Keywords Crystal structure; Acyclovir; Water clusters; Proton wires.
Crystal Growth and Physical Characterization of Acyclovir Crystallized with Ascorbic Acid and Zinc Chloride

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Crystal growth of multicomponent pharmaceutical materials containing an active pharmaceutical ingredient (API) with other components in well-defined stoichiometry within the same unit cell is an important and active area of research today. Cocrystals are important in drug design, particularly for improving physicochemical properties such as solubility or bioavailability, or creating potentially synergistic materials. Acyclovir is the API in the most common antiviral drug used for treatment of HSV and VZV infections. Advantages for acyclovir are low cytotoxicity and low HSV resistance as well as the availability of low cost generic forms. Disadvantages include low bioavailability, perhaps partially due to low solubility. Herein, we present crystallization of acyclovir with ascorbic acid and zinc chloride forming a new complex with potentially improved solubility of the acyclovir drug, or a possibly synergistic material useful for HSV/VZV treatment. The physical characterization by FT-IR and energy-dispersive X-ray fluorescence spectroscopy (EDX) shows that new compounds are formed. DSC and TGA results are also presented.

Keywords Crystal growth; Physical characterization; Acyclovir; Ascorbic acid; Zinc chloride; Crystallization
Spectrophotometric Method for Studying the Reaction of Acyclovir with Ascorbic acid and Zinc Chloride for Design of Crystallization Processes

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Acyclovir is an active pharmaceutical ingredient (API) used to treat herpes simplex virus types 1 and 2 (HSV-1 and HSV-2) that cause herpes zoster diseases including chickenpox. Advantages of acyclovir are low cytotoxicity and low HSV resistance to acyclovir. Disadvantages include low bioavailability, perhaps partially due to low solubility. The reaction of acyclovir with two other anti-HSV active agents, ascorbic acid and zinc cation as zinc chloride, was studied by the spectrophotometric method in 9 solvents; H2O, 0.1M HCl, 0.5M HCl, 0.01M NaOH, H2O:EtOH, H2O:HOAc, H2O:DMSO, MeOH:DMSO and EtOH:DMSO. The maximum absorbance at 294-296 nm of acyclovir with ascorbic acid and zinc chloride in H2O:HOAc (1:1) [pH=2.14], 0.5 M HCl [pH=1.39], and MeOH:DMSO (1:1) [pH=4.14] are 1.676, 1.548, and 1.287, respectively. The absorbance of acyclovir with ascorbic acid and zinc chloride in H2O:HOAc (1:1), 0.5 M HCl and MeOH:DMSO, increases when compare with pure acyclovir in the same solvents, suggesting the presence of new complexes. Such solution screening may be useful in discovering new complexes which when crystallized will give improved solubility for the acyclovir drug, perhaps along with the possibility of synergistic action.

Keywords Spectrophotometric method, Acyclovir, Ascorbic acid, Zinc chloride, Crystallization processes
Color Stability and Thermochromism of Polydiacetylene/Zinc Oxide Nanocomposite in Various Solvents and Polymer Matrices

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Polydiacetylene (PDA)-based materials exhibit color transition when subjected to external stimuli, rendering them to be attractive for sensing technologies. To extend their applications, these materials must be able to mix with various polymer matrices for desired fabrications. In this research, PDA/ZnO nanocomposite developed by our research group is successfully prepared in various solvents; 1,2 dichlorobenzene, chlorobenzene, toluene, butanol, hexanol, ethanol, chloroform, tetrahydrofuran and water. Assembling of diacetylene monomer, 10,12-pentacosadiynoic acid, onto ZnO surface occurs by strong interfacial interaction. Polymerization by UV irradiation produces the PDA/ZnO nanocomposite with deep blue color. The PDA/ZnO nanocomposites in various solvents are characterized by uv/vis spectroscopy, scanning electron microscopy, laser light scattering and infrared spectroscopy. All nanocomposites are highly stable. Color changes are not observed for longer than 30 days. Thermochromic behaviors of the nanocomposites are altered by solvent types. Upon heating, the nanocomposite in aqueous medium changes colors from blue to purple while those in other solvents exhibit both purple and red phases at high temperature. The nanocomposite in aqueous medium also exhibits slightly higher color transition temperature than those in other solvents. Moreover, all nanocomposites show reversible thermochromism when cooling to room temperature. The nanocomposites in solvents are mixed with polystyrene, poly(methyl methacrylate), polyethylene and polyvinyl alcohol. Then, films are fabricated by drop casting. All nanocomposite films change from blue to red at 160 °C and exhibit completely reversible thermochromism upon cooling to room temperature. The reversible thermochromism can be observed up to 200 °C, however, with an incomplete transition.

Keywords Polydiacetylene; Color stability; Thermochromism
Effects of Chemical Foaming Agent Content on Cell Morphology and Physical Properties of Poly(lactic acid) Biopolymer Foam

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The high price of poly(lactic acid) (PLA) biopolymer makes it an interesting plastic for foaming. In this study, PLA was foamed with two types of chemical foaming agents (CFA) at 0-3 phr. Azodicarbonamide (ADC) was selected as the exothermic CFA while Sodiumbicarbonate (SBC) represented the endothermic one. The influences of the content and the type of CFA on the cellular structure and the physical properties of PLA foam were investigated. Microscopic study of the foam revealed that an increase in the contents of ADC and SBC raised the cell density of PLA foams. At identical content, ADC yielded PLA foam with higher cell density than SBC; the highest cell density of 619 cells/cm³ was observed when ADC was applied at 3 phr while the lowest one at 72.5 cells/cm³ was found at 0.5 phr of SBC. The average cell size was reduced as the ADC content increased, but cells tended to be larger as the SBC content was raised. Physical properties of PLA foams in terms of hardness and impact strength were found to depend largely on the cellular structure and the foaming agent contents. Both hardness and impact strength decreased as ADC content was raised up to 2 phr, above which they tend to lower slightly. The impact strength dropped by 50% to 23.50 J/m and the Vickers hardness number also did by 16% to 18.26 HV when ADC was applied at 2 phr. Both hardness and impact strength dropped continuously with increasing SBC content. Maximum reduction of the impact strength by 58% to 19.72 J/m and the Vickers hardness number by 22% to 17.02 HV when 3 phr of SBC was employed. Hence, the exothermic ADC yielded PLA foam with superior impact strength and hardness than those foamed with the endothermic SBC.

Keywords Poly(lactic acid); Chemical foaming agent; Azodicarbonamide; Sodiumbicarbonate; Cell morphology
Thermoresponsive Behaviour of Metal Organic Frameworks

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The majority of solids exhibit thermal expansion behaviour and in rare cases negative thermal expansion (NTE) can occur. NTE materials have been used in many potential applications especially for engineering the overall coefficient of thermal expansion of composite materials. However, only a number of NTE materials have been reported and most of them are inorganic compounds which are not applicable in the polymer composite industry. Furthermore, the fundamental understanding of this anomalous behaviour has not yet been fully established and thus thermal behaviour of materials cannot be intrinsically controlled. In this work, we aim to discover new NTE materials, to further the basic understanding of the mechanism underlying the observed thermal behaviour and to elucidate the factors that influence the properties of NTE materials. Five MOF materials containing dicarboxylate organic linker were chosen to study by X-ray diffraction techniques; including four members in the MIL-53 family [Al(OH)(bdc)], [AlF(bdc)], [Cr(OH)(bdc)] and [VO(bdc)] and a microporous [Sc\textsubscript{2}(bdc)\textsubscript{3}]. It was found that thermoresponsive behaviour varies greatly within the candidate materials with regards to the rigidity of the inorganic component, the connectivity of the structural framework and the constituent species of the framework e.g. cations, anions and the organic linkers.

\textbf{Keywords} Thermoresponsive behaviour; Metal Organic Frameworks; Negative thermal expansion; MIL-53
Preparation and Luminescence Properties of CaSnO$_3$:Eu$^{3+}$ Phosphor by Solid-State Reaction method

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CaSnO$_3$:Eu$^{3+}$ phosphors have been prepared and proposal as a red phosphor for the application in field emission display (FED). The CaSnO$_3$:Eu$^{3+}$ phosphors were synthesized by solid-state reaction. The influence of Eu-doping on the crystallization, surface morphology and luminescent properties of CaSnO$_3$ phosphor were investigated. The present result showed luminescent properties and degree of crystallization were increased which Eu ions contents. The relationship between crystalline and luminescent properties were also studies, Eu$^{3+}$ doping effectively enhanced not only the crystallization but the luminescent brightness of CaSnO$_3$:Eu$^{3+}$ ceramics.

Keywords CaSnO$_3$: Phosphor; Crystallization; Rare earth
Photocatalytic Degradation of Diuron over Zinc Oxide Nanoparticles Film on Stainless Steel Plate Prepared by Dip Coating Technique

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Zinc oxide (ZnO) nanoparticles thin film on stainless steel plates were fabricated by dip coating technique. The dip coating solution was prepared from the mixture of polyvinylpyrrolidone (PVP), zinc nitrate hexahydrate (Zn(NO₃)₂·6H₂O) and acetic acid in absolute ethanol. The obtained ZnO films were calcined at various temperatures in the range of 300 to 600°C. The obtained nanoparticles ZnO film was characterized by using scanning electron microscope (SEM) and X-rays diffraction (XRD) to study the morphology and the crystallographic structure, respectively. The products were ZnO in hexagonal wurtzite structure. The results also showed the ZnO grains growth and grains agglomeration as the calcination temperature was increased. The photocatalytic degradation of diuron [N-(3,4-dichlorophenyl)-N,N-dimethyl urea] was used to investigate photocatalytic activity of the synthesized nanoparticles ZnO film. The maximum degradation of 29% after 6h of irradiation was obtained when ZnO film at calcination temperature of 400°C was used.

**Keywords** ZnO; Photocatalytic activity; Diuron
Photocatalytic Degradation of Diuron Prepared by Electrospun Titanium (IV) Oxide Nanofibers Coated on Stainless Steel Plate

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The titanium (IV) oxide nanofibers were fabricated via electrospinning technique and coated onto stainless steel plates. In the spinning process, the spinning solution was prepared based on the mixture of polyvinylpyrrolidone (PVP), titanium tetraisopropoxide (TTIP) and acetic acid in absolute ethanol. TiO₂ nanofibers were calcined at various temperatures from 300 to 600°C. The obtained fibers were characterized by using scanning electron microscope (SEM) and X-ray diffraction (XRD). The average diameters of the pre-calcined and calcined fibers were in the range 150-170 nm and 90-130 nm, respectively. The crystallographic structure of the calcined fibers was found to be mixed phase of anatase and rutile. The fraction of anatase in calcined fibers was gradually decreased as calcination temperature was increased. The anatase fraction was found to enhance of the photocatalytic activity of TiO₂ nanofibers on stainless steel plate in degradation of diuron [N-(3,4-dichlorophenyl)-N,N-dimethyl urea].

Keywords: TiO₂ Nanofibers; Photocatalytic Degradation; Diuron.
Cu Decorating of Functionalized Multi-Walled Carbon Nanotubes

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The pristine and functionalized multi-walled carbon nanotubes (MWCNTs) were decorated with Cu species by wet impregnation method. Multi-walled carbon nanotubes were functionalized by acid solution (H2SO4, HNO3 and H3PO4) to remove impurities and form functional groups on the surface of MWCNTs. The Brunauer-Emmett-Teller (BET) surface area, pore volume, pore size, morphology and derivatized surface of the functionalized carbon nanotubes were characterized by N2 adsorption/desorption, Scanning electron microscope (SEM), Raman spectroscopy, Fourier transform spectroscopy (FTIR) and X-ray diffraction. Acid functionalization would form surface species and resulted in defection on the MWCNTs. The synchronization of hydroxyl and aldehydic group could produce carboxyl group. BET surface area and pore volume of the functionalized MWCNTs are larger than those of pristine ones. After Cu loading and calcination, copper oxide (CuO) and copper (I) oxide (Cu2O) crystalline were defected in the Cu-decorated MWCNTs.

Keywords Carbon nanotubes; Functionalization; Wet impregnation; Raman spectroscopy; Fourier transform spectroscopy; X-ray diffraction
Preparation of Bis(8-hydroxyquinoline)cadmium(II) Complex in Montmorillonite

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Metal complexes of 8-hydroxyquinoline, such as bis(8-hydroxyquinoline)cadmium(II) (Cdq₂) and so on, are of interest in various remarkably flat panel display applications. Since molecular structure and/or molecular distribution of the metal chelate complexes affected their electronic properties, so that many researchers have focused on the molecular design to improve the properties and stability of the complexes. A systematic study of metal complexes in the confined structure of inorganic solids including montmorillonite is one of the attractive ways for controlling the molecular structure and packing, as well as increasing the stability of the complexes. In this study Cdq₂ was incorporated into the interlayer space of montmorillonite by two methods, the first one is in situ formation of Cdq₂ in cetyltrimethylammonium-montmorillonite (Cdq₂@CTA-montmorillonite) and the other one is adsorption of cetyltrimethylammonium coated Cdq₂ in hydrophilic montmorillonite (Cdq₂CTA@montmorillonite). The XRD patterns of the products showed the symmetrical d₀₀₁ peaks at 1.83 nm, indicating to the intercalation of Cdq₂ in the interlayer space. The appearance of the absorption and emission bands of the products confirmed the formation of Cdq₂ in montmorillonite. The absorption band of Cdq₂@CTA-montmorillonite (380 nm) blue shifted from that of Cdq₂CTA@montmorillonite (382 nm), ascribing that the size of Cdq₂ formed in CTA-montmorillonite was smaller than that of CTA coated Cdq₂ in montmorillonite. The luminescent intensity of Cdq₂CTA@montmorillonite observed at 505 nm was higher than that of Cdq₂@CTA-montmorillonite, indicating to the difference in microstructure and/or packing of Cdq₂ in the interlayer space. These observations suggested that the emission intensity of Cdq₂ can be improved by the role of alkylammonium ion and the environment of montmorillonite. The hybridization of Cdq₂ and montmorillonite is a new alternative way for improving the optical properties of metal complexes that might be potentially used in organic light emitting devices.

Keywords 8-Hydroxyquinoline; Montmorillonite; Photoluminescence
Synthesis of Nanosized Gold Particles from Gold Foil for Cosmetic Applications

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The cosmetics industry has been developed dramatically in recent years, leading to a breakthrough in new chemical substances used in cosmetics. The unique properties of nanosized gold particles benefit the skin efficiently in terms of skin whitening and face illuminating. This research was aimed to synthesize high-quality gold nanoparticles from gold foil in liquid solvent by citrate reduction and tannic acid reduction methods, combining with heat and constant stirring. Various synthesis methods were carried out in order to compare the properties of gold nanoparticles prepared under different conditions. The physical and chemical properties of gold nanoparticles were characterized by UV–Visible Spectroscopy, Transmission Electron Microscopy (TEM) and Dynamic Light Scattering (DLS) technique. Different colors of nanosized gold solution, ranging from red to purple, were obtained from various conditions. The citrate reduction method was found to be the most effective way to synthesize the stable gold nanoparticles with the use of 5 wt% polyvinyl alcohol as a stabilizer. The gold nanoparticles, characterized by TEM, were found to be mostly spherical and well-dispersed with the particle size ranged between 10-50 nm. The beneficial effect of nanosized gold solution was preliminary tested on human skin in the form of nanosized gold water spray. According to the personal satisfaction survey, the beneficial effect of the gold solution could be evident after the product was continuously applied for 14 days.

Keywords Nanosized Gold; Citrate Reduction; Tannic Acid Reduction
Utilization of Epoxy waste from Electronic Industry as Reinforcement in Polypropylene Composites

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This study shows the reuse of epoxy waste powder as reinforcing fillers in the PP composites which is the trend of industrial waste recycling and the better resolution of environmental pollution. Epoxy waste was obtained from the runners of electronic chip molding. It was ground into powder and sieved to obtain two different sizes, 63-78 micron and <45 micron. Its energy dispersed X-ray analysis showed the presence of silica, 11.0%. Epoxy waste powder, 0-40% by weight, was mixed with polypropylene (PP), using a two-roll mill and made into sheets by compression molding. Their mechanical properties were measured, including impact strength, tensile properties, flexural properties and Rockwell hardness. It was found that PP composites with smaller particle size of epoxy waste powder promoted higher impact strength than the larger one. At 30% loading of epoxy powder, the impact strength of PP composite exhibited the maximum value of 3.72 kJ/m², which was 21.7% higher than PP. Moreover, morphology of the composites was investigated using the scanning electron microscopy (SEM).

Keywords Polypropylene; reinforcement; Epoxy resin; recycling; mechanical properties
Formation of Silica-Coated Cobalt Oxide Hybrid

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The hybrids of inorganic and inorganic species have received broad interest in both basic chemistry and applications due to their unique properties and promising morphologies. Metal oxides including cobalt oxide are of tremendous importance because of the properties arising from quantum confinement, surface effect and so on. In this work, the silica-coated cobalt oxide was investigated to examine their performance for potential use in various applications. The preparation of metal oxides in inorganic solids, including silica, may make them suitable for numerous applications. The hybrid was synthesized by microemulsion process of cobalt oxide, tetraethyl orthosilicate and cetyltrimethylammonium bromide. The sample was characterized by X-ray diffraction, thermogravimetric/differential thermal analysis, Fourier transform infrared, Raman, UV-visible and photoluminescence spectroscopies (PL), as well as scanning and transmission electron microscopies. The X-ray diffraction pattern of the product showed a diffraction peaks at 31.36°, 36.86°, 59.27° and 65.12° that can be indexed to (220), (311), (511) and (411) planes of Co₃O₄ together with a broad diffraction pattern of amorphous phase of silica, indicating to the combination between cobalt oxide and silica. TEM image of product showed the spherical and uniform particle of silica-coated cobalt oxide with the average size of 200 nm for cobalt oxide core and of 58 nm for silica shell. FT-IR spectra of the product revealed the characteristic vibration band of both silica and cobalt oxide, confirming the existence of cobalt oxide and silica. The PL spectrum of the hybrid exhibited three emission bands at 469, 479 and 492 nm due to the cobalt oxide and silica that could be attributed to the presence of cobalt oxide in the hybrid. Moreover, PL intensity of cobalt oxide increase without changing the band position by the hybridization with silica, suggesting that the PL efficiency of cobalt oxide could be modified by the interactions with silica.

Keywords Silica; Cobalt Oxide; Core-Shell; Hybrid Material
N719 and FTO Glass: Our materials for DSSC device

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The dye-sensitised solar cell (DSSC) has been proposed as a new type of photovoltaic cells. At present, efficiencies of more than 10% can be obtained for DSSCs using electrolytes based on volatile organic solvents. With the commercial target, we need the cheap materials for fabrication. For that reason, we demonstrate the low-cost DSSC device with our synthetic materials (FTO glass and dye-sensitizer (N719)). The result shows that the similar efficiency can be obtained with our device.

Keywords N719; FTO; DSSC; Solar cell
Cross-linked polymer sheets were manufactured of poly(vinyl alcohol) (PVA) and silk sericin (SS), using different amounts of dimethylolurea (DMU) as the cross-linking agent and glycerol as the plasticizer. SS is a water-soluble protein and consists of high serine and glycine, it was removed from Thai silk cocoons by a hot water degumming process. The sericin powders were precipitated at different temperatures; room temperature (RT-SS), 10 °C (C-SS) and frozen (F-SS). The conformational structures of these powders (random coils and β-sheets) from the different temperatures were investigated. Structure and crystallinity of SS and casted sheets were analyzed using Fourier transform infrared (FTIR) spectroscopy and X-ray diffraction (XRD) techniques. Amide I (C=O stretching), II (N-H bending) and III (in phase combination of N-H in plane bending and C-N stretching vibrations) were used to determine the conformational structure of RT-SS, C-SS and F-SS, these appeared at 1661, 1538, and 1232 cm$^{-1}$, respectively. These amide frequency bands are correlated to the random coils of RT-SS and C-SS. However, the bands all shifted to a lower frequency, which are attributed to the β-sheets of F-SS. The N-H stretching (3400-3200 cm$^{-1}$) of F-SS is also observed at a lower frequency and broader band than RT-SS and C-SS due to the hydrogen bonding in the β-sheets. The different X-ray peaks between RT- and C-SS ($2\theta = 17-35^\circ$) and F-SS ($2\theta = 10-15^\circ$, 17-26°, 27-35°) were also measured. Using high concentrations of DMU increases the hydrogen bonding interactions, decreases the crystallinity, and lowers the elongation at break in both PVA/RT-SS and PVA/F-SS films. The RT-SS was selected to produce a porous 3D scaffold (that will be suitable for medical applications) prepared by a lyophilisation technique, as it possessed a lower crystallinity and higher elongation than that of F-SS. Greater concentrations of DMU produced smaller pore sizes in the scaffolds.

Keywords Sericin; Scaffolds; Conformational structure; Poly(vinyl alcohol)
The Development of Blue Electroluminescent Device using Charged Iridium Complexes

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This project shows the synthesis and characterization of four charged iridium complexes namely {((1,10-phenanthroline-N-N’)-bis-(2-(2’,4’-difluoro-phenyl)-1H-pyrazole-C⁶,N)-iridium(III)) hexafluorophosphate (UM01), {((3,4,7,8-tetramethyl-1,10-phenanthroline-N-N’)-bis-(2-(2’,4’-difluoro-phenyl)-1H-pyrazole-C⁶,N)-iridium(III)) hexafluorophosphate (UM02), {((4,5-diaza-9,9’-spirobifluorene-N-N’)-bis-(2-(2’,4’-difluoro-phenyl)-1H-pyrazole-C⁶,N)-iridium(III)) hexafluorophosphate (UM03)}, and {((3,4,7,8-tetramethyl-1,10-phenanthroline-N-N’)-bis-(2-(2,4-difluorophenyl)-5-(trifluoromethyl)pyridine-C⁶,N)-iridium(III)) hexafluorophosphate (UM04)}. The complexes were synthesized by 4 steps. The preliminary result show that the device structure: ITO/PEDOT:PSS/UM01-04:BMIM/Al give maximum current efficiency 1.12 cd/A and maximum brightness 1,037 cd/m².

Keywords Blue; Iridium complex; OLED
Hydrothermal Synthesis of Ferrite Nanoparticles via Biomolecular Templating and Their Chromium(VI) Removal Experiments

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Glucose and egg white have been used as biomolecular templates in the hydrothermal synthesis of ferrite nanoparticles, g-Fe₃O₄ and e-Fe₃O₄, respectively. Both magnetic materials were analyzed by X-ray diffractometer which displayed the diffraction pattern corresponding to the inverse spinel structure of magnetite. Scanning and transmission electron microscopes revealed that g-Fe₃O₄ was formed successfully as spherical shape with the monodispersed characteristic possessing the size range between 70 and 100 nm. The e-Fe₃O₄ size, however, were varied from 10 to 25 nm with the presences of various shapes. Considering a g-Fe₃O₄ particle via microscope magnification, we observed that it was the aggregate form of spherical nanoparticles with the size of c.a. 8 nm indeed, which resulted in higher specific surface area than that found in e-Fe₃O₄. These characteristics of the as-synthesized ferrites affected predictably the adsorption efficiency toward chromium(VI) ions in water, which were experimentally confirmed by the results indicating that g-Fe₃O₄ nanoparticles performed greater chromium(VI) ions removal, compared to how the e-Fe₃O₄ nanoparticles did. Recovery of these ferrites from the treated Cr(VI) solution were also proven to be possible using a permanent magnet.

Keywords nanoparticles; adsorption; monodispersed; magnetic; glucose; egg white
Synthesis and Characterization of ZnO Nanoparticles for UV Protection

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The synthesis and characterization of ZnO nanoparticles have been carried out in the present work for textiles applications. The ZnO nanoparticles were prepared by using wet chemical method. The technique is based on precipitation procedure, using soluble starch as stabilizing agent and zinc nitrate and sodium hydroxide as precursors. Scanning electron microscopy, X-ray diffractrometry and UV-Vis spectrophotometry were used to characterize the synthesized ZnO nanoparticles composition, their size, shape, crystallinity and optical properties. The result of nanoparticle size measurement of powder samples by scanning electron microscope was 150-200 nm. All diffraction peaks of ZnO nanoparticles powder matched well with standard pattern of ZnO (JCPDS 36-1451) indicating the products consisted of a pure phase. In addition, ZnO nanoparticles showed strong absorption in the UV range resulting in successful for textiles applications to protect UV radiation.

Keywords: ZnO nanoparticles; UV protection; wet chemical method
A Small-scale Biodiesel Production From Palm Oil Using a Rod-like shape WO$_3$ as a Heterogeneous Catalysts

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Biodiesel production from palm oil is alternative fuel that can be used directly in any existing unmodified diesel engine. The main objective of this work was to develop process for production of biodiesel by using a tungsten(VI) oxide (WO$_3$) heterogeneous catalyst as it has high catalytic active and easily separated from the reactor. To this purpose, highly porous rod-like shape WO$_3$ with dimension of 3 mm were fabricated. A small-scale biodiesel production from palm oil (500 mL) with rod-like shape WO$_3$ were investigated by using fixed bed reactor. The transesterification was optimal at 65 °C with molar ratio of methanol to oil 21:1, exhibited the best catalyst activity with a FAME yield of 97% after 2 h reaction time. The reusability and stability of catalyst were investigated. The catalyst proved to be stable over four transesterification cycles. Fuel properties of the obtained biodiesel without any treatment and cleaning process.

**Keywords** Biodiesel production, Heterogeneous catalyst, Transesterification, Tungsten oxide
CdS-MnS Heteronanoparticles in Montmorillonite
Prepared by Solid-Solid Reaction

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Hybridization of organic and inorganic species with layered inorganic solids such as montmorillonite is an interesting topic for constructing ordered organic-inorganic or inorganic-inorganic materials with unique microstructures and properties. Cadmium sulfide (CdS) and magnesium sulfide (MnS) are important semiconductors due to their properties that made them potential for various applications including catalysts and optical materials. Progresses have been made in the preparation of particles with smaller size and narrower size distribution to tailor their optical properties precisely. Herein, solid-solid reaction was carried out to prepare mixed CdS-MnS nanoparticles in montmorillonite that may lead the unique optical properties.

Cd(II)-Mn(II) exchanged montmorillonite was prepared by adding the aqueous solutions of CdCl₂ as well as MnCl₂·4H₂O (Cd(II) or Mn(II) = 60 meq/100 g clay) into a dispersion of sodium-montmorillonite. Subsequently, the mixture was stirred overnight. The resulting solid (Cd(II)-Mn(II)-montmorillonite) was manually ground with Na₂S·xH₂O in an agate mortar and a pestle for 10-15 minutes and heated at 200°C for 1 hour in air atmosphere. The product was characterized by powder XRD, TEM, Raman, UV-Vis and photoluminescence spectroscopies.

The XRD pattern of the hybrid showed the expansion of the interlayer space by 0.50 nm, indicating the intercalation of CdS and MnS in montmorillonite. Raman spectrum of the hybrid showed two broad bands at 304 and 605 cm⁻¹ corresponding to the first-order (1LO) and second-order (2LO) Raman band of CdS, as well as the band at 511 cm⁻¹ owing to vibrational modes of MnS, supporting the in-situ formation of mixed CdS and MnS in montmorillonite. The TEM image revealed the disk shaped CdS and MnS in between the silicate layers. In comparison with the emission spectra of free CdS and MnS nanoparticles, the increase of photoluminescence intensities was thought to be caused by the confinement effect.

Keywords Cadmium Sulphide; Manganese Sulphide; Montmorillonite; Intercalation
Fabrication and Properties of Calcium Phosphate Cements

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Fabrication of a calcium phosphate cement and the effect of disodium hydrogen phosphate (Na₂HPO₄), an cement accelerator, on setting time and mechanical properties have been investigated. The ratio of dicalcium phosphate dihydrate (CaHPO₄·H₂O) and calcium carbonate (CaCO₃) was fixed and mixed with 0, 10, 20 and 30wt% Na₂HPO₄ powder. Cement pastes were then prepared by mixing the resulting powder with DI-water (P/L= 2:1) and the mixture poured into silicone molds having a diameter of 10 mm and a height 15 mm. Setting times of the cements fabricated with various Na₂HPO₄ powder were measured using a vicat needle apparatus. Microstructure, phases present and chemical functionalities of the cements were characterized using SEM, XRD, FT-IR analysis, respectively. It was found that the amount of Na₂HPO₄ had a significant effect on setting time, but had not affected the phase transformations of the cements. Correlation of Na₂HPO₄ content to setting characteristics is discussed.

Keywords Calcium phosphate cement; Dicalcium phosphate dihydrate; Calcium carbonate; Setting time
Tin-doped Titanium Dioxide: Synthesis and characterization

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The aim of the present work was to synthesize and characterize TiO$_2$ doped with tin oxide using an impregnation method. Degussa P25 TiO$_2$ was impregnated with SnCl$_4$.5H$_2$O with different molar ratios (Sn:Ti molar ratios were 0.5%, 1%, 2% and 4%). After continuous stirring, the well mixed suspension was dried, ground and calcined at 400, 600 and 800°C. The synthesized powders were characterized using X-ray diffraction (XRD), Transmission Electron Microscopy (TEM), Brunauer, Emmett Teller method (BET method) and Fourier Transform infrared spectroscopy (FTIR). Experimental results showed that the dopant content and calcination temperature were related to retardation of crystal size and phase transformation of the TiO$_2$.

Keywords P25 TiO$_2$; Tin doping; Impregnation; Phase transformation
Zinc Oxide Nano-Paddles Synthesized by Chemical Vapor Deposition

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Zinc oxide (ZnO) nano-paddles were synthesized by a simple chemical vapor deposition (CVD) of metallic zinc powder 99.9% at temperature of 900 °C for 1 hour on the silicon (100) substrate. Surface morphologies and composition of ZnO nanostructures were characterized by scanning electron microscopy- (SEM) and X-ray photoelectron spectroscopy (XPS), respectively. It is found that the products were ZnO nano-paddles and completely covered the substrate surface. Photoluminescence (PL) spectrum shows a small peak at 385 nm (3.22 eV), which is corresponded to the bandgap of ZnO nano-paddles. In addition, the high intensity green emission peak at around 538 nm, which is corresponded to oxygen vacancy, was observed. Based on our results, the ZnO nano paddles show a great potential for possible application as light emitting diode and flexible displays.

Keywords Zinc oxide (ZnO); Nano-paddles; Chemical vapor deposition (CVD)

The figure show surface morphologies and photoluminescence of zinc nano-paddles.
Preparation and Utilization of Durian Seed Starch/PVOH composite Hydrogels for Removal of Methylene Blue in Aqueous Solution

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Fresh durian seed consists largely of starch and can be considered such a suitable raw material for producing biodegradable composite hydrogels. Thus, the aim of this work was to prepare novel durian seed starch/polyvinyl alcohol (DSS/PVOH) composite hydrogels. The DSS/PVOH composite hydrogels was modified by chemical cross-linking with glutaraldehyde. Scanning electron microscopy (SEM) was used for characterization of the film morphology. The swelling of the PVOH hydrogel was dramatically decreased when DSS was added due to the interaction between starch and PVOH. Their application in the removal of methylene blue (MB) dye was evaluated as a function of the DSS content. MB has been used as the model cationic dye contaminant to evaluate the dye sorption property of the DSS/PVOH hydrogels. MB is a typical dye with a heterocyclic aromatic molecule structure and has been used in many industries. However, its direct discharging may lead to environment problems because MB is stable and difficult to biodegrade in natural conditions. The amount of the dye adsorbed on the composite hydrogels was determined by measuring the residual concentration of the dye remained in the filtrate by the UV-vis spectroscopy at 665 nm. The DSS/PVOH composite hydrogels displayed an efficient adsorption capacity in the removing MB at low concentrations from aqueous solution. The adsorption capacity of the DSS/PVOH composite hydrogels is up to 75\% higher than the PVOH hydrogel. Thus, the incorporation of DSS in the PVOH hydrogel could improve the removal of MB in aqueous solution. Sorption of MB on the composite hydrogels has been well described by the pseudo-second order kinetic model. The findings show that DSS/PVOH composite hydrogels can be an alternative use for removal of MB from wastewater.

Keywords Hydrogel, durian seed starch, polyvinyl alcohol, dye removal, methylene blue
Disintegration of Ester Vapors by UV and Visible Light Photocatalysis of TiO$_2$/BC: GC Analysis Study

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Previous gas chromatographic (GC) study indicated that, besides the adsorption of isoamyl acetate, the TiO$_2$/bamboo charcoal composite (TiO$_2$/BC) mainly disintegrated the vapor of this compound to 3-methyl-butanol in the non-UV light environment at room temperature. The extended work in this report was to explore the photocatalytic property of TiO$_2$/BC composite under visible light, UV, and dark condition to track the possible cause of this selective disintegration. GC-MS results showed that TiO$_2$/BC composite was photoactive under both visible and UV light activation, but not for the dark condition. Apparently, the pure 3-methyl-butanol was obtained from the visible light activation while the mixed 3-methyl-butanol and 3-methyl-butanal was found in the UV light activation. This photo-disintegration characteristic was also further explored for other esters such as benzyl acetate and isobutyl propionate.

**Keywords** photocatalyst; ester; GC-MS; titania
Swelling Properties of Sulphonate Containing Hydrogel Wound Dressings

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A moist wound-healing environment has shown to give the best results. Hydrogels are able to donate moisture to dehydrated tissue and absorb some moisture from an exuding wound. The monomers chosen for this work were 2-acrylamido-2-methyl-1-propanesulphonic acid (AMPS), 3-sulfopropyl acrylate (SPA) and [2-(methacyryloyloxy) ethyl] dimethyl-(3-sulfoproyl) ammonium hydroxide (MDS). All three of these monomers contain the sulphonate group (-SO₃⁻) this group due its size and electronegativity can have a larger number of water molecules associated with it compared to both hydroxyl and carboxylic groups. The hydrogels were prepared by redox initiation using L-ascorbic acid and oxone as the redox pair. These gels are formulated with water as part of the formulation. The compositions of these hydrogels were varied and the effect this had on the swelling properties and gelation times were measured. Both homo- and copolymers of the three monomers were produced. For example a homopolymer of AMPS and a copolymer of AMPS and SPA in a 2:1 ratio both formed soft, smooth, clear gels, the gelation time for the AMPS homopolymer was 2-3 minutes, whereas the AMPS/SPA gelation time was less than 1 minute. These gels were then soaked in water and the size and weight recorded at 0, 5, 10, 15, 20, 25, 30, 60, 120, 180 minutes respectively. After 5 minutes both gels (AMPS and AMPS/SPA) had increased in size by 50% and the weight had increased by 236 and 328% respectively, after 25 minutes the size and weight had increased again, 300% for size and 1190 and 1914% for weight. The gels continue to increase in weight but not size until the crosslinks could no longer hold the gels in one piece. In summary these types of gels are excellent candidates for hydrogel wound dressings due to their hydration characteristics.

Keywords Hydrogels; Wound Dressings; Sulphonate containing; swelling;
Silk Fibroin-Calcium Pectin Beads as 3D Scaffolds Intended for Drug Delivery

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The purpose of this research was to prepare the suitable controlled drug delivery from calcium pectin silk fibroin. The wild silk fibroin obtained from boiled the cocoon with the Na₂CO₃ for 30 min. Then takeout the sericin, the fibroin was dissolved by 8 M Ca(NO₃)₂ and the solution was dialyzed against water to removed the salt. Fibroin solution was precipitated with calcium-pectin. The result shows that the 3D scaffold was obtained. This scaffold was used to study the release of BSA. The percent BSA releases was evaluated by soaking against the pH 7.4 of phosphate buffer saline solution for 300 min at 37 °C. Then the content of BSA released was determined by Bradford assay. The 3D scaffold that prepared from Calcium-pectin was present the BSA release in 10% and the scaffolds from calcium-pectin-fibroin was present the BSA release in 19.23%. The result indicated that silk fibroin could be the suitable BSA adsorbed and controlled released. Cause the high porous of silk fibroin play the suitable BSA control released. In addition, the structure of silk fibroin to composites with pectin could be BSA encapsulated which promoted release and get better.

Keywords Silk Fibroin; 3D Scaffold; Pectin; BSA released
Investigation of Sugarcane Bagasse and Sugarcane Bagasse Ash as Adsorbents for Oleic Acid

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Free fatty acids (FFA) can cause some problems in the production of biodiesel such as catalyst deactivation and lower biodiesel yield. Therefore, removal of FFA from an oil source is of concern. There are many methods used for lowering FFA in the oil and one of those is adsorption. In this work, sugarcane bagasse (SB) and sugarcane bagasse ash (SCBA) were investigated as adsorbents. Oleic acid was used as a representative of FFA. SB was treated with H$_2$SO$_4$ and calcined in the temperature range of 400-500 °C. SCBA was treated with NaOH for 1-6 h at room temperature. The treated SB and SCBA were characterized by X-ray techniques and scanning electron microscopy. Adsorption was performed at 25 °C for 1 h in a solution of oleic acid in isooctane using 0.20 g of the adsorbents. The adsorbents obtained from the treated SB and SCBA could adsorb oleic acid with the adsorption capacity in the range of 8-27 mg/g. The prepared adsorbents could be potentially used for the removal of FFA in vegetable oils.

Keywords Adsorption; Oleic acid; Sugarcane bagasse; Sugarcane bagasse ash
Oriented Crystallization in Polycaprolactone using Self-assembly Nanofibrils and Natural Fiber: WAXS and SAXS study

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Two types of natural fiber (pineapple leaf fiber, PALF and banana fiber, BF) were used to reinforce polycaprolactone (PCL). These were prepared into short fibers and surface modified by chemical treatments to improve adhesion between the fibers and PCL. Fibers were mixed with PCL by melt mixing using a two-roll mill and then compressed into a 1 mm thick sheet. 1,3:2,4-Bis (3,4-dimethylbenzyldene) sorbitol (DMDBS) is a self-assembly molecule and was also mixed with PCL. WAXS and SAXS techniques were used to study the effects of; sample preparation, addition of self-assembly molecules and natural fibers on the orientation of PCL. The patterns of PCL reveal the orientation of crystal and lamellar structure when dispersing small amounts of self-assembly molecule. WAXS pattern showed the two strongest peaks at 2θ = 21.4° and 23.7° which corresponded to the reflection of 110 and 200 planes, respectively. Small amounts of DMDBS dispersed in PCL gave anisotropic patterns for both WAXS and SAXS. Various amounts of BF dispersed in PCL revealed more preferred orientations compared to the PCL reinforced with PALF. BF and PALF, which were dispersed in PCL together with DMDBS also showed a preferred crystal orientation. The effect of the preparation method and self-assembly nanofibrils is clearly shown in the structural organization on the lamellar level from SAXS patterns. However, the long period for all samples are about 16-17 nm and not affected by addition of these fibers. The morphology of semi-crystalline PCL depends on the crystallization process. Therefore the preparation step of composites is important to control the morphology and orientation of the polymer.

**Keywords** orientation; Natural fiber; WAXS and SAXS ; self-assembly
Preparation and Characterization of Nano-Calcium Carbonate from Cockle Shell

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This research aims to feasibility study for nano-calcium carbonate preparation from cockle shell by using eco-nanotechnology to utilize the scrap organic material and support environmental friendly. The methodology started up with the cockle shells were pounded by hand and passed through 200 mesh sieve size. Then, these reduced-size calcium carbonate particles from cockle shell were reacted with hydrochloric acid and sodium carbonate using chemical ratio as calcium carbonate: hydrochloric acid: sodium carbonate was 1: 2: 1 at room temperature, 60°C and 80°C for 20 hr. All of experimental results from Fourier transform infrared spectroscopy (FTIR) were found the characteristic of calcite for wavelength number 715 cm\(^{-1}\) to 875 cm\(^{-1}\). In addition, the wavelength number of 1397 cm\(^{-1}\) indicated the maximum absorption of carbonate. Besides, the results of the X-ray diffractometer (XRD) revealed the crystalline structural characteristic of calcite as same as overall results from FTIR. And it can be also calculated the average unit cell of crystalline using Scherrer’s equation that is nearby 32.48 nm for every temperature testing. Likewise, results from scanning electron microscopy (SEM) also showed a cubic shape as defined as the calcite crystalline. Moreover, determination of elemental composition (mole%) by means of Energy dispersive X-ray analyzer (EDX) was found that calcium is the major component of 74.347%, followed by composition of oxygen 20.001% and carbon components of 5.652%. These results are agreed well with the phase structure from XRD which showed the cockle shell powder contained the peaks of CaCO\(_3\).

Keywords Nano-particle; Calcium carbonate; Cockle shell
Amine Sensor with Charged Iridium(III) Complexes

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The iridium(III) complexes, one of the best phosphorescent heavy-metal, are well known for their rich photochemical and photophysical properties. This project shows the synthesis and characterization of 2 charged iridium(III) complexes by $^1$H NMR, $^{13}$C NMR and mass spectroscopy. Both complexes were designed with ester functional groups in the complexes which were used for the reaction with amine to form amide groups. The preliminary results of the amine sensor application show that the complexes show the blue shift in the UV-Vis absorption with butylamine addition. This study could be a benefit system to detect many narcotic drugs in the future.

Keywords Amine sensor; Charged iridium complex; chemical sensor
Microwave Method and Hydrothermal Method to Synthesize Calcium Silicate from Rice husk and Egg shell

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Microwave is recently attractive to develop many advantages for human in a daily activity life, also for researchers in laboratory to save time and energy compared with hydrothermal method. In this work, calcium silicate was synthesized from sodium silicate produced by rice husk and calcium oxide produced by egg shell. The method to synthesis was hydrothermal method by heated sodium silicate and calcium solution at 100 and 150 °C for 6 hr with microwave-assisted method by heated at 700 W for 5 min. Another method was microwave method. Sodium silicate and calcium solution were mixed in Teflon tube and put in kitchen microwave. The suspension was heated at 700 W for 1, 3, and 5 min. Calcium silicate synthesized by hydrothermal method with microwave-assisted method was provided the pattern of Fourier transform infrared (FTIR) spectra as same as by microwave method. The formation of Ca–O–Si was exhibited in range of 970-979 cm\(^{-1}\). Electron dispersive X-ray (EDX) showed the appearance of calcium and silicon. FTIR and EDX results led to the conclusion that calcium silicate could be synthesized by microwave method.

**Keywords** calcium silicate; hydrothermal method; microwave method
Snail-Shell of *Pomacea Canaliculata* and Rice Husk Ash as Raw Materials to Synthesize Calcium Silicate by Solid State Reaction

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Shells of *Pomacea canaliculata* and rice husk ash were used as starting material to synthesize calcium silicate by solid state reaction. The shell and rice husk ash were manually ground in the molar ratio of 1:1 for 1 and 2 hr. The solid products were calcined at 800, 900 and 1,000 °C for 2 hr in muffle furnace. Fourier transforms infrared spectroscopy and X-ray diffractometry revealed the formation of calcium silicate. In addition, scanning electron microscopy was employed to study of morphology of the synthesized products.

**Keywords** *Pomacea canaliculata* shell; rice husk ash; solid state reaction
Green Synthesis of ZnO and Ag Doped ZnO by a Starch-assisted Method with Enhanced Their Photocatalytic and Antimicrobial Activities

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ZnO and Ag doped ZnO nanoparticles were synthesized through a facile simple chemical method and using tapioca starch as a template. Tapioca starch could be regarded as a low-cost and environmental friendly template. The ZnO nanoparticles were characterized by X-ray diffraction, scanning electron microscope and transmission electron microscope. XRD pattern of all samples showed wurzite phase. SEM and TEM exhibited the uniform spherical-like particles with an average diameter in the range of 40-80 nm. The UV photocatalytic activity was studied by analyzing the degradation of methylene blue. The photocatalytic performance indicated that an appropriate amount of Ag could decrease the electron-hole recombination and improve the photostability of ZnO. Comparing with the as-prepared ZnO and commercial ZnO nanoparticles, the 1 mol% Ag doped ZnO nanoparticles exhibited stronger antibacterial activity against Staphylococcus aureus and Escherichia coli. Moreover, they can also inhibit the growth of a plant pathogenic fungi, Colletotrichum gloeosporioides and Lasiodiplodia theobromae.

Keywords Zinc oxide; Tapioca starch; Photocatalytic activity; Antimicrobial activity
Effect of Rice Husk Silica Prepared by Acid-leaching and Precipitation on the Modenite Synthesis

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Mordenite zeolite (MOR) was synthesized by using silica source from rice husk prepared by acid treatment-calcination (A) and dissolution-precipitation (B) with various crystallization times. Phase, morphology and elemental composition of the MOR from both silica sources were investigated. From x-ray diffraction, MOR phase was observed after 72-h crystallization and a complete formation was obtained after 144 h crystallization. From scanning electron microscopy, MOR from A showed nearly uniform particles with dimension of 2.5×15×10 µm³ whereas that from B gave non-uniform particles. From elemental analysis by x-ray fluorescence, the formula of MOR from A and B is Na₅[Al₅Si₄₅O₁₀₀]·aH₂O and Na₆[Al₆Si₄₄O₁₀₀]·aH₂O, respectively. Thus, preparation method of silica from rice husk influenced the morphology and composition of MOR.

Key words Mordenite; rice husk silica; morphology; elemental composition
Effects of Polymer Additives on Porous Structure Formation of Biphasic Calcium Phosphate Scaffold

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One of important functions for bone scaffold is it can allow cells to attach, proliferate, adhere and organize as same as natural bone. Pore size, porosity and interconnectivity are parameters to determine whether cell can pass through the scaffold and improve the mechanical properties of scaffold. In this work, we have focused on preparation of biphasic calcium phosphate (BCP) scaffold of hydroxyapatite (HA) and β-tricalciumphosphate (β-TCP) by sintering method. BCPs were prepared using calcium carbonate (CaCO₃) and calcium phosphate (Ca₃(PO₄)₂) powders as raw materials. The powder mixtures were pressed into pellets and sintered at 1250°C. To synthesize porous structure of scaffold, paraffin oil was chosen to create the macroporous pore. Poly(-acrylic) acid (PAA) was also used to enhance a cohesion of calcium phosphate particles. Moreover, the different molecular weight of Poly(-acrylic) acid (PAA) and different viscosity of paraffin oil were chosen in order to study on the effects of polymer additives to the formation of pore size, porosity and interconnectivity. X-ray diffraction analyses showed that as-sintered scaffolds consisted of biphasic phases of HA and β-TCP. In addition, macropores and micropores in BCP specimens were also clearly observed by SEM micrographs.

Keywords Biphasic calcium phosphate; Scaffold; Porous structure; Paraffin oil; Polyacrylic acid
Water Repellent and Fire Retardant Finishes on Hemp Woven Fabrics

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With its exceptional physical properties, high comfort, excellent durability as well as relatively eco-friendly manufacturing process, hemp is regarded as one of the highest quality fibers and is in high demand. In this research, a combination of functional finishes, i.e., fluorochemical water repellent and organophosphorous salt fire retardant on textiles based on hemp fiber using a pad-dry-cure technique was investigated. Based on AATCC Test Method 22 (Water Repellency: Spray test) results, it was found that the treated hemp fabrics had the resistance value to wetting by water of 80, that is, there was wetting of upper surface of the fabric at spray points. According to ASTM Test Method D1230 (Standard Test Method for Flammability of Apparel Textiles) results, no flame spreading was observed after the ignition source was removed, but afterglow occurred at the flame contact area and it was finally self-extinguished. However, this functional finishing produced color shade change, especially for hemp fibers dyed with natural dyes.

Keywords Hemp; Finishes; Water repellent; Fire retardant; Natural dyes
Single Core-Shell Nanoparticle as Surface-Enhanced Raman Scattering Substrate

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Core-shell plasmonic nanoparticles covered with sharp rods are synthesized by a silver-assisted seed-growth method. Silver seeds must be deposited on acid-terminated polystyrene beads first to promote the formation of sharp rods. The seed-decorated polystyrene beads then were added into the growth solution, the reduction of HAuCl4 by ascorbic acid in the presence of AgNO3 lead to formation of gold shell covered with sharp rods. The presence of silver ions in growth solution was necessary in order to control the growth of the sharp rods. These plasmonic nanoparticles exhibit strong field enhancement at their tips due to the localized plasmon resonance. The intense field enhancement at the tips coupled with near-field interaction of the tips lead to formation of “hot spots” which allow the use of the individual plasmonic nanoparticle as surface-enhanced Raman scattering (SERS) substrate. The single-particle SERS measurements of the plasmonic nanoparticles show reproducible signal with small intensity variation. These properties of the core-shell plasmonic nanoparticles with sharp tips make them a good system for chemical sensing application.

Keywords plasmonic nanoparticle; hot spot; surface-enhanced Raman scattering
Dyeing and Fastness Properties of Silk Dyed with Natural Dyes Using Chitosan Pretreatment and Alum Mordanting

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As a result of an increasingly environmental awareness over the use of synthetic dyes in textile industry, a worldwide attention in natural dyes has been recently revived. However, textile goods dyed with natural dyes have some drawbacks, compared to synthetic dyes, especially in aspects of color yield and color fastness properties. Chitosan, a natural biopolymer obtained from the shells of crabs, shrimps and other crustaceans, has been known for its ability to improve the dyeability of textiles due to its polycationic nature. In this present work, the influence of chitosan pretreatment and alum mordanting on dyeing of silk fabrics with four natural dyes; lac (Laccifer lacca Kerr.), marigold flower (Tagetes erecta L.), maphut tree bark (Garcinia Dulcis (Roxb.) Kurz) and Siamese neem tree bark (Azadirachta indica var. siamensis Valeton) was explored. Color strength in terms of K/S values and color fastness to washing, light and crocking of the dyed fabrics were also evaluated. Dyed silk fabrics pretreated with chitosan as well as mordanted with alum had higher K/S values than the corresponding untreated samples. The increase in color yield and the fastness properties depended on the types of natural dyes and the mordanting methods.

Keywords Chitosan; Alum mordanting; Natural dye; Dyeing; Silk
Controlled Synthesis of Ag-doped Flower-like Zinc Oxide Nanostructure for Photocatalytic Degradation of Phenol

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Photocatalytic degradation has been proved to be the most efficient method for water treatment. Our research has been concerned with the studies of surface modified ZnO nanostructure as photocatalyst for degradation of phenol in contaminated water. Flower-shaped of ZnO nanostructures composed of hexagonal ZnO nanorods were synthesized by hydrothermal method. In addition, Ag-doped flower-like ZnO nanostructures with various Ag contents were prepared through one-pot and successive preparation methods. For one-pot method, Zn$^{2+}$ and Ag$^+$ precursor were mixed and heated while successive reaction, ZnO with rod-like flower morphology was prepared and then Ag nanoparticles were prepared and directly deposited on the surface by colloidal chemical reduction method. The morphology, surface structure and surface composition of the obtained nanostructures were characterized by scanning electron microscopy combined with Energy dispersive X-ray analysis (SEM/EDX), transmission electron microscopy (TEM) and X-ray powder diffraction (XRD). In addition, optical and photoluminescence properties was studied. For photocatalytic testing, a suspension of ZnO and Ag-doped ZnO nanostructures were illuminated at 365 nm by a 400 W mercury lamp. The extent of phenol degradation in water was monitored by UV-visible absorption spectroscopy at 270 nm. Factors affecting the photocatalytic activity such as radiation time and the amount of catalyst were systematically studied. At a concentration of phenol 25 ppm where optimum catalysis was experienced, more than 90% decomposition of phenol was achieved within 120 min. Ag-doped flower-like ZnO nanostructures demonstrated higher photocatalytic activity than pure ZnO in the degradation of phenol. This can be attributed to the high separation efficiency of the photogenerated electron-hole pairs based on the cooperative roles of Ag loading on ZnO nanorod. In addition, it clearly showed higher catalytic activity and stability on the catalysts prepared by successive methods.

Keywords Photocatalytic degradation; Ag-doped Flower-like ZnO Nanostructure; Phenol degradation
Crystallization of Vertically Aligned TiO$_2$ Nanorods on FTO substrate

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Crystallization of titanium dioxide (TiO$_2$) under hydrothermal conditions was investigated using SEM and XRD. The results showed that rectangular TiO$_2$ nanorods were formed on the fluorine-doped tin oxide (FTO) substrate in vertically aligned manner. The nanorods preferentially grew along specific crystallographic direction, along with the absence of (110) reflection of rutile phase. In contrast, without FTO surface, similar rutile nanorods were also formed but preferential growth was not observed. It is believed that epitaxial growth on the FTO surface plays a key role in controlling the organized crystallization of TiO$_2$ nanorods.

Keywords epitaxial growth; hydrothermal synthesis; TiO$_2$ ; nanorod
Preparation of Titanium Dioxide-Cadmium Selenide Hybrid by
A Simple Method

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The preparation of inorganic-organic and inorganic-inorganic hybrids is a great deal of interest for tailoring the performances of the organic and inorganic species. Titanium dioxide is a promising material for the application as a photocatalyst, co-catalyst and so on due to its semiconducting properties, chemical stability, natural abundance and environmental friendly nature. However, titanium dioxide shows photocatalytic activity only in the UV region. Therefore, the modification of titanium dioxide with visible light absorbing semiconductor such as cadmium sulfide cadmium selenide and cadmium telluride is very important in order to enhance light absorption and photocatalytic activity under UV and visible light irradiation. Here, titanium dioxide-cadmium selenide hybrid with unique optical properties was reported. Titanium dioxide solution obtained from titanium tetraisopropoxide and stearic acid were dissolved in aqueous isopropanol, then subsequently mixed together with the aqueous solution of cadmium selenide and vigorously shaken for 24 hours. The precipitate was separated by centrifugation, washed with isopropanol thoroughly and dried at 60°C for one day. The titanium dioxide-cadmium selenide hybrid was characterized by IR, TG-DTA, UV-Vis, Raman and SEM. The diffuse reflectance absorption spectrum of titanium dioxide-cadmium selenide hybrid showed the absorption onsets due to titanium dioxide and cadmium selenide at 345 and 665 nm, respectively, indicating to the formation of titanium dioxide and cadmium selenide. The appearance of the two absorption onsets in UV and visible regions may assume that the present hybrid might be used as a photocatalyst under UV-visible irradiation.

Keywords: Hybrid; Titanium dioxide; Cadmium selenide, Photocatalyst
Adsorption Characteristics of Crystal Violet dye in Aqueous Solution on Amorphous TiO₂

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Amorphous TiO₂ was prepared by precipitation from solution of titanium oxy sulfate (TiOSO₄) with four different bases (sodium hydroxide, potassium hydroxide, hexamethylenetetramine (HMT), and urea) at pH = 7. The obtained materials were characterized by X-ray diffraction spectrometry (XRD), diffused reflectance spectroscopy (DRS), Fourier-transformed infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM) techniques. The prepared TiO₂ was investigated for the adsorptive removal of Crystal Violet dye (CV), a harmful cationic dye, from aqueous solutions. The main parameters like initial dye concentration, pH of solution, and reaction time were investigated. All samples showed the same trend of behavior that rapid sorption of CV dye took place in the first 5 min while the equilibrium was reached in around 30 min. Among the amorphous TiO₂ adsorbents tested under the same experimental conditions, the one prepared by using NaOH showed the highest adsorption capacity for CV dye at 0.56 mmol dye/g TiO₂ (pH 7) as determined from the Langmuir isotherm from which the better fit was found than the Freundlich isotherm. Results of this study will be useful for future scale up using of this material as a low-cost adsorbent for the removal of dye from wastewater.

Keywords Amorphous TiO₂; Dye pollution; Crystal Violet; Dye adsorption
Effect of Sodium Dodecyl Sulfate on Characteristics of Nano-CaCO$_3$ from Cockle Shell

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This work presents a simple novel and low cost method for preparation of CaCO$_3$ nanoparticles from cockle shell with surfactant that can be reduced binding power between substances. The first step is a mechanical grinding to 74 micrometers from cockle shell scraps. The second procedure, nano calcium carbonate is carried out of various temperatures as 5°C, room temperature and 70°C for 12 hrs by using sodium dodecyl sulfate (SDS) as surfactant. The last one is characterization the particles by Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR) and X-ray Diffraction (XRD). The ATR-FTIR results were found the aragonite polymorph for both of before and after adding SDS that the prominent peak at 1088 cm$^{-1}$ and the XRD patterns also show peaks of aragonite polymorph that can be concerned with the ATR-FTIR results. Beside, the average particle size from SEM measurement is in the range of 570 nanometers and the particle size distribution of CaCO$_3$ is based on least-square optimization technique which in the range of 409-597 nanometers. Moreover, the particles are prepared at various temperatures as 5°C, room temperature and 70°C with SDS also show functional groups of Aragonite phase. In other words, the addition of SDS does not significantly change aragonite polymorph or mixed polymorph because of anionic surfactant SDS cannot transform of aragonite CaCO$_3$ to other polymorphic phase through other weak interactions. This effect depends on the concentration and specific mode of aggregation of surfactant in the bulk solution and at the solution interface.

**Keywords** Sodium dodecyl sulfate; Nano calcium carbonate; Cockle shell
Preparation of Zero-valent Iron Nanoparticles for Catalytic Degradation of 1,2 Dichloroethane

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The use of nanoscale iron particles as environmental remediation reagent could provide high activity, cost-effective and benign solutions to many challenging cleanup problems. This work, zero-valent iron nanoparticles (Fe$^{0}$) were synthesized and examined their potential to transform 1,2 dichloroethane contaminated in water. Highly dispersed iron nanoparticles in colloidal form were obtained by modifying the borohydride reduction approach in basic solution. Different types of green protecting agents were used such as carboxymethyl cellulose (CMC) and water soluble starch. The obtained colloid Fe nanoparticles were characterized by electron microscopy techniques; SEM and TEM. CMC and starch–stabilized Fe nanoparticles were presented as discrete particles. The catalytic activity of the obtained iron nanoparticles to dechlorination process was determined by GC-MS gas chromatography with head-space microextraction (HPME) technique. At the optimum reaction condition, more than 50% decomposition of 1,2 dichloroethane was achieved within 2 h. For the environmental point of views, the ability of colloidal iron nanoparticles to remain in the water and the ability to penetrate in sand was also studied. CMC and starch–stabilized Fe nanoparticles remained suspended in water for days and able to pass through and be completely dispersed in the sand and then eluted completely with three bed volumes of deionized (DI) water.

Keywords Zero-valent iron nanoparticles; dechlorination; stability; mobility
Dye Degradation by Heterogeneous Fenton-Like Reaction using Activated Carbon / Ferric Oxide Catalyst

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Fenton process is one of the most techniques to solve the environmental severe issue in term of chemicals in wastewater. However, traditional Fenton process provides via a homogenous catalyst which cannot regenerate an active species and leads to a high concentration of metal ions resulting in another environmental problem. In this research, we successfully synthesized a heterogeneous Fenton-like catalyst with a simply technique and use an activated carbon as supporting material due to its well known advantage in an absorption term, an activated carbon impregnated with ferric oxide (AC-Fe). The calcinations temperature of AC-Fe pre-catalyst was evaluated to obtain the best AC-Fe catalyst to perform a crystal-violet degradation in aqueous solution. The AC-Fe catalyst was characterized by X-ray diffractometry (XRD), scanning electron microscope (SEM), Transmission electron microscope (TEM) and also Brunauer-Emmett-Teller technique (BET). The AC-Fe in the present of H₂O₂ showed the highest performance compared with other conditions such as AC, AC/H₂O₂, H₂O₂ and AC-Fe without H₂O₂ which afforded more than 90% removal of 100 ppm crystal-violet dye within 60 minutes at 50 °C and neutral pH detected by UV-Vis spectroscopic technique. The reusability of AC-Fe catalyst will be also studied in further.

Keywords Fenton-like; Dye degradation; Crystal-violet; Activated-carbon; Ferric oxide
Levulinic acid Formation from Xylose with Desilicated Zeolite

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Xylose is a major product from a hydrolysis of hemicellulose, and is an important building block for many biochemical productions. In this project, xylose was converted into levulinic acid, a useful starting material widely used in the cosmetic and medical industries. The conversion of xylose to levulinic acid was carried on in a hot-compressed water condition using modified zeolite as a catalyst. Zeolite HY with the initial Si/Al ratio of 15 was desilicated with 0.25 M NaOH to produce desilicated zeolite. The prepared catalysts were characterized by means of XRD, FTIR, N₂-sorption, and SEM to show their physico-chemical properties. The characterization results suggested that desilicated zeolite possessed a larger pore volume and a lower surface area, along with demolished crystallinity, compared to those of parent zeolite. NH₃-TPD study showed stronger acid sites of the zeolite after desilication. The catalytic activity was performed via a batch reactor at 170°C for 3 h. The results suggested that treating zeolite with NaOH enhanced the formation of levulinic acid up to 30% while the xylose conversions were not significantly different.

**Keywords** Desilication; Zeolite; Xylose; Levulinic acid
Removal of Free-Fatty Acid from Waste Cooking Oils using Iron Oxide Magnetic Nanoparticles for Use in Biodiesel Production

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In conventional alkaline-based biodiesel production, free fatty acid (FFA) in oil feedstock can cause undesirable soap. To develop a new technique for FFA removal, iron oxide magnetic nanoparticles (MNPs) synthesized using co-precipitation were used as sorbent for removing FFA from waste cooking oil (WCO). Using oleic acid-spiked palm oil as a model of WCO, maximum FFA adsorption on MNPs in oil was determined to be about 64 mg FFA/g MNP with equilibrium contact time of about 10 hours and 25% MNP loading. The synthesized MNPs can be easily separated from treated oil using a simple magnetic decantation allowing for a fast and efficient removal of FFA. In real WCO with the initial acid value of 0.9 mgKOH/g and with the 25% MNP loading, the acid value can be reduced by about 50% to the value of 0.45 mgKOH/g. Vibrating sample magnetometer was used to study magnetic properties and the results show that MNPs possess superparamagnetic behavior with saturation magnetization of about 83 emu/g. Energy dispersive spectroscopy analysis of iron oxide sorbent shows atomic ratio of 52.78% iron and 44.65% oxygen. This ratio is closed to 2iron:3oxygen which is found in maghemite and hematite. Transmission electron microscope images show that sizes of synthesized MNP particles are in nanometer range of about 10-14 nm in agreement with result from X-ray diffraction. In oil, nanoparticles aggregate into large clusters with mean size of about 440 nm.

Keywords FFA removal; Biodiesel production; Iron oxide magnetic nanoparticles
Copper Conductive Patterns by Thermal Decomposition of Self-reducing Copper Amine Complexes

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Printing has been widely studied for fabrication of electronic circuits on a low cost flexible substrate, as an alternative technique for the photolithography/etching process. Several studies have reported the synthesis of self-reducing silver complexes inks and self-reducing copper complexes inks. In this work, self-reducing copper amine complex inks were prepared. Copper acetate was dissolved in ammonia solution. Diethanolamine was then titrated into the solution, which was mixed thoroughly. The obtained solution was then used as conductive ink, and screen printed on substrate. The printed patterns were sintered in air at various temperatures and varying sintering times in order to study the effect of sintering time on the electrical resistivity of the obtained patterns. The electrical resistivity of the printed patterns sintered under various conditions was measured by using 2-point probe. The microstructure and morphology of printed patterns were characterized via Scanning electron microscope (SEM). The crystallite phase of the printed patterns was examined by X-ray diffraction (XRD).

**Keywords** Copper inks; Printed electronics; Copper conductive patterns
Effect of Water Dilution on Nucleation of Mn-doped ZnS Nanoparticles Synthesized by Microemulsion Method

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Water-in-oil microemulsion could be simply prepared by dispersing an aqueous solution in another oil phase with the assistance of surfactant and co-surfactant. In this work, Mn-doped ZnS nanoparticles could be synthesized by the microemulsion method. Effect of water dilution on particle size distribution and photoluminescence of Mn-doped ZnS nanoparticles has been experimentally examined by varying molar ratio of water to Triton X-100 surfactant (W) in a range of 1, 3, 5, 7, 11 and 15. Characteristics of synthesized Mn-doped ZnS nanoparticles would be analysed by transmission electron microscope (TEM), particles size analyser (Zetasizer), spectrofluorometer and X-ray diffractometer for their morphology, particle size distribution, photoluminescence and crystalline structure, respectively.

Keywords: Mn-doped ZnS nanoparticles; Tunable synthesis; Photoluminescence; Micro-emulsion
Synthesis and Characterization of Copper (core) - Silver (shell) Nanoparticles by Polyol Successive Reduction Process

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Copper has high electrical conductivity and low cost compared to silver. However, copper is prone to oxidation in ambient atmosphere. An effective approach to protect the copper nanoparticles is to use protective shell made of a noble metal such as silver. Because silver has highest electrical conductivity. Moreover, oxide of silver has considerable conductivity. Recently, the polyol-mediated synthesis of metal nanoparticles appears as an easy method to carry out and versatile route. Polyols are excellent reaction media to synthesize metal nanoparticles with controllable size and morphology due to their ability to act as solvent, reducing agent and protecting agent. In this work, copper (core) - silver (shell) nanoparticles were synthesized through the polyol successive reduction process in the solution of glycerol and NaOH. The effects of molar ratio of NaOH to Cu from 0:1 to 5:1, the molar ratio of Cu to Ag (1:0.01, 1:0.05, 1:0.1, 1:0.15 and 1:0.2) and method of adding solutions were investigated. The particles size, microstructure and morphology of nanoparticles obtained were characterized by TEM, SEM and XRD. The results confirmed the formation of bimetallic copper (core) - silver (shell) with diameters of particles in range of 40-50 nm.

Keywords Copper core - silver shell nanoparticles; Polyol process; Conductive ink
Preparation and Optimization of Alginate Nanoparticles Coated with Modified Cationic Polymers for Drug Delivery System

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Alginate nanoparticles coated with cationic polymers were prepared by nanoemulsion technique. The obtained polymeric coated-ALG-NP possess positively surface charges which promoted cellular internalization in cervical cancer cell; SiHa. This alginate nanocarrier has the potential to be applied in drug delivery system.
Surface Morphology and Photocatalytic Activity of F-TiO$_2$/AC Prepared by Sol-Gel and Dipped Coating Technique

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The preparation and characterization of TiO$_2$ films on activated carbon (TiO$_2$/AC) that were prepared by sol-gel method and TiO$_2$ surface fluorination (F-TiO$_2$/AC) were investigated. TiO$_2$ films were coated by dipped coating technique. Effect of titanium tetra-isopropoxide (TTIP) to 2-propanol (2-PP), number of coated cycles, coating times and acidity on surface morphology and photocatalytic activity were investigated. After coating, TiO$_2$ films were annealed at 400 $^\circ$C then immersed in NaF solution for doping F on TiO$_2$-surface. The effects of surface fluorination and procedure on nanostructure of F-TiO$_2$-coated AC (F-TiO$_2$/AC), such as morphology, light absorption and photocatalytic activities were investigated in detail. SEM images showed that the TTIP: 2-PP ratio of 1:30, coated cycles of 1 time, coating time of 10 min. and pH 2-3, F-TiO$_2$ formed nanoparticles to be nano-fiber. UV spectrophotometric analysis showed changes of some F-TiO$_2$ physico-chemical characteristics in catalysts containing. The photocatalytic activity of F-TiO$_2$/AC was tested by degradation of methylene blue solution. The results showed high-performance of F-TiO$_2$/AC photocatalysts.

Keywords Activated Carbon; Photocatalytic; Sol-Gel Method; TiO$_2$ Surface Fluorination
Kinetic Study on the Acid-Catalyzed Hydrolysis of Cassava Starch Granule to Nanocrystalline Starch Particles

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Carbohydrate chemists have developed products that have greatly expanded starch use and utility. Most recent developed products from starch chemistry include starch derivatives and nanocrystalline starch particles (NSPs). NSPs are crystalline platelet-like particles obtained by the acid hydrolysis amorphous parts of the growth rings of starch in a granular form. The hydrolysis of starch could be schematically described as a “peeling process” of nanomaterials from microparticles. Thus, the kinetics of such a process will evolve with granule hydrolysis. A detailed kinetic study on the acid-catalyzed hydrolysis of granular starch from cassava to NSPs is reported in this paper. To assess the kinetics of acid-catalyzed hydrolysis of starch granules, the reaction between 312 hrs in shaking incubator at 37ºC was carried out to prepare NSPs. The hydrolysis was stopped after 5 hrs, 24 hrs, 48 hrs, 72 hrs, 168 hrs, 216 hrs, and 312 hrs for each the yield was assessed. Rate of reaction can be observed by investigating the change in the concentration of a starch reactant with the time (dCₛ/dt). Two-stage hydrolysis profile was observed: (i) an initial fast hydrolysis step presumably due to the hydrolysis of the amorphous regions of starch granules, and (ii) a second slower step presumably due to the hydrolysis of the crystalline regions crystalline areas. Initial concentration of starch granule present in reaction mixture is 0.12 kgL⁻¹. Linearity of a plot of 1/Cₛ² versus t indicated that acid hydrolysis of starch follows Third-order reaction base on starch (S). The rate equation are described as -rₛ = k´Cₛ³ with k´ value equal to 2.0019 L²kg⁻²h⁻² at 37ºC.

Keywords Acid hydrolysis; Cassava starch; Chemical kinetic; Nanocrystalline starch; Reaction rate
Structure and Properties of Starch-Based Bionanocomposite Foams Reinforced by Bacterial Cellulose

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In recent years, a trend of plastic or packaging materials has shifted to biodegradable polymers from renewable resources. Starch is one of the most popular choices and starch-based foams have been widely used in replacement of petroleum-based foams, particularly, in food packaging. However, in some applications, these foams still show evidence of inadequate strength and water resistance. In this study, the nanocomposite foams of starch reinforced with bacterial cellulose (BC) were successfully prepared by baking technique. The optimum processing conditions were determined. The effect of BC content on structure and properties of the nanocomposite foams was also investigated. SEM revealed that the density of starch/BC foams increased with increasing BC content. The skin-core structure of the nanocomposite foams was gradually diminished with the denser core presented. According to mechanical tests, the results showed that both flexural modulus and strength of the starch-based foams can be effectively improved by very low contents of BC addition.

Keywords Starch; Bacterial Cellulose; Foam; Bionanocomposite
Ratio Effect of Water Treatment Sludge/Nanoscale Zero Valent Iron (NZVI) Composites in Hexavalent Chromium (Cr$^{6+}$) Adsorption

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The water treatment sludge was modified with nanoscale zero valent iron (NZVI) in order to remove chromium hexavalent (Cr$^{6+}$). There were 3 ratios of the sludge/NZVI composites; 1:1, 3:1, and 6:1, weight by weight. These ratios were compared in 10 mg L$^{-1}$ Cr$^{6+}$ adsorption in batch experiment, collect every 10 minutes for an hour. The samples were analyzed by colorimetric method used UV-VIS spectrometer at 540 nm wavelength. The results indicated that sludge/NZVI composites 1:1 had the most adsorption efficiency in order to adsorb Cr$^{6+}$ which can remove chromium hexavalent up to 97% in an hour, more than the 3:1 and 6:1 ratios that can remove 50% and 7%, respectively. In addition, all materials were characterized the ions at the surface of the materials particle by zeta potential analyzer. The results showed that in the different pH, each material had the different ions on their surface which affect the performance of Cr$^{6+}$ removal efficiency. The results showed that all materials had the anions at the surface area of particle at pH 7, which is the pH in batch experiment. The zeta potential value of the sludge/NVZI composite; 1:1, 3:1, and 6:1 are -17.17, -9.20, and -7.93, respectively. Cr$^{6+}$ at pH 7 was in HCrO$_4^-$ form, thus it can’t be reacted with anions around the particle. It can conclude that ions at the surface area of all materials were not much important in Cr$^{6+}$ removal, but the cations inside the particle had more efficiency to oxidize the Cr$^{6+}$ into Cr$^{3+}$ form.

Keywords Chromium hexavalent; Water treatment sludge; Nanoscale zero valent iron; Adsorption
Synthesis and Characterization of Sodium-Titanosilicate Coated Magnetic Particles for Removal of Cesium from Contaminated Water

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One of the major fission products of the nuclear power plant reactor is the radioactive cesium (Cs). Cs is highly soluble in water, making it difficult to be separated from the contaminated water. Conventional sorbents for Cs such as zeolites and hexacyanoferrate compounds cannot be easily separated from the treated water. New magnetic sorbents coated with silicotitanate compounds have been developed. The sorbents display the maximum Cs sorption capacity of about 1.2 mg Cs/g sorbent. XRD patterns reveal the crystalline structure of the synthesized sorbents to be that of the sodium titanosilicate (or natisite, Na$_2$TiOSiO$_4$) together with the maghemite (Fe$_2$O$_3$). SEM image shows coexistence of the natisite with the maghemite with about 1:1 weight ratio determined using energy dispersive spectroscopy (EDS). FTIR spectra reveal that coating of natisite onto MNP strongly suppresses the characteristic peak at 1454 cm$^{-1}$, assigning possibly to the Na-Si bond. The MNP-natisite compound has improved Cs sorption performance over that of pure natisite possibly due to the change in the Na substitution in the titanosilicate structure.

**Keywords** magnetic particles; titanosilicate; cesium
Phase Characterization and Thermal Behavior of Co-Cu Mechanical Alloys by X-Ray Absorption Spectroscopy

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Thermal behavior of Co-Cu mechanical alloy was investigated by in situ heat treatment x-ray absorbance spectroscopy. Co and Cu mixed powder with various elemental compositions was milled at ambient temperature and characterized by X-ray diffraction (XRD) and X-ray absorbance spectroscopy. The results revealed that the prepared powder comprised metallic Co hexagonal and Cu cubic phases together with mixed Co and Cu oxide phases as a consequence of the milling. The composition of Co phases was determined by X-Ray Absorption Near Edge Structure (XANES) carried out at Co K-edge energy. The results suggested that the metallic Co was the main composition with CoO and Co₃O⁴ phases. The amount of CoO oxides was progressively increased with the initial Co composition. In addition, the thermal behavior of the Co-containing phases under the in situ heat treatment was investigated by time-resolved X-ray absorbance spectroscopy (TRXAS). The results showed that metallic-to-oxide phase transition of Co in the alloy began to occur at about 350 °C.

Keywords Co-Cu alloy; mechanical alloy; time-resolved x-ray absorbance (TRXAS)