

A Highly Sensitive Sensor for Homogenous Fluorescence-based DNA Detection

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Homogenous fluorescence-based DNA detection often lacks low detection limit. In an attempt to solve the problem, this work proposes a highly sensitive DNA sensor based on the method of enzyme-free DNA circuits and the Nanometal Surface Energy Transfer (NSET) technique. The sensor comprises a hairpin (H2) and a nanoprobe, which is a gold nanoparticle (AuNP) functionalized with 5'-thiolated hairpin (H1) whose 3'-terminus is labeled with fluorescein (FAM). In the absence of the DNA target, FAM is close to the surface of the AuNP and fluorescence is quenched due to NSET. While in the presence of the target, a cascade of strand displacement reactions causes the separation of the dye and the AuNP surface giving rise to high fluorescence intensity. At the current state of development, it is found that the sensor is capable of detecting the target strand in a picomolar range.

Keywords Enzyme-free DNA circuits; NSET; Homogenous detection; DNA sensor

Primer Immobilized Magnetic Nanoparticle for Translocation Gene of Chronic Myelogenous Leukemia (CML) Detection

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Leukemia is common hematologic malignancies worldwide and chronic myeloid leukemia (CML) preserves the first acquired chromosomal alteration linked to human cancer. Many diagnostic tools for CML have been focused on molecular level. In this study, we developed a novel molecular diagnostic tool for detection of translocation gene, *BCR/ABL* of CML. This tool combined the magnetic nanoparticles (MNPs) with RT-PCR technology. Specific forward primer was immobilized onto MNPs. Using biotin tagged reverse primer, after RT-PCR, the amplified MNPs-tagged target gene can be concentrated by an external magnetic field. Using biotin-Streptavidin (SA) interaction, the enzyme labeled SA and substrate (ABTS) was applied to increase the sensitivity as shown in quantitative results. By comparing with the standard RT-PCR, our system can provide the quantitative values which were useful for evaluation of disease severity. This proposed technique is practical, rapid, reliable, high sensitivity which was advantage for followed up patients.

Keywords Chronic myelogenous leukemia; Magnetic nanoparticle; BCR/ABL

Silver-Nanoplate Paper-Based Sensor for Hydrogen Peroxide Detection

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In this work, silver nanoplates are employed to detect a small amount of hydrogen peroxide (H₂O₂) based on the decomposition of silver nanoplates. Because of localized surface plasmon resonance (LSPR), silver nanoplates show characteristic colors depending on their shape, size, and environment. The decomposition (oxidation) of silver nanoplates by H₂O₂ causes the changes in shape and size of silver nanoplates, which affect the colors of silver nanoplates. By following the changes in colors, the degree of silver-nanoplates decomposition and numbers of H₂O₂ could be determined. Generally, silver nanoplates are used in solution system, which is not portable and inconvenient for utilizing outside a laboratory or in daily life. Therefore, a new method has been developed using paper-based system to determine H₂O₂. Silver nanoplates were deposited on filter paper coated with (3-mercaptopropyl) trimethoxysilane. When the modified filter paper was immersed in H₂O₂ solution, the color of silver nanoplates on filter paper was bleached due to the oxidation of silver nanoplates by H₂O₂. The changes in color can be observed by naked eye. Various parameters affecting the determination of H₂O₂ such as size of silver nanoplates, the concentration of (3-mercaptopropyl) trimethoxysilane, contact time and volume of H₂O₂ sample solutions were optimized. When the paper-based sensor was produced by using small-sized silver nanoplates deposited on the paper coated with 0.5% v/v (3-mercaptopropyl) trimethoxysilane, it could detect H₂O₂ of the concentration as low as 0.3 mM by naked eyes. The detection time was 10 minutes when the volume of H₂O₂ sample solutions of 5 mL was used. The results show a great potential to apply this method to determine some biomolecules or biomarkers, which are related to H₂O₂ production, such as glucose by naked eye.

Keywords Silver nanoplates; Hydrogen peroxide; Paper-based sensor

Novel Derivative of Amide Chemosensor: Metal Ions Detection

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A novel derivative of amide has been studied for the optical and electronic properties. A spectra of the photophysics of this chemosensor has been undertaken by stationary absorption and emission techniques. The compound consists of dithieno[3,2-b;2',3'-d]pyrrole (DTP) as a fluorophore and amide moiety as an ionophore which linked by aromatic structure. The transition metal ion-induced modulation of the fluorophore-receptor communication shows the prospect of amide to function as a fluorosensor for metal ions, through noticeable fluorescence enhancement. This compound is experimentally detected metal ions at 2.5 mM with various solutions: dichloromethane, methanol, dimethyl sulfoxide, dimethylformamide and acetonitrile through optical detection.

Keywords Dithieno[3,2-β;2',3'-δ] pyrrole (DTP); Chemosensor; Metal ions detection

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Layer-by-Layer Self-Assembly of Silver Nanoparticles/ Polyaniline Composite Thin Films for Ammonia Sensing

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The layer-by-layer deposition technique was used to prepare composite thin films of silver nanoparticles and polyaniline. The multilayer composite thin films are constructed by alternating of anionic and cationic polyelectrolyte. Anionic water soluble polyaniline was prepared by interfacial polymerization of aniline monomer in presence of poly (styrene sulfonic acid co maleic acid), (CoPSS). Silver nanoparticles stabilized with anionic water soluble polyaniline were then deposited in thin film and characterized for optical properties. The optical properties of thin films were measured by UV-Vis spectroscopy. The surface of the film was measured by Atomic force microscopy (AFM). As these films are to be used as sensor for the ammonia detection, the changes in optical properties of the film were evaluated for various ammonia concentrations. A strong color shift from orange to yellow was visible when exposed to ammonia. This composite of polyelectrolyte, silver nanoparticles and polyaniline is a promising composite film for ammonia sensing that could be used as freshness indicator for seafood and meats packaging.

Keywords Silver nanoparticles; Polyaniline; Layer-by-layer; Ammonia sensing

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Immobilization of Silver Nanoparticles on Polyester Fibers Using Layer-by-Layer Self-assembly Technique and Its Antimicrobial Application

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Silver nanoparticles stabilized with polyelectrolyte were prepared by high energy UV reduction of silver nitrate in dilute solution of poly(acrylic acid), (PAA). The silver nanoparticles displayed a deep blue color with a maximum absorbance at 650 nm. The formation of the nanoparticles was confirmed using Transmission Electron Microscope (TEM), Nano-Zetasizer and UV-Vis spectrophotometer. The silver nanoparticles stabilized with PAA were immobilized on polyester fibers using layer-by-layer technique, that is the sequential dipping of polyester fibers in the dilute solution of poly(diallyldimethylammonium chloride), (PDADMAC) and polyelectrolyte stabilized silver nanoparticles. The morphology of particles deposited on the surface of the polyester filters was characterized using Field Emission Scanning Electron Microscopy (FE-SEM). Silver nanoparticles coated on polyester fibers were also appropriate to be used as antimicrobial activity. It was found that the coated fibers showed effective antimicrobial activity when tested against *staphylococcus aureus*, (*S. aureus*). This polyester fibers coated with silver nanoparticles could be used as air filters.

Keywords Silver nanoparticles; Antimicrobial activity; Layer-by-layer; Green synthesis

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Direct Ink-Jet Printing of Silver Nitrate/Silver Nanowire Hybrid Inks to Fabricate Silver Conductive Lines

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In this paper, silver nanowires were synthesized by a polyol method in the presence of poly(N-vinyl-2-pyrrolidone) (PVP) with Pt seeds. X-ray diffraction (XRD), transmission electron microscopy (TEM), and energy dispersive spectrometric (EDS) analysis results indicated that the silver nanowires have been prepared. The silver nanowires were added to silver nitrate to form a binary hybrid ink to fabricate silver conductive lines by ink-jet printing on a flexible Kapton® substrate. The results showed that adding silver nanowires was a very effective way to improve morphological control, and lower the resistivity of the printed silver conductive lines. Using a 20 wt% silver nitrate/silver nanowire ink, continuous and smooth silver conductive lines with a resistivity of $7.31 \times 10^{-5} \Omega \text{ cm}$ could be fabricated by the ink-jet printing system.

Keywords Silver nitrate; Silver nanowire; Inkjet printing; Poly (N-vinyl-2-pyrrolidone)

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Synthesis and Luminescence Properties of Colloidal GdVO₄:Re³⁺ (Re³⁺ = Eu³⁺, Dy³⁺, Nd³⁺)

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Gadolinium orthovanadate (GdVO₄)-based materials have interesting luminescent and magnetic properties. Gd compounds can be easily doped with luminescent lanthanide ions because of the equal valence and similar ionic radii. They can be efficiently excited with UV radiation because of the strong absorption of the VO₄³⁻ groups and efficient energy transfer from GdVO₄ to lanthanide ions. Therefore, GdVO₄ is used as a phosphor (doped with Eu³⁺, Dy³⁺, Sm³⁺), an upconverter (doped with Er³⁺/Yb³⁺, Ho³⁺/Yb³⁺, or Tm³⁺/Yb³⁺), and a laser (doped with Nd³⁺).^{1,2} In addition, GdVO₄ NPs can act as T1-positive contrast agents for MRI, because Gd³⁺ ions possess unpaired electrons that efficiently alter the relaxation time of the surrounding water protons. In this report we present the way to prepare water colloids of super thin GdVO₄ particles doped with trivalent Eu, Dy and Nd ions. All chemicals: gadolinium(III)-nitrate hexahydrate, Gd(NO₃)₃·6H₂O (99.9%, Alfa Aesar), europium(III)-nitrate hexahydrate, Eu(NO₃)₃·6H₂O (99.9%, Alfa Aesar), dysprosium(III)-nitrate hexahydrate, Dy(NO₃)₃·6H₂O (99.9%, Alfa Aesar), neodymium(III)-nitrate hexahydrate, Nd(NO₃)₃·6H₂O (99.9%, Alfa Aesar), ammonium-vanadium oxide, NH₄VO₃ (min. 99.0%, Alfa Aesar) and sodium-hydroxide, NaOH (min. 99%, Moss Hemos) were of the highest purity and used without any further purification. RE³⁺ (Eu, Dy, Nd)-doped GdVO₄ colloidal solutions were synthesized by follow procedure: 0.05M solution of sodium citrate (15 ml) is added dropwise to the mixture of 0.05M solution of Gd(NO₃)₃ and Re(NO₃)₃ (20 ml) in stoichiometric ratio at room temperature. In this step, a white precipitate from lanthanide citrate complex was formed, while in the next step, white precipitate is completely dissolved by the addition drop by drop 0.05M NH₄VO₃ (15 ml, dissolved in 0.15M NaOH). The clear and colorless solution, whose pH is about 8, is subsequently heated at 60 °C for 60 min. Finally, the colloidal solution is cooled down to room temperature. Slow growth of the particles was achieved by using dialysis in against water until the pH=7 were reached. The prepared colloids exhibit strong emission in the visible (Eu and Dy) and near-infrared (Nd) spectral region. We present excitation and emission luminescence spectra, analysis of emission decays and concentration dependence of the emission intensity.

Keywords Luminescence; Colloids, Phosphors; Vanadates

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Effect of Eu^{3+} - Dopant Concentration on Structural and Luminescence Properties of SrY_2O_4 Nanocrystalline Phosphor

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In a last couple of decades, rare earth based phosphors are indispensable materials for applications in solid state lighting, especially in the form of light emitting diodes (LEDs). Phosphor doped with Eu^{3+} give rise to strong red emission and play important role in modern display technology, such as plasma display panel (PDP), field emission display (FED) and in industry lighting, such as tricolor lamps. In this work, SrY_2O_4 phosphors were doped with different concentration of Eu^{3+} (0.25, 0.5, 1.5, 3, 5, 7 and 10 at %) in order to investigate the maximal doping of Eu^{3+} before concentration quenching. Samples were synthesized by combustion method using citric acid and glycine as fuel. Powders were burned in the furnace at 500 °C for 1.5 h and additionally thermally treated for 2 h at 1000 °C. The X-ray powder diffraction (XRPD), scanning electron microscopy (SEM) and photoluminescence measurements (emission spectra and lifetime) were used to characterize the samples. XRD patterns confirmed the pure phase of SrY_2O_4 while structural refinement in Topas Academic software gave detail microstructure parameters. SEM micrographs of samples showed agglomerate phenomenon with spherical-like shape and diameter of about 200 nm. Upon excitation with 393 nm emission spectra were recorded in the range from 430-750 nm and in all samples the same energy transitions were observed $^5\text{D}_0 \rightarrow ^7\text{F}_J$ ($J = 1, 2, 3$ and 4). Emission intensities implies that maximal doping concentration of Eu^{3+} in SrY_2O_4 matrix is 7 at%, since higher concentration is followed by decreasing of intensity. Lifetime value is decreasing from 3.45 ms for sample with 0.25 at% Eu^{3+} to 2.60 ms for sample with 10 at% Eu^{3+} .

Keywords Luminescence; Phosphors; SrY_2O_4 ;

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Synthesis and Luminescent Properties of Dy³⁺ and Tm³⁺ Doped Gd₂Ti₂O₇

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Gadolinium titanate doped with lanthanide metal ions (Gd₂Ti₂O₇: 1 at% Dy³⁺ or 1 at% Tm³⁺) were synthesized by the Pechini-type polymerized complex route based on polyesterification between citric acid (CA) and ethylene glycol (EG). Crystallite size and particle size of powders obtained at 880°C are evaluated through X-ray diffraction analysis and transmission electron microscopy. Photoluminescence spectroscopy has been used to investigate optical properties (emission spectra and lifetime) of powders. X-ray diffraction measurements showed that Dy³⁺ and Tm³⁺ doped Gd₂Ti₂O₇ samples have cubic structure with crystallite size about 13nm and 36nm, respectively. Results of transmission electron microscopy are used to check morphology of synthesized material. We found nanopowders in the form of particle agglomerates with dimensions of individual particles of about 20 nm for Dy³⁺ and 40 nm for Tm³⁺ doped Gd₂Ti₂O₇. The photoluminescence spectra showed the characteristic emission bands of Dy³⁺ and Tm³⁺. Dy³⁺ doped Gd₂Ti₂O₇ nanopowder showed two dominant bands which are assigned to the transition from the ⁴F_{9/2} level to ⁶H_{15/2} and ⁶H_{13/2}, respectively. The transition ⁴F_{9/2} → ⁶H_{15/2} has a magnetic-dipole character, while ⁴F_{9/2} → ⁶H_{13/2} has an electric-dipole character. Blue emission was observed from the Gd₂Ti₂O₇: Tm³⁺ nanopowder from the ¹D₂ → ³F₄ transition. Lifetime values showed difference between Dy³⁺ (1.08 ms) and Tm³⁺ (90μs) doped sample.

Keywords Pyrochlores; Gd₂Ti₂O₇; Luminescence; Rare earths

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Synthesis of Novel Europium-Containing Organic Complexes

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Europium complexes of Eu(DBM)₂(Phen)(MA), Eu(DBM)₃(MA), Eu(TTA)₂(Phen)(MA), and Eu(TTA)₃(MA) have been successfully synthesized by Europium ions (Eu³⁺), organic ligands and methacrylic acid. They were determined by FTIR, ¹HNMR, UV, FL. They have different solubility and fluorescence property. Among them, Eu(DBM)₂(Phen)(MA) has the best property. Methacrylic acid plays a dual role of the organic ligand and compatilizer, so the europium chelates can utilize the olefinic double bonds to copolymerize with other monomers.

Keywords Europium-containing complexes; Photoluminescence; Solubility

Bacterial Cellulose Fiber Reinforced Cassava Starch/Chitosan Composites

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Bacterial cellulose fiber reinforced cassava starch/chitosan composite sheets were prepared by solution casting. The effects of polymer blend ratio and fiber content on the composite properties were studied by mean of mechanical, thermal properties and morphological analysis. The optimum ratio of cassava starch/chitosan blend sheet at 1:1 showed the best mechanical and thermal properties. Moreover, the composite sheet with 15% w/w bacterial cellulose fiber showed the highest improvement in the Young's modulus and tensile strength increased 94% and 78% respectively, while the elongation at break decreased 205% compared to those of polymer blend. TGA analysis showed higher thermal stability than blend films, increasing of the onset temperature from 240 °C to 254 °C. In addition, SEM analysis showed good compatibility between the fiber and the matrix, which indicated good interfacial adhesion between the two phases.

Keywords Cassava starch; Chitosan; Bacterial cellulose

Cattail Fiber Reinforced Poly(Lactic Acid) Composites: Effect of Fiber Surface Treatment

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Cattail fiber is substantially benefit for industrial domain due to its special attributes, as regard of strength, stiffness, low density, and cheap. The structural compositions of Cattail fiber, consist of cellulose, hemi-cellulose, lignin, pectin, and waxy substances, can absorb environmental moisture, leading to poor attachment of matrix materials. Hence, this natural fiber needs chemical modification. The study aimed to investigate the effect of fiber surface chemical treatment of Cattail fiber on PLA/cattail fiber composites. The treatment of fiber surface was to improve the interfacial adhesion between fiber and poly(lactic acid); PLA. The treatments were undertaken through applying various chemicals for improving fiber surface without heating: Alkali, Peroxide and Silane. Composites were prepared by a twin-screw extruder, then the extrudated compound was injection molded to obtain testing samples. Chemical composition on the fiber surface was examined by FTIR. Morphology characterization was proved by SEM. The outcome of testing mechanical properties by tensile and izod impact found that silane was the best performance, in terms of reinforcing fiber composites at 20%wt fiber. They possessed not only an increase of Young's modulus (31.12%) and tensile strength (17.63%); but also decreasing in percentage of elongation at break (13.46%). The impact strength also reduced to 27.65%, compared with those of neat PLA. Moreover, silane treated fiber/PLA composites demonstrated an enhancement of thermal stability, T_m, and crystallinity.

Keywords Cattail fiber; Poly(lactic acid); Chemical treatment

The Preparation of Microfibril Cellulose Fibers from Rice Straw

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In the present work, microfibril cellulose fibers were successfully isolated from sticky rice straw via chemical treatments. The rice straw was treated with 5wt% NaOH solution at 80°C for 1hr. and then bleaching with 30 wt% H₂O₂ at 80°C for 2hr. The structure, chemical composition and morphology of cellulose fiber were studied by using fourier transform infrared (FTIR) spectroscopy, x-ray diffraction (XRD) and scanning electron microscopy (SEM) techniques. FTIR and SEM results showed removal of hemicellulose and lignin from the structure of fibers. The chemical treatment of rice straw when used long time and high temperature during the chemical treatment, the separated micro fibril cellulose showed distribution very well. XRD results reveal the chemical treatment results in improved crystallinity of the fibers. Experimental results show the evidences removal of lignin and hemicellulose, and thus making microfibril cellulose as a candidate for using in reinforced polymer composites.

Keywords Rice straw; Cellulose; Chemical Treatment

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Preparation and Characterization of *Ananas comosus* and Chitosan Derivatives Biocomposite

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The blending of polymers to improve their chemical and physical properties has received extensive attention in the past several decades. Biopolymers or their derivatives can be blended with other polymers (including biopolymers) resulting in a number of new composite materials with enhanced properties and applications in several fields. Blending the polymer in order to obtain the desired properties can be achieved by cross-linking which may be physical or chemical cross-linking. Chemical cross-linking of polysaccharide is highly versatile method with good mechanical stability but they are not preferred owing to their physiological toxicity. Therefore, the search for natural cross-linking agents are great interest, safe used and environmentally friendly. In this work, *Ananas comosus* was used as source of cellulose. Ferulic acid (FA) was used as biocompatible crosslinker. Concentration of FA, reaction time and temperature were studied to prepare biocomposite. It was found that when increase concentration of FA the yield of biocomposite was increased at optimal condition (at 50^oC, 60 minute). The biocomposite was characterized using UV-visible spectroscopy, FTIR, DSC, TGA and zetasizer. It demonstrated UV absorbance value at 280-330 nm with size ~ 338 nm and The IR spectrum changed at 1500-1600 cm⁻¹ (-NH₂) and 1700-1800 cm⁻¹ (-COOH) which indicated the chemical crosslink between FA and polymers. DSC thermogram showed endothermic at range 160-180 ^oC and 190-230 ^oC and TGA thermogram exhibited decomposition at about 170 ^oC and continue until 347 ^oC which were different from the reactants. The results obtained indicate that the biocomposite was successfully prepared by *Ananas comosus* and chitosan derivatives using FA.

Keywords *Ananas comosus* cellulose; Chitosan; Biocomposite; Natural crosslinker.

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Dyeing of Cotton Yarn with Natural Dye Extract from Achiote Seeds using Solutions of Chitosan and Quaternized Chitosan

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The aqueous dye extract from achiote (*Bixa Orellana* L.) seeds has potential for use in cotton dyeing. Spectroscopic analysis of the dye extract from the pericarp of the seeds was investigated using UV/Vis, NMR spectroscopic analyses, and mass spectrometry. It was found that the major colorant in the extract was bixin. The optimal conditions for dyeing were found to be at initial dye concentration of 400 mg/L, a material to liquor ratio (MLR) of 1:50, at 60 °C, and a contact time of 30 min. Pretreatment of cotton yarn with a chitosan solution (together with a cross-linking glyoxal solution), or an aqueous solution of quaternized chitosan, increased the binding sites for the adsorption of the dye resulting in better dye adsorption on the cotton yarn in comparison to alum post-mordanting and the untreated cotton yarn (control). From ATR-FTIR spectroscopic analysis, the presence of chitosan on the dyed cotton yarn was revealed by a characteristic absorption band at 1578 cm⁻¹ that was assigned to amide group N–H bending. Similarly, the presence of the quaternized chitosan was confirmed on the corresponding dyed cotton yarn through a diagnostic absorption band at 1636 cm⁻¹ ascribed to C–H symmetric bending of the methyl groups in the quaternized chitosan.

Keywords Achiote; Cotton; Quaternized chitosan; Chitosan; Dyeing

Efficiency of Microcrystalline Cellulose (MCC) Biofilm from Rice Straw

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Biofilm made from natural materials or petrochemicals. It can be transformed chemical structure to degradable product. This project developed rice straw to microcrystalline cellulose (MCC) biofilm that extracted from rice straw. Firstly, rice straw was boiled in NaOH 80°C for 4 hours. Next, bleached it with H₂O₂ and NaOCl before boiled it with HCl. MCC was obtained as a white powder. MCC, Carboxymethyl cellulose (CMC) and mixture (MCC and CMC) were formed into biofilm by convection dryer at 40° C for 24 hours, continued with 110° C for 6 hours. Distinguished they were performed by Universal Material Testing Machine (QC-505B1). The results show that CMC biofilm is the most flexible (extension 320.10% from 20.00 mm), MCC biofilm (extension 235.70% from 20.00 mm), and the mixture biofilm (extension 233.00% from 20.00 mm), respectively.

Keywords Biofilm; Rice straw; Microcrystalline cellulose

Adsorption Properties of Biomass Waste, Banana and Areca Fruit Peel Alcoholic Extract on the Corrosive Inhibition of Steel in Hydrochloric Acid Solution

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The alcoholic extract of biomass waste; cultivated fruit peel of banana (*Musa sapientum* Linn.) and areca nut (*Areca catechu* Linn.), were evaluated as environmental friendly corrosion inhibitor. Inhibitive actions of banana and areca nut peel extract on corrosion of SS400, one of the most commonly used hot rolled steel, in 1 M HCl solution were investigated through electrochemical techniques. The polarization curve of specimens at 30, 40, and 50°C clearly show that the corrosion rate is retarded by coating with different concentrations of the banana peel or areca nut peel extracts. The corrosion inhibitor efficiency of the alcoholic extracts from both banana peel and areca nut peel were increased with the extract concentration. The inhibition efficiency of the extracts was higher than 70% at 30 °C and then decreases at the higher temperature. The surface adsorptions of both waste extracts were found to obey adsorption isotherm of Langmuir. They also showed the negative values of adsorption energies and ΔG°_{ads} suggesting a stable and a spontaneous inhibition processes. They also showed the decreasing of K_{ads} when increasing temperature which correlated to the decreasing of inhibition efficiency. These results show the good opportunity to make the value added chemicals from the biomass wastes in the country.

Keywords *Areca catechu* Linn.; *Musa sapientum* Linn.; Corrosion inhibitor; Adsorption energy

Preparation and Characterization of *Dendrocalamus Asper Backer* Bamboo Activated Carbon using Microwave Radiation

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Activated carbon was prepared from the *Dendrocalamus Asper Backer* bamboo with phosphoric acid activation by using microwave radiation. The *Dendrocalamus Asper Backer* bamboo was first carbonized at 600°C on conventional thermal process and then using microwave induced to become activated carbon (AC). The effects of microwave power, ratio of charcoal: phosphoric acid and activation time on the properties of product were studied. Under the conditions of 360 watts microwave power, 15 min activation time and the ratio of charcoal : phosphoric acid as 1 : 4, the prepared bamboo activated carbon has the highest iodine number value, 1398 mg/g, indicating a large of adsorption capacity. AC from the carbonized bamboo was characterized by moisture, ash, volatiles and fixed carbon contents. The results were found that the moisture content does not change much (2.0%) and the calculated ash contents is low (2.4%) indicating that less phase does not participate in the activation. In addition, the AC has less volatile of 3.6% and the high weight of fixed carbon percentage of 94%. The results demonstrated that *Dendrocalamus Asper Backer* bamboo is a good material for preparing activated carbon and microwave radiation is a highly time-saving technique.

Keywords *Dendrocalamus Asper Backer* bamboo; Activated carbon; Microwave; Phosphoric acid

Cu-Promoted Fe_xO_y Catalysts from Fe-Coagulated Sludge Produced by Ferric Chloride Coagulation of Wastewater

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Copper promoted iron oxide (zCu-Fe_xO_y) catalysts were prepared by coagulation of wastewater and coagulant at the volume ratio of 1:2, impregnation by z = 0.5, 1.0, 1.5, 2.0, 5.0, and 15.0 wt% Cu, and calcination at 750 °C for 4 h. All zCu-Fe_xO_y catalysts were investigated by X-ray diffraction (XRD) and X-ray absorption (XAS), including X-ray Absorption Near-Edge Structure (XANES) and Extended X-ray Absorption Fine Structure (EXAFS). These promoted catalysts were compared to the unpromoted ones in term of oxidation state, phase, and local structure prior to their uses for hydrogen production by water splitting process in further studies.

Keywords Iron oxides; Waste water; Coagulation

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Adsorption and Swelling of Lepidocrocite Titanate by Heptanoic acid and Palmitic acid

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This study investigated the adsorption and swelling by heptanoic acid and palmitic acid in a layered titanate with lepidocrocite structure. $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$ was synthesized by a conventional solid state synthesis¹ from mixtures of the oxides /carbonates. A 5%w/w heptanoic acid in isopropanol was adsorbed to $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$ at 60°C. The solid product was separated and analyzed by X-ray powder diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and transmission electron microscopy (TEM). The amount of adsorbed heptanoic acid increased with time. It was stabilized at 6.2% by weight after 36 h. TEM images showed that the repeating distance of 0.8 nm in $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$ expanded to 1.1-4.4 nm, indicating the swelling by heptanoic acid. A wide range of the observed repeating distance suggests that there are several arrangements of intercalated heptanoic acids. The presence of organic functional groups in this lepidocrocite-heptanoic acid hybrid was confirmed by FTIR. Similar results were obtained with the use of palmitic acid. The intercalation fatty acids into the lepidocrocite titanate $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$ without a pretreatment with inorganic acids represents the simple method to modify the hydrophilicity /hydrophobicity at the interlayer space.

Keyword Lepidocrocite; Adsorption; Swelling; Heptanoic acid; Palmitic acid

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Preparation of Calcium Carbonate Nanoparticles in Calcite Phase from Green Mussel Shells, Cockle Shells and Enamel Venus Shells by Solvothermal Method

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Nanoparticle of calcium carbonate in calcite phase was successfully prepared by solvothermal method for synthesis of calcite phase and nanoparticles from green mussel shells, cockle shells and enamel venus shells. Calcite of calcium carbonate is widely used as fillers for plastic. The solvothermal method involves an easily performable and low-cost mechanical of the nano-sized CaCO_3 powders. The synthesized CaCO_3 were characterized by Fourier transmission infrared spectroscopy)FTIR(, X-ray powder diffraction)XRD(, X-ray fluorescence spectrometry (XRF), Thermogravimetric analysis) TGA(, and scanning electron microscopy)SEM(. The reproducible and low-cost method suggested that it could be used in industry for the large synthesis scale of CaCO_3 .

Keywords CaCO_3 ; Nanoparticles; Solvothermal method; Shells

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Synthesis and Characterization of $\text{La}_2\text{O}_3/\gamma\text{-Al}_2\text{O}_3$ by Simple Impregnation Method

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Lanthanum oxide (La_2O_3) obtained from decomposition of Thai monazite ore by alkali method and using ion exchange technique as purification process was used as a precursor to prepare $\text{La}_2\text{O}_3/\gamma\text{-Al}_2\text{O}_3$. The powders were synthesized by simple impregnation method. The effect of La_2O_3 loading (0-50%) on the structure and the morphology of $\text{La}_2\text{O}_3/\gamma\text{-Al}_2\text{O}_3$ were investigated. The prepared powders were characterized by X-ray diffraction (XRD), N_2 adsorption-desorption (Brunauer-Emmett-Teller, BET) method, Thermogravimetric analysis (TGA), Scanning electron microscope (SEM) and Fourier transform infrared (FT-IR) spectra. XRD patterns and FT-IR spectrum revealed that an increasing of La_2O_3 loading led to the formation of LaAlO_3 . The presence of La_2O_3 phases was confirmed by the TGA study. The surface area values of $\text{La}_2\text{O}_3/\gamma\text{-Al}_2\text{O}_3$ decreased from 161.95 to 75.11 m^2/g with the La_2O_3 loading increasing from 0 to 50%. SEM studied showed that the average particle size of $\text{La}_2\text{O}_3/\gamma\text{-Al}_2\text{O}_3$ increased with increasing of La_2O_3 loading. The La_2O_3 is expected to be an efficient precursor for $\gamma\text{-Al}_2\text{O}_3$, which is promising for several catalytic applications.

Keywords Synthesis; Charecterization; Lanthanum oxide; Gamma alumina; Impregnation method

Low Temperature Growth and Characterization of ZnO Nanorods by Hydrothermal Method

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Zinc Oxide (ZnO) nanorods were grown on the various substrates such as Si, glass slide and GaN on sapphire with and without seed layers using hydrothermal method. The seed layer was firstly grown on the substrates of Si and glass slide by spin coater using zinc acetate as a precursor. The nanorods were subsequently grown on all substrates with the different temperatures and concentrations of two main precursors that are zinc nitrate and hexamine. A Teflon liner autoclave is introduced to fabricate ZnO nanorods when it is put in the oven for 6 hr. The characteristics of ZnO nanostructures were investigated by field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD) and UV-Vis spectrophotometer. FESEM images showed the morphology of hexagonal ZnO nanorods on the substrate surface. The seed layer assisted the ZnO nanorods to protrude in vertical direction from the substrate but ZnO rods only grew in horizontal on the substrate surface without seed layer. The crystalline ZnO nanorods were indicated from the peak pattern of XRD. Moreover, the % optical transmittance of the nanorods investigated by UV-Vis spectrophotometer is about 65 % at the wavelength of 550 nm. The growth condition, which is found that ZnO nanorods are grown well in vertical direction and better geometry, is 10 mM and 100 °C with the diameter of 50 nm and the length of 500 nm.

Keywords Autoclave; Hydrothermal method; ZnO nanorods

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Study on Fabrication of Ni5W Long Tapes with CeO₂ Buffer Layer by Reel-to-Reel Route

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A 10-meter-long home-made textured Ni-5at%W (Ni5W) long tape with a CeO₂ buffer layer has been prepared successfully by means of rolling assisted biaxially textured substrate (RABiTS) route followed by a chemical solution deposition (CSD) method in a reel-to-reel manner. Globally, the Ni5W substrate and CeO₂ film exhibit high homogeneity in terms of biaxial texture over the tape. The average values of full width at half maximum of in-plane and out-of-plane texture are 7.2° and 6.1° in Ni5W substrate, 7.6° and 6.1° in CeO₂ buffer layer respectively, all of those with a small standard deviation. On a micro level, the CeO₂ film epitaxially grows well on top of the Ni5W tape. A continuous, smooth and crack-free morphology was observed on the CeO₂ film and the fraction of low angle grain boundaries ($\leq 10^\circ$) is about 98%. This process is a potential possibility for producing long-length textured CeO₂/Ni5W tapes for coated conductors with a low cost.

Keywords NiW alloy tape; Cube texture; CeO₂ film; Chemical solution deposition

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Textural and Structural Properties and Surface Acidity of SBA-15 Supported Zn Catalyst for Transesterification Reaction: Effect of Zinc Loading Method

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The effects of the Zn incorporation method on the textural and structural properties of SBA-15 mesoporous silica were investigated. SBA-15 mesoporous silica was prepared by the co-condensation method reported by Chen et al. Three different Zn incorporation processes were used: (i) impregnation, (ii) solvothermal, and (iii) hydrothermal method. Its structure has been investigated using X-ray diffraction, N₂-physisorption, NH₃ temperature-programmed desorption, and scanning electron microscope. The experimental results revealed that textural and structural differences are induced by change in the incorporation conditions. Zn/SBA-15 synthesized through hydrothermal method retains hexagonal order with large surface area (837 m² g⁻¹). The impregnated catalyst shows lowest surface area and pore volume, which has been attributed to partial pore blocking by Zn species. Evidently, ZnO existing in crystalline form of wurtzite are superior to non-crystalline form in catalyzing BDF synthesis. The catalytic activity of ZnO/SBA-15 catalyst for the transesterification of Jatropha oil depends on textural properties and surface acidity together with crystallinity of ZnO.

Keywords Mesoporous silica; Zn/SBA-15; Transesterification

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Synthesis and Characterization of Boron Modified Alumina Catalyst for Ethanol Dehydration to Ethylene

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Dehydration of ethanol to ethylene requires solid acid catalysts consisting of bronsted acid site on surface. The alumina catalyst is interesting because of its excellent thermal stability, high surface area, fine particle size and low side reaction. In this present study, alumina was studied in ethanol dehydration over a wide range of nanocrystalline alumina catalyst having mixed gamma and chi crystalline phases prepared by the solvothermal method. The synthesis method can control the structure and crystallite size of mixed phase gamma and chi alumina. Acidity of alumina catalyst affects on dehydration activity, depending on the calcination temperature. In order to improve acidity of alumina catalyst, it can be modified with boron. In this research, we investigated the effect of mixed gamma-chi phase alumina catalysts with boron modification on ethanol dehydration. The catalysts were characterized by X-ray diffraction (XRD), N₂ physisorption, transmission electron microscopy (TEM), scanning electron microscopy (SEM), and NH₃-temperature programmed desorption (NH₃-TPD).

Keywords Mixed phase alumina; Ethanol dehydration; Boron promoter; Gamma and chi alumina

Kinetic Study of Thermal Decomposition of $\text{Ce}(\text{HPO}_4)_2 \cdot 2\text{H}_2\text{O}$ from DSC Data Combined with Origin Lab Software Program

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Thermal dehydration kinetics of cerium (IV) hydrogen phosphate dihydrate ($\text{Ce}(\text{HPO}_4)_2 \cdot 2\text{H}_2\text{O}$) was studied using an alternative procedure with, the combination between DSC data and the peak area. The studied hydrate and its decomposition products were characterized by TG/DTG/DTA, DSC, XRD and FTIR techniques. The results reveal that this convenient method is a suitable tool for the determination of reliable kinetic parameters. The peak area at each temperature can be calculated using the Origin Lab program. Thus, the kinetic parameters (E_a , A and $g(\alpha)$) of thermal decomposition of the title compound under non-isothermal conditions can be calculated. The activation energies were determined by using Kissinger-Akahira-Sunose (KAS) and iterative methods. All detectable peaks from XRD patterns of this compound are indexed as the formula $\text{Ce}(\text{HPO}_4)_2 \cdot 2\text{H}_2\text{O}$ according to the standard data file PDF#33-0336.

Keywords $\text{Ce}(\text{HPO}_4)_2 \cdot 2\text{H}_2\text{O}$; Non-isothermal; Kinetic parameters

Effect of Acid Treatment and Hydrothermal-Carbonization (HTC) of Carbon Nano-villi from *Typha Angustifolia* Flower

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Typha Angustifolia Flower (TAF) was subjected to produce carbon nano-villi by hydrothermal-carbonization (HTC): hydrothermal at 200°C for 4h (adding acid catalysts) and carbonization techniques (under nitrogen atmosphere at 300-900°C for 2 h). This research study the influence of acid treatment (H₂SO₄, HNO₃, H₃PO₄ and HCl) and carbonization temperature. The samples have been characterized by scanning electron microscope (SEM), fourier transform infrared spectroscopy (FTIR) and nitrogen sorption to investigate the morphology, surface function, and specific surface area, respectively. The results indicated that the acid treatment and carbonization temperature are the most important factors affect on the properties of TAF. Hydrothermal process at 200°C for 4 h and adding 3 wt% HNO₃ acid catalyst and then carbonization process at 900°C was found the highest S_{BET} (415 m²/g). With an increase in the carbonization temperature, the carbon spheres were increased, leading to surface area increased.

Keywords Carbon nano-villi; *Typha angustifolia* flower; Hydrothermal; Carbonization; Acid treatment

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Growth of Zinc Oxide Nanoparticles on Graphene Assembly

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Graphene is of interest across a wide range of research fields and may even motivate researchers to develop a novel hybrid material with exceptional properties. In this works, growth of zinc oxide (ZnO) nanoparticles on reduced graphene oxide (rGO) using chemical reduction method was reported. The specific surface area of ZnO/rGO varied in range of 660 ± 50 m²/g with investigated by Brunauer Emmett Teller (BET) analysis using nitrogen adsorption. Particle size, morphology and crystal structure of ZnO/rGO were investigated by transmission electron microscopy (TEM) and X-ray diffraction (XRD) technique, respectively. Potentiostat/Galvanostat was used to measure the I-V curve and sensitivity of hybrid material. Sensing application of ZnO/rGO was explored. ZnO/rGO was used as an active material for sensing ammonia diluted in water. The preliminary results showed that the sensitivity and the response time were dependent on specific surface area of ZnO/rGO.

Keywords Graphene; Zinc oxide nanoparticle; Growth

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The Synthesized of CoFe₂O₄-Graphene Oxide Composites and Their Photocatalytic Performance on Dye Degradation

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Magnetic cobalt ferrites-graphene oxide composite (CoFe₂O₄-GO) was synthesis by simply reflux method at 85°C. The nanosized cobalt ferrite (CoFe₂O₄) was synthesized by a simple hydrothermal method using glycerol as stabilizing agent. Graphene oxide was synthesized according to the modified Hummer method. The effect of pH on the microstructure was investigated. The synthesized CoFe₂O₄-GO composites were characterized by X-ray powder diffraction (XRD), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR). The synthesized CoFe₂O₄-GO composites at various pH of reaction have different microstructure. All prepared CoFe₂O₄-GO various pH showed the characteristic diffraction peak of GO and the cubic spinel structure of CoFe₂O₄. The SEM results revealed the highly agglomerated of CoFe₂O₄-GO at low pH. The photocatalytic degradation of methylene blue (MB) dye was evaluated under visible irradiation. The synthesized CoFe₂O₄-GO at pH7 exhibits high photocatalytic activity for degradation of methylene blue dye. All synthesized CoFe₂O₄-GO composites can be separated by external magnet.

Keywords Cobalt ferrites-graphene oxide composite; Photocatalyst; Degradation of dye

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Fabrication of Hydroxyapatite/Graphene Composites for Hybrid Porous Materials

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Hybrid material owning high porosity, high mechanical strength, good electrical conductivity and biocompatibility is important for many applications such as biosensors, fuel cells, super capacitors, batteries etc. Graphene is well known for its superior mechanical and electrical properties. Hydroxyapatite (HAp) is commonly used in bio-related applications as a biocompatible material. In this work, we presented preliminary data on fabrication of HAp/graphene porous hybrid materials. Graphene oxide (GO) was prepared by modified Hummers' method. HAp crystals were grown on GO by wet-chemical synthesis. GO and HAp solution mixtures were then incubated in an hot air oven at 37 °C for 1, 3, 5 and 7 days. Effects of HAp growth times on HAp size were discussed. After incubated, the solutions were then filtrated through filter papers to remove excess calcium and phosphate ions. HAp/GO composites were annealed at different temperatures, including 50, 100, 150 and 200 °C. Effects of annealing temperatures on reduction degree of GO and porosity formation were investigated using Raman spectroscopy, X-ray diffraction, scanning electron microscopy and transmission electron microscopy. Reduction degree of GO was directly proportional to annealing temperature. At high temperature, GO was reduced to be reduced graphene oxide (rGO) and the composite material then became HAp/graphene. Electrical resistance of the hybrid porous material was investigated by two-probe measurement.

Keywords Graphene; Hydroxyapatite; Hybrid materials

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Crystal Field Analysis of Mn⁴⁺ Emission in Mg₂TiO₄ Nanoparticles

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In this report we present structural properties and crystal field analysis of Mn⁴⁺:Mg₂TiO₄ nanoparticles. We have successfully synthesized nanoparticles by Pechini-type polymerized complex route, with stoichiometric ratio Mg : Ti = 2 : 1, after calcination at 600°C for 1 h. The structures of nanoparticles were analyzed by X-ray diffraction. Mg₂TiO₄ is a classic example of an inverse spinel in which the tetrahedral sites are solely occupied by Mg²⁺ ions, and the octahedral sites are occupied by both Mg²⁺ and Ti⁴⁺ ions in a 1:1 ratio. Structural refinement provided the value of the lattice constant of 8.43 Å. The energy levels of the Mn⁴⁺ ions in Mg₂TiO₄ were calculated using the crystal field exchange-charge model.¹⁻³ The point symmetry of the Mn⁴⁺ position is C_{3i}, which is in agreement with the structure of the crystal-field Hamiltonian and calculated pattern of the energy-level splitting. The calculated energy levels of Mn⁴⁺ in a trigonal crystal field are in good agreement with the experimental excitation and emission spectra and allow for the designation of all prominent spectral features. The values of the crystal field parameters (CFPs) for Mn⁴⁺ ions in Mg₂TiO₄ are similar to those calculated for Mn⁴⁺ in other crystals with trigonal point symmetry at Mn⁴⁺ sites. The crystal-field analysis also showed that contributions of covalent and exchange effects to CFPs are nearly eight times greater than the point-charge contribution.

Keywords Nanoparticles; Mn⁴⁺; Mg₂TiO₄; Crystal field

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Influence of Gelled Electrolyte to Acid Stratification and Battery Performance for Lead-Acid Battery

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Since performance of lead-acid batteries normally reduces over long storage time due to stratification of acid electrolyte. This research aims to study effect of gelled electrolyte on acid stratification and battery performance. The gelled electrolyte was prepared by adding colloidal silica (1.0 – 2.5 %wt) in to H₂SO₄ (s.g.1.280 and 1.300 at 20 °C). Tests for battery performance included capacity test, charge acceptance test, over potential charge test, water loss and battery lifetime. The results showed that addition of colloidal silica reduced some battery performances such as capacity, and amount of current input in the overcharge state. However, batteries with gelled electrolytes had lowered amount of water loss, reduced acid stratification and longer battery life cycle.

Keywords Gelled electrolyte; Colloidal silica; Lead-acid battery; Stratification

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Pore Development of Nanoporous Anodic Aluminum Oxide in Growth Process

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Anodic aluminum oxide (AAO) was successfully fabricated by two step anodization process at mild anodization (low voltage and temperature). Morphology features and mechanical property of anodic aluminum oxide depend on various process parameters. Pore enlargement process (temperature and time) is one of the most important parameter for developing of pore. The formation of nanoporous anodic aluminium oxide is used phosphoric acid with different temperature and time to investigate pore development process. Field emission scanning electron microscope (FE-SEM) and micro hardness tester were used to characterize the morphology and the mechanical property of anodic aluminum oxide, respectively. It was found that, when increased the pore enlargement temperature and time pore diameter of anodic aluminum oxide is increase. The hardness of anodic aluminum oxide is decrease when increase the pore enlargement temperature and time. For more detail will also be discussed.

Keywords Anodization process; Pore enlargement; Nanoporous; Phosphoric

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A Study of Dye Sensitized Solar Cell from Co-Sensitizer Ruthenium Complexes

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A dye-sensitized solar cell (DSSC) has been studied in two approaches: individual and co-sensitized devices of tetrabutylammonium (4,4'-dicarboxy-2,2'-biquinoline)(4-carboxy-2,2'-bipyridine-4'-carboxylate) dithiocyanatoruthenium(II) ion (**YN07**). The results show that a individual DSSC device of **YN07** shows a low power conversion efficiency (PCE) of 0.46 % with J_{sc} , V_{oc} and ff of 1.41 mA/cm², 0.48 V and 0.68, respectively. The co-sensitized device (**YN07** + **N719**) showed significantly enhanced the J_{sc} value. Upon optimization, the device yielded J_{sc} of 4.08 mA/cm² with V_{oc} , ff and PCE of 0.53 V, 0.74 and 1.59 %. The enhanced of J_{sc} and PCE have been attributed to the fact that the **N719** co-adsorbent effectively improved the light absorption in the 450-550 nm region.

Keywords Ruthenium; Sensitizing dye; Dye-sensitized solar cell

Poly(3,4-ethylenedioxythiophene) Counter Electrode in Conjunction with Poly(ethylene oxide)-based Hole Conductor for Perovskite Solar Cells

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The development of solid state organic-inorganic metal halide perovskite solar cells (PSCs) with a rapid improvement in efficiency from 3.81% to over 16% at lab-scale (1-3) makes it promising for this device as potential third generation photovoltaics. This work employed poly(3,4-ethylenedioxythiophene) (PEDOT) conductive polymer as a substitute for gold or platinum counter electrode to help reduction of rare metal consumption and production cost. The PEDOT film electrodes were uniformly deposited on fluorine doped tin oxide (FTO) glass by electrochemical polymerization of bis-ethylenedioxythiophene (bis-EDOT) at potential of 1.5 V. The Scanning electron microscopy (SEM) image of the PEDOT film showed rough and porous surface. The porous TiO₂ film electrodes were spin-coated with methyl ammonium lead iodide perovskite (CH₃NH₃PbI₃). These photo-electrodes were then assembled with the PEDOT counter electrodes. Poly(ethylene oxide) (PEO)/CH₃NH₃I/I₂/TiO₂ composites modified with natural carmine or ascorbyl palmitate as hole conductor were sandwiched between the two electrodes. The energy conversion efficiency was improved from 0.471% achieved by PSC using PEDOT counter electrode and without the use of PEO composite as hole conductor to 0.864% achieved by PSC using PEDOT counter electrode and in conjunction with PEO composite modified with ascorbyl palmitate. The conductivity of the modified composite materials were studied by electrochemical impedance spectroscopy (EIS). The device can be further developed to improve the efficiency.

Keywords Perovskite solar cell; Counter electrode; PEDOT; PEO

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A Computational Study of Donor- π -Cyanoacrylic Acid for Dye-Sensitized Solar Cell, a Sonogashira Coupling Reaction.

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The organic dyes based donor-linker-accepter was designed as sensitizers for the application of dye-sensitized solar cells (DSSCs). The density functional theory (DFT) and time-dependent DFT (TD-DFT) calculations has employed to investigate the electron distribution, frontier molecular orbitals, absorption spectra and the intramolecular charge transfer (HOMO -LUMO) of the dyes. The effect of linker moieties including thiophene and thiazole between donor and cyanoacrylic acceptor was studied the intensity and the absorption spectra which are important features that affect the performance of DSSCs. To understand mechanism, the ground and excited stated properties and the density of state (DOS) analysis were studied and review the electron density of HOMO which is located at the donor moiety and extended to the π -conjugated linker whereas the electron density of LUMO is concentrated at the π -conjugated linker and acceptor about 36%.

Keywords Donor-linker-accepter; Dye-sensitized solar cells; Density functional theory

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The Microstructure and Photocatalytic Efficiency of Magnetic ZnFe₂O₄ Nanoparticles

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Zinc ferrites (ZnFe₂O₄) were prepared by simple co-precipitation method from Zn(NO₃)₂•6H₂O and Fe(NO₃)₃•9H₂O aqueous solutions using NH₄OH as precipitating reagent and sodium dodecyl sulfate (SDS) as stabilizing agent. The calcination temperatures (400 °C, 600 °C, 800 °C) were investigated. The as-prepared ZnFe₂O₄ samples were characterized with X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR) and UV-Vis diffuse reflectance spectroscopy (DRS). The XRD patterns of ZnFe₂O₄ confirm the formation of cubic spinel structure in all samples. The SEM results showed that SDS molecules play a crucial role to control the microstructure of samples. The DRS spectra revealed that all samples showed extended absorption in the visible region. A vibrating sample magnetometer (VSM) is used for measuring the magnetization of samples. The photocatalytic activity was evaluated by degradation of methylene blue (MB) under visible light irradiation. The photo-catalytic results indicated that ZnFe₂O₄ enhanced photocatalytic activity with increasing of calcination temperature. In addition, the ZnFe₂O₄ prepared via adding 16.4 mM of SDS showed the highest photocatalytic activity. The synthesized ZnFe₂O₄ photocatalysts have great potential applications for cleaning polluted water using magnetic separation.

Keywords Photocatalytic; Zinc ferrites ; Nanoparticles

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The Microstructure of Magnetic Fe₃O₄ Nanoparticles Prepared via Solvothermal Process

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Fe₃O₄ nanoparticles were successfully synthesized via solvothermal method using FeCl₃·6H₂O, ethylene glycol solution as solvent, and sodium acetate as precipitating reagent. In this work, we have studied the types of solvent and reducing agents on the microstructure of products. The synthesized nanoparticles were investigated by several techniques such as X-ray powder diffraction (XRD), scanning electron microscopy (SEM), Fourier-transformed infrared spectroscopy (FT-IR). XRD results showed the inverse cubic spinel phase of Fe₃O₄ when using ethylene glycol as solvent. For the used of ethanol and water as solvent, the rhombohedral phase of α-Fe₂O₃ were found. Results of experiment show that solvents and reduction agents have a crucial role on the microstructure of synthesized magnetic nanoparticles.

Keywords Fe₃O₄; solvothermal method; magnetic nanoparticles

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In-Situ Synthesis of Zeolite A, Zeolite P and Zeolite Y/Carbon Composite with Carbonaceous Rice Husk Ash

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This research aimed to study synthesis of zeolite A, zeolite P and zeolite Y using aluminosilicate gel and carbonaceous rice husk ash (CRHA) as the starting material. When characterized by X-ray fluorescence (XRF) technical found that it have a lot of impurities such as Fe₂O₃, TiO₂, MgO, CaO, K₂O and SO₃. Impurities removal by acid-washing pretreatment at 3M of HCl. The synthetic time was about 1 hr at 80 °C. The result found that the sample was the highest pretreatment performance and caused high silicon dioxide (SiO₂) up to 96%. The zeolite-synthesized samples were characterized by X-ray diffraction (XRD), found that successful synthesis zeolite from carbonaceous rice husk ash (CRHA). The morphologies and crystal structures of the products were confirmed by scanning electron microscope (SEM).

Keywords Zeolite; CRHA; Aluminosilicate gel

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Synthesis and Characterisation of Nanomaterials: Mesoporous Silicas MCM-41, MCM-48 and Mg-Al Layered Double Hydroxides

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The aim of this work is to synthesise nanomaterials: mesoporous silicas MCM-41, MCM-48 and Mg-Al layered double hydroxides (Mg-Al LDHs) for being used as toxic metal adsorbent in environment. The synthesis of MCM-41 and MCM-48 were carried out by using tetraethylorthosilicate (TEOS) as a silica source and cetyltrimethyl ammonium bromide (CTAB) as a structural directing agent in the basic condition. In the case of Mg-Al LDHs, two synthesis routes which are urea hydrolysis and co-precipitation method were conducted. Fourier transform infrared spectroscopy (FTIR) results showed the characteristic functional group of silica in MCM-41 and MCM-48. To confirm that the resulting MCM-41 and MCM-48 are mesoporous materials, gas physisorption experiment was performed. Type IV adsorption isotherms, the characteristic of mesoporous structure, and the pore diameter of 2.4 nm for both MCM-41 and MCM-48 were observed. Mg-Al LDHs have been characterised by X-ray diffraction (XRD). The XRD patterns of synthesised Mg-Al LDHs match well with results of Mg-Al LDH from the reference method.

Keywords Mesoporous silica; MCM-41; MCM-48; Mg-Al LDHs

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Drug Release Studies on Highly-Porous Silica-Modified Microcrystalline Cellulose Beads

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The highly-porous silica-modified microcrystalline cellulose was used as a host material for drug release studies. Theophylline used for asthma medication was incorporated into this hybrid material. The silica-modified microcrystalline cellulose containing theophylline was prepared by mixing 250 mg microcrystalline cellulose (MCC), 10 mL of 3 % (m/V) sodium alginate solution, silica sol and theophylline dissolved in ethanol. The mixture was then dropped into 0.2 M CaCl₂ to obtain round-shape beads containing drug. The beads were filtered and freeze-dried for several hours to obtain highly porous silica-modified MCC beads. They were further analyzed by SEM, thermogravimetric analysis and BET method. Drug release was performed at pH 1.2 and 6.8 using dried beads. The amount of released theophylline was monitored by spectrophotometry at the wavelength of 271 nm. The amount of released drug was reached the equilibrium in a few minutes. The complete drug release was observed at pH 6.8.

Keywords Drug release; Silica-modified microcrystalline cellulose beads; Highly porous hybrid material

Reaction of Ethanol Over Acid-activated Montmorillonite Clay Catalyst

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Acid-activated montmorillonite clay is widely studied as catalyst for many reactions such as isomerization, alkylation, acrylation and dehydration. Treatment of montmorillonite with various acids was studied to increase acidity and Brønsted acidic site of catalyst. First, the montmorillonite clay was treated in three different acids (HCl, H₂SO₄, HNO₃) on solution (4 mol/l, 30 ml) at 125 °C for 20 hr. All samples were washed with distilled water after treatment and dried at 110 °C overnight. In addition, this study also investigated the effect of calcination temperature on the catalyst. Some of acid-activated montmorillonite after drying were calcined at 450 °C for 5 hr. The materials were characterized using X-ray diffraction (XRD), FT-IR spectroscopy, N₂ physisorption, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and NH₃-temperature programmed desorption (NH₃-TPD). In order to investigate the catalytic performance of acid-activated montmorillonite, all catalyst samples were tested in ethanol dehydration. XRD data showed that the montmorillonite structure was changed and damaged from treatment with sulfuric acid. After calcination montmorillonite clay found that calcination effect on BET surface area of catalyst. It reduced surface area of catalyst. For the catalytic activity, montmorillonite clay gave 81% of ethanol conversion and 86% of ethylene selectivity at 400°C. It was found that conversion of ethanol was 12-81% and selectivity of ethylene was 4-86% when temperature of reaction increased from 200 to 400°C.

Keywords Montmorillonite; Clay; Acid-activated; Catalyst; Dehydration

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Influence of Surface Modification of Thai Kaolins on Their Mn EPR Spectra

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Various interpretations have been presented in the scientific literature for the oxidation state and location of manganese that is often seen in the EPR spectra of kaolin samples. These include both Mn(II) and Mn(IV) in either octahedral or tetrahedral sites in the kaolin mineral structure, and the presence of Mn(II) as exchanged ions or in associated impurity minerals. In the present paper we describe the influence of physical and/or chemical modification of two Thai kaolins on the resulting EPR spectra, and use these results to probe the sites occupied by Mn in the original mineral specimens. The spectra were insensitive to acid extraction and prolonged grinding either separately or in combination, but line narrowing was observed when samples were incubated in solutions with pH values above the point of zero charge (PZC). These results are in contrast to the behaviour of the Fe(III) component in octahedral sites, where prolonged grinding results in major changes in the EPR spectra. Therefore, the Mn results are interpreted in terms of protonation/deprotonation of oxygen atoms on the surface of the tetrahedral sheet, and provide strong evidence for Mn substituting for Si as Mn(IV) in tetrahedral sites in the kaolin mineral structure.

Keywords EPR; Kaolin; Mn; Fe; pH

Effect of Fumed Silica on Efflorescence Reduction of Clay Products

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Efflorescence is a salt deposition phenomenon on the surface of porous ceramic materials. It changes the color impression and appreciation of surface. The origin of efflorescence is partly associated with intrinsic porosity and soluble salts in the ceramic body. The soluble salts can move from one region to another through the pores. Sulfate soluble salts such as calcium sulfate, magnesium sulfate, sodium sulfate and potassium sulfate are the main cause of efflorescence problem. To control the efflorescence, this research investigated the addition of fumed silica to reduce porosity in clay products. The soluble sulfate in raw material and fired product were extracted by distilled water, and then the sulfate concentration was determined by using a UV-visible spectroscopy at the wavelength of 420 nm following the ASTM C1580-09 standard. The sulfate-rich raw material from Tambon Suan Phung, Ratchaburi was selected for this study. Fumed silica was added into the raw materials at 1.0, 1.5 and 2.0 wt.%, and then homogeneously mixed with distilled water to prepare clay slip. The clay products were mold casted to 1 x 1 x 3 inch³ in size. Then, they were fired at 800 °C. The results showed that the addition of fumed silica reduced the efflorescence and the concentration of soluble sulfate. In addition, the microstructural analysis revealed the decrease of porosity which was attributed to the reduced porosity and water absorption by the addition of the fumed silica.

Keywords Efflorescence; Clay products; Fumed silica

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Effect of Alkali-Activated Metakaolin Cement on Compressive Strength of Mortars

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This study aimed to investigate the effect of alkali-activated metakaolin cement on compressive strength of mortars. Metakaolin was used to replace part of Portland cement at 70% by weight. The ratio of liquid alkaline to binder was 0.8 by weight and sodium silicate to sodium hydroxide ratio of 0.50, 0.67 and 1.0 by weight were adopted. Concentration of sodium hydroxide was 10 M and 40 mL of water base was used. Compressive strength of alkali-activated metakaolin cement was tested. Microstructure and phase characterizations were investigated using scanning electron microscope (SEM) and X-ray diffraction analysis (XRD). The specimens for compressive strength test were cured in saturated lime water and stored at a control temperature of $23\pm 2^\circ\text{C}$ until test age of 3, 7 and 28 days. The results show that the workability decreases with increases sodium silicate to sodium hydroxide ratio. Moreover, the sodium silicate to sodium hydroxide ratio has an influence on the compressive strength of alkali-activated metakaolin cement.

Keywords Metakaolin; Alkali-activate; Compressive strength

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Effect of Alkali-Activated Fly Ash Cement on Setting Time of Cement Paste

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Fly ash contents in fly ash-cement system affect the hardening process as a result inappropriate fresh properties through retard setting time. Which differ from alkali solutions that influenced setting mechanism by accelerated interaction between fly ash and cement coagulation. So this research aim to study the effect of alkali-activated fly ash cement on setting time of cement paste. Portland cement (PC) (was used to replace high calcium fly ash (FA) (at 0%, 10%, 30% and 50% by weight of binders. Alkali solutions (Na₂SiO₃ and NaOH) (were used as activator at alkali liquid/binder of 0.40 and Na₂SiO₃/ NaOH ratio was 0.67. The results indicated that the setting times was increase with increasing Portland cement contents in all mixes. In addition to fresh properties of cement pastes, characterization were carried out on the microstructure using scanning electron microscope (SEM) and X-ray diffraction (XRD).

Keywords Fly ash; Alkali activated; Cement; Setting time

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Effect of Staining Beverages on the Color Stability of Dental Fillers

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Commercial glass ionomer cement (GIC), resin modified glass ionomer cement (RMGIC) and a laboratory-made GIC (MTEC-GIC) were used in this study to evaluate color stability after immersion in three different staining solutions; deionized water (as a control), soft drink and coffee for 30 days. Fifteen disk-shaped specimens (16 mm diameter x 1 mm thickness), using acrylic mold sheet were fabricated for each type of dental fillings. Specimens from each group were randomly distributed into three subgroups for each staining solution. Color difference (ΔE^*) was measured on day 1, 3, 7, 14, 21, 28 and 30 after immersion by spectrophotometer. Color changes were statistically compared using one way ANOVA and multiple comparisons. The results showed statistical significance ($p < 0.05$) among the groups of the specimens soaked in different staining solutions. Coffee showed the strongest staining effect of color change among three staining solutions. For type of materials, the most color change was observed in (MTEC-GIC) particularly in coffee solution ($\Delta E^* = 43.71 \pm 4.3$). The minimum color change in coffee and soft drink were observed in GIC ($\Delta E^* = 8.51 \pm 1.3$) and RMGIC ($\Delta E^* = 4.97 \pm 1.9$), respectively.

Keywords Glass ionomer cement; Resin modified glass ionomer cement; Color stability

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Nano-Calcium Carbonate Synthesis from Supercritical Carbon Dioxide via Rapid Expansion of Supercritical Solution Technique

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The aim of this research is to investigate the preparation of nanocalcium carbonate from cockle shell. This study was focused on synthesizing nanoparticles via supercritical carbon dioxide by rapid expansion of supercritical solutions (RESS) technique. The experimental conditions for producing of nanocalcium carbonate were carried out at CO₂ pressure of 100 bar and temperature up to 50°C in a high pressure reactor. The synthesized nanoparticles were characterized by attenuated total reflectance fourier transform infrared spectroscopy (ATR-FTIR), particles size distribution and scanning electron microscopy (SEM). (The ATR-FTIR results showed the aragonite and calcite polymorph with the prominent peak at 1083, 871 and 712 cm⁻¹ and carbonate absorption peak was observed at 1390 cm⁻¹. Similarly, the result of ATR-FTIR was corresponded with the nanoparticles morphologies from SEM. Here, the average particle size distribution was in the range of 126 nanometers. Therefore, The RESS technique can be used to rapidly precipitate nanocalcium carbonate by supercritical carbon dioxide because it was non toxic and environmentally friendly process.

Keywords Organic material; Nano calcium carbonate; Supercritical carbon dioxide

Development of Binder for Restoration of ThaiMural Painting

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In the past, tamarind kernel glue was generally use as a binder for Thaimural painting because it is easy to find and also provides good adhesion to the wall. However, the problem encountered in such glue is the difficulties in preparation and in preservation. At present, Thaimural painting conservators have applied gum acacia as a binder instead because of its convenience to prepare. However, no study on comparison of the quality between tamarind kernel glue and gum acacia has been reported. In this study, both tamarind kernel and gum acacia were characterized in terms of morphology, viscosity and adhesion by using scanning electron microscopy (SEM), viscometer and scratch adhesion test, respectively. In addition, the denaturation of glue on odor, pH and viscosity was tested at room temperature.

Keywords Gum Acacia; Tamarind kernel; Xyloglucan

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Preparation and Characterization of Electrospun Polyacrylonitrile Fiber Mats as an Ultrathin-Layer Chromatography Stationary Phase for Food Dye Analysis

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Ultrathin-layer chromatography (UTLC) was developed from *thin*-layer chromatography (TLC) and high performance *thin*-layer chromatography (HPTLC) plates to improve sensitivity and reduce analysis time and sample amount. In this study, UTLC was developed by using electrospun fibers mats as a stationary phase for food dye analysis. The electrospinning process can prepare faster and inexpensive UTLC plate. It is used to produce ultrafine fibers with diameters in nanometer or micrometer range. Polyacrylonitrile (PAN) is a material used for fabricating UTLC plate. The electrospun PAN fiber mats was prepared by dissolving 12 %w/v PAN in dimethylformamide (DMF). The PAN solution was then electrospun at a fixed high voltage power supply of 16 kV to obtain the electrospun PAN fiber mats. These fiber mats were characterized for their morphological appearance by Scanning Electron Microscopy (SEM). The fiber diameters were measured directly from SEM images using SemAphore 5.21 software. Lastly, the electrospun PAN fiber mats were used for characterizing food dye separation efficiency.

Keywords Electrospinning; Thin-layer chromatography; Polyacrylonitrile; Food dye

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Freestanding Functionalized Electrospun Carbon Nanofibrous Mats Based Humidity Sensors

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A mat of carbon nanofibers, in this work, was prepared via heat-treatment process of polyacrylonitrile (PAN) nanofibrous fabrics electrospun from a homogeneous PAN/*N,N*'-dimethylformamide (DMF) solution. During electrospinning under ambient conditions, a high voltage was applied at 19 kV. As well, a nozzle-to-collector distance and concentration of PAN solution were fixed at 10 cm and 9 wt%, respectively. During heat-treatment process of electrospun PAN nanofibrous fabrics, a stabilization temperature was controlled at 260°C for 2 h before a carbonization of the stabilized mats at a temperature of 700°C for 1 h. Afterward, a functionalization of CNF mats was performed by refluxing them in concentrated nitric acid at a temperature of 120°C for 1 h. Morphologies of both as-prepared and functionalized CNF mats were all observed by scanning electron microscopy (SEM). Data from energy-dispersive X-ray spectroscopy (EDX) and Fourier transform infrared spectroscopy (FTIR) of all fabrics were discussed. For electrical-resistance measurements, a sensing performance of the fabric sensors was investigated. Sensing properties of the sensors including sensitivity, responsibility, and reproducibility were all estimated. The percent sensitivity of the functionalized CNF mat is more than three times higher than that of unfunctionalized one. As well, it provided a rapid response time to changes in humidity. A result from dynamic test of humidity adsorption-desorption cycles could also confirm the good reproducibility of the fabric sensors. The resulting sensor fabrics herein possess a promising freestanding structure and semiconducting nature without using any sophisticated interdigitated electrode. They are also lightweight and consume low power, which are attractive for portable devices and other sensor applications.

Keywords Carbon nanofibers; Electrospinning; Functionalization; Humidity sensor

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Aligned Electrospun Poly(vinyl alcohol) Nanofibers for Ultrathin Layer Chromatography

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Aligned electrospun poly(vinyl alcohol) nanofibers (AE-PVA) were used as a stationary phase for ultrathin layer chromatography (UTLC). Because PVA is soluble in water, this is a limitation for using as stationary phase. To enhance stability in water, PVA was crosslinked with glutaraldehyde. Therefore, AE-PVA-UTLC plate was prepared by in situ crosslinking electrospinning technique and collected on a high speed rotating drum. Rotational speed and collector distance were optimized. From SEM images, the alignment of nanofibers was affected by rotational speed of collector. Increasing rotational speed caused more alignment and reduced the diameter of nanofibers. However, exceeding speed may break fiber jet and continuous fiber cannot be collected. For applying AE-PVA in UTLC, mobile phase velocity of AE-PVA-UTLC plate was studied. The aligned nanofibers increased mechanical properties and improved efficiency of a stationary phase. Since PVA consists of hydroxyl groups, it becomes polar stationary phase and AE-PVA-UTLC plate can be used to separate amino acids. In addition, AE-PVA-UTLC plate provided shorter analysis time compared to commercial silica-gel plate.

Keywords Ultrathin layer chromatography; Poly(vinyl alcohol); Aligned electrospun nanofibers

Stability and Solubility of Theophylline Cocrystallized with Salicylic Acid and Picolinic Acid

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Theophylline drug is an oral bronchodilator medicine, known that poor water solubility, slow release tablets, and to transform to a hydrate form with a function of relative humidity (RH) then leading to low bioavailability. This work was carried out the improving in physicochemical properties of theophylline API such as melting point, solubility and humidity by cocrystallization method. The 1:1 cocrystals of theophylline (TP) with salicylic acid (SA) and picolinic acid (PI) were prepared by solid and solution crystallization methods with controlling pH value at 2, 4 and 7, and were characterized by XRD, FT-IR and DSC techniques. Pharmaceutically relevant properties *e.g.* tablet content uniformity test, powder solubility-dissolution and stability, and hygroscopicity of the TP-SA and TP-PI cocrystals were evaluated. Cocrystals offer great promise in enhancing theophylline drug aqueous solubilities as compares to the pure theophylline drug. All TP-SA and the TP-PI at pH2 cocrystals were found to be stable in aqueous solution that do not transform to the theophylline monohydrate, while the TP-PI cocrystal at pH4 and 7 were obtained as a minimal transformation to the other forms. In addition, the stability and hygroscopicity of the 1:1 TP-SA and TP-PI cocrystals were considerably higher than those of anhydrous theophylline (Active Pharmaceutical Ingredients or API) in the examine conditions at 27±2 °C with 48-55% RH for 60 days.

Keywords Theophylline; Theophylline cocrystal; Solubility; Stability; Relative humidity

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Screening and Physical Characterization of Antibiotic Nitrofurantoin Cocrystals

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Nitrofurantoin (NF) is an antibacterial drug for the oral treatment of genitourinary tract infections. This drug belongs to Class II of Biopharmaceutics Classification System, which exhibits low water solubility and low cell permeability. NF exists in two anhydrous polymorphs (α and β -forms), two monohydrate polymorphs (form I and form II), and two pseudopolymorphs NF with dimethylformamide (form III) and dimethyl sulfoxide (Form IV). This drug is stable in a β anhydrous form and slowly releases after initial dissolution, which converts to the more stable monohydrate form II. Thus, the physicochemical properties of NF are the critical factors for controlling the bioavailability of the NF drug. These properties of NF such as solubility, dissolution, hydration, stability, and bioavailability can be improved by co-crystallizing with co-formers. Herein, we reported the 1:1 co-crystals of NF with salicylic acid, picolinic acid, and phthalic acid. Co-crystals were screened by neat grinding, solvent-drop grinding, and crystal growth via slow evaporation at room temperature. The crystals were grown in the methanol-water and acetonitrile mixture with controlled pH at 2.0 and 7.0. Thermostability and hygroscopicity were examined. The new forms are characterized by XRD, FT-IR, and DSC techniques. FT-IR results show that the screening products are almost identical to the products from slow evaporation. NF co-crystals were found to be stable and did not transform to the NF monohydrate form II after dissolved in water.

Keywords Antibiotic Nitrofurantoin; Nitrofurantoin cocrystal; Salicylic acid; Picolinic acid; Phthalic acid;

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Cocrystallization of Theophylline with 4-Aminobenzoic Acid and Gallic Acid

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Medical and pharmaceutical scientists are interested in improving the stability of solid Active Pharmaceutical Ingredients (API) in thermodynamic phases, high solubility, bioavailability, and other physicochemical properties. Pharmaceutical co-crystal is well-known to improve the physicochemical properties of APIs by co-crystallized with other or supplementary materials *via* non-covalent interactions. In this work, we present the theophylline (TP) co-crystallized with 4-aminobenzoic acid (PABA) and gallic acid (GA) in a 1:2 molar ratio. Which is prevented the transformation of an anhydrous into a monohydrate form as a function of relative humidity and is to investigate the stability of the co-crystals. The solid co-crystal formation of 1:2 TP-PABA and TP-GA by neat co-grinding or thermal treatment was investigated. The solution co-crystals were prepared by solvent evaporation method. Products were characterized by XRD, FT-IR, and DSC techniques. FT-IR results show the weak broad bands of $\nu(\text{O-H})$ in the range 3300-3400 cm^{-1} of the hydrogen bonding between two components. XRD demonstrates that new compounds of the 1:2 TP-PABA and TP-GA were formed, and the co-crystal formations depend on pH. Different storage conditions affecting the stability of the co-crystals and pure TP were also determined. Co-crystals were found to be stable and do not transform to the theophylline monohydrate in both aqueous solution and at ambient environment.

Keywords Theophylline cocrystal; 4-Aminobenzoic acid; Gallic acid; Stability; Relative humidity

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Cytotoxicity Evaluation of Curcumin Encapsulated Polymeric Nanocapsules for Cervical Cancer Diagnostic Imaging System

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Cervical cancer, the most common malignancy in women worldwide, remains a leading cause of cancer-related death for women in developing countries. Development of effective methods for cervical cancer diagnosis remains an important strategy of disease prevention and control. This study aimed to characterize and evaluate cytotoxicity of the prepared curcumin, near-infrared fluorophore, encapsulated polycaprolactone (PCL) nanocapsules which will be further applied for cervical cancer diagnostic imaging system. Particle size and zeta potential of the fluorescent PCL nanocapsules were determined by zeta sizer. Using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay it was found that the curcumin encapsulated PCL nanocapsules presented no cytotoxic potential to cervical cancer cell line (HeLa cell) and fibroblast cell line (L929 cell) comparing to curcumin itself. After that, surface of the curcumin encapsulated PCL nanocapsules was functionalized with antibody specific to antigen on cervical cancer cell (anti-EpCAM) for improving specificity of particle and cell attachment.

Keyword Polymeric nanocapsules; Polycaprolactone; Cervical cancer; Anti-EpCAM, Curcumin

An Aptamer-Gelatin Hybrid Material for Protein Delivery Systems

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Recently, gelatin has been used as a matrix of drug delivery systems because it provides biocompatibility and biodegradability. However, the rate of drug release from gelatin-based delivery system is still lack of on-demand release kinetics. To overcome this problem, nucleic acid aptamer as molecular recognition has been incorporated in to gelatin to facilitate the desired release kinetics. Herein we aim to develop a delivery system with desirable protein release profiles. Platelet-derived growth factor-BB (PDGF-BB) and its aptamer were used as model molecules. The aptamer-protein interaction was investigated by surface plasmon resonance (SPR). The SPR results showed that complementary oligonucleotides (CO) could interrupt the binding interaction between the aptamer and PDGF-BB. The aptamer was then incorporated into the gelatin using a composite method. The aptamer-gelatin composite preparation was characterized by flow cytometry and microscopy. The study of PDGF-BB release from the composite was carried out at several time points. The amount of the protein released was quantified by ELISA. The results revealed that the PDGF-BB release rate could be slowed down due to strong binding of proteins and aptamers. In addition, the release rate increased significantly when CO was added into the system, since the aptamer formed the hybridization with the CO and lost its binding function. This work suggests a promising strategy for controlling the release of bioactive molecules in medical treatments.

Keywords Gelatin; Aptamers; Composites; Hybridization

Poly(lactic-co-glycolic) Acid Nanoparticles Embedded in Hyaluronic Acid-Ceramide Nanostructure for Tumor-Targeted Drug Delivery

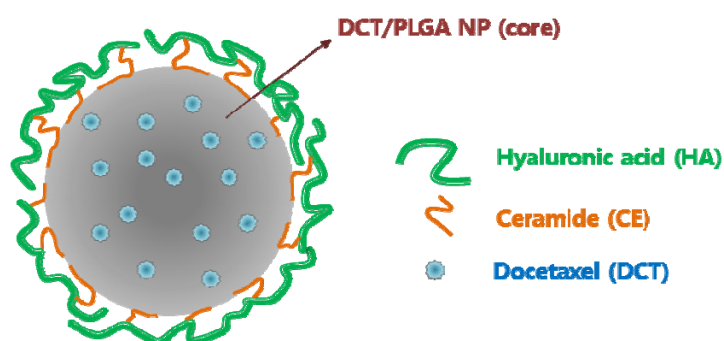
Poly(lactic-co-glycolic) Acid Nanoparticles Embedded in Hyaluronic Acid-Ceramide Nanostructure for Tumor-Targeted Drug Delivery

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The objective of this study was to prepare and evaluate a hyaluronic acid-ceramide (HACE) nanostructure embedded with poly(D,L-lactide-co-glycolide) (PLGA) nanoparticles (NPs) for tumor-targeted delivery of docetaxel. NPs with a narrow size distribution and negative zeta potential were successfully prepared by embedding DCT-loaded PLGA NPs into a HACE nanostructure (DCT/PLGA/HACE). DCT-loaded PLGA and DCT/PLGA/HACE NPs were characterized by solid-state techniques, including Fourier-transform infrared (FT-IR) spectroscopy, differential scanning calorimetry (DSC), and powder X-ray diffraction (PXRD). A sustained drug release pattern from the NPs developed was observed and negligible cytotoxicity was seen in NIH3T3 cells (normal fibroblast, CD44 receptor negative) and MDA-MB-231 cells (breast cancer cells overexpressing the CD44 receptor). PLGA/HACE NPs containing coumarin 6, used as a fluorescent dye, exhibited improved cellular uptake efficiency, based on the HA-CD44 receptor interaction, compared to plain PLGA NPs. Cyanine 5.5 (Cy5.5)-labeled PLGA/HACE NPs were injected intravenously into a MDA-MB-231 tumor xenograft mouse model and demonstrated enhanced tumor targetability, compared with Cy5.5-PLGA NPs, according to a near-infrared fluorescence (NIRF) imaging study. These results support that the DCT/PLGA/HACE NPs developed could be useful as a candidate for tumor-targeted anticancer drug delivery system.



Keywords Tumor targeting; Nanoparticles; Hyaluronic acid-ceramide

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The Synthesis and Photocatalytic Activity of Fe³⁺ Doped TiO₂ Nanoparticles

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The Fe³⁺ (0, 1, 3 and 5 mol%) doped TiO₂ powders was synthesized by titanium (IV) isopropoxide, iron (III) nitrate nonahydrate, nitric acid and ethanol using sol-gel method. Follow by annealing at 500 °C for 2 h in ambient with a heating rate of 10 °C/min. The physical and chemical properties of synthesized powders were examined using XRD, SEM, TEM, BET, and photocatalytic performance was evaluated using means of degradation of methylene blue (MB) solution under UV irradiation. The synthesized powder was anatase in phase with 10 to 100 μm of grain size according to the SEM and TEM images. The results from photocatalytic tests suggested that the performance TiO₂ powders doped Fe³⁺ was greater than pure TiO₂. Furthermore, the 5 mol% Fe³⁺ doping exhibited the highest photocatalytic activity on MB (59%) under UV irradiation for 6 h.

Keywords Fe³⁺ doped TiO₂; Photocatalytic activity; Sol-gel method

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Efficient Photocatalytic Degradation of Methylene Blue over Novel Magnetically Separable CoFe₂O₄/BiVO₄ Nanocomposites

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The novel magnetically separable CoFe₂O₄/BiVO₄ nanocomposite was synthesized by facile hydrothermal method. The samples were physically characterized by X-ray diffraction, scanning electron microscopy, transmission electron microscopy, Brunauer, Emmett and Teller (BET)-specific surface area, UV-vis diffuse reflectance spectrophotometry, vibration sampling magnetometer, and photoluminescences. The CoFe₂O₄/BiVO₄ nanocomposites exhibited good photocatalytic activity in degradation of methylene blue under visible light irradiation. A photocatalytic degradation test showed that the highest efficiency degradation of methylene blue was obtained using 0.2CoFe₂O₄/0.8BiVO₄ composite with photocatalytic efficiency of 49%. Based on the obtained results, the as-prepare CoFe₂O₄/BiVO₄ nanocomposite possessed great adsorptivity of methylene blue, extended light adsorption range, and efficient charge separation properties. Overall, this work could provide new insights into the fabrication of a CoFe₂O₄/BiVO₄ composite as high performance photocatalyst and promise as magnetic photocatalyst for dye wastewater treatment.

Keywords CoFe₂O₄; BiVO₄; Magnetic; Nanocomposites; Photocatalytic activity

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Recent Progress in Synthesis of Carbon-Doped Titanate Nanoribbons via One-Step Solvothermal Method for Enhancing Visible Light Photocatalytic Activity

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For a treatment of organic dye wastewater, a carbon-doped titanate nanoribbon (C-TNR) photocatalyst was prepared by a facile one-step solvothermal method at a temperature of 200°C for 12 h, using titanium tetraisopropoxide (TTIP), D-glucose and sodium hydroxide (NaOH) as starting materials. Isopropyl alcohol was utilized as a solvent. The prepared photocatalyst was characterized by x-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), Brunauer-Emmett-Teller (BET), and UV-Vis absorption spectroscopy techniques. A photocatalytic activity of the resulting photocatalyst was evaluated by a degradation of methylene blue (MB) in aqueous solutions under visible light irradiation. The results indicate that the kinetics of the photocatalytic degradation of MB are consistent with pseudo-first-order kinetics and the C-TNR shows the highest photocatalytic activity. The degradation rates of MB are 0.033, 0.013, and 0.005 min⁻¹ for C-TNR, undoped titanate nanoribbons (TNR), and commercial titanium dioxide (P25), respectively.

Keywords Carbon-doped titanate nanoribbons; Titanium dioxide; Photocatalyst; Solvothermal

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Characteristics and Catalytic Properties of Pt/N-doped TiO₂ in the Liquid-Phase Selective Hydrogenation of 3-nitrostyrene

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The chemoselective hydrogenation of 3-nitrostyrene (NS) is an important chemical transformation to produce 3-vinylaniline (VA) which is an important intermediate for pharmaceuticals, pigments, herbicides, and other fine chemicals. 3-ethylnitrobenzene (ENB) can also be obtained simultaneously with VA during the reaction and then both products are further hydrogenated to ethylaniline (EA). The desired product is a VA and byproduct is an EA. Selective hydrogenation has typically been performed using a stoichiometric amount of reducing agents which produces a large amount of byproducts. Thus, the development of a heterogeneous catalytic system for the chemoselective hydrogenation of nitroaromatic compounds is desirable and important for industry. Platinum is a highly active traditional metal in the hydrogenation of NS. In the present work, titanium oxide (TiO₂) was prepared by the solvothermal method at 300 °C and used as a support for preparation of supported Pt catalysts. The surface of TiO₂ supports was modified with various concentrations of N-methylpyrrolidone (NMP) solution as the nitrogen source of the N-doped TiO₂. The catalytic performances of Pt/N-doped TiO₂ were evaluated in the NS hydrogenation at H₂ pressure 2 MPa and 40 °C. The catalysts were characterized by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), Temperature program reduction (TPR) and CO chemisorption. The use of N-doped TiO₂ provided larger surface area, smaller Pt particles, higher amount of Pt active sites, higher Pt dispersion, and stronger metal-support interaction so that high conversion of NS with high selectivity of VA can be obtained over the Pt/N-doped TiO₂ catalysts.

Keywords Pt/TiO₂; Liquid-phase selective hydrogenation; 3-Nitrostyrene and N-doped

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Influence of Nickel-doping on the Photocatalytic Activity of ZnO Thin Films under UV Light Illumination

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In this study, pure and nickel-doped zinc oxide thin films with photocatalytic activity were synthesized via dip-coating technique. The effect of nickel-doping on microstructure, surface, transparency and photoluminescence (PL) intensity of zinc oxide thin films was also investigated. X-ray diffraction results showed that wurtzite structure of the films was retained with the reduction of both crystallite size and crystallinity after nickel incorporation. The AFM images indicated that grain size of the films decreased by nickel doping while surface roughness increased. The doped film presented a slight decrease in the transparency and a lower PL intensity than the undoped zinc oxide film. We found that introducing nickel into ZnO film not only affected the physical and photoluminescence properties of the zinc oxide film but also caused the decline of its photocatalytic performance leading to lower degradation rate of the malachite green dye over the film under UV-light illumination.

Keywords ZnO; Nickel-doping; Thin film; Dip-coating; Photocatalysis

Photocatalytic Degradation of Metolachlor by Mesoporous Titanium Dioxide under Simulated Solar Light

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Metolachlor [2-chloro-*N*-(2-ethyl-6-methyl-phenyl)-*N*-(2-methoxy-1-methylethyl) acetamide], is a chloro-acetanilides herbicide used to control weeds in a variety of food around the world. However, contamination of surface water with residues of this herbicide has been reported in many countries. In this study, mesoporous TiO₂ (M-TiO₂) was prepared by using titanium (IV) butoxide as precursor and Pluronic P123 as template. The calcination temperature was at 600 °C. The resulting catalyst was characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM). The experimental results showed that the M-TiO₂ has anatase phase 73.98% and an average size of 37.6 nm. The photodegradation of metolachlor was monitored by 20 µL injection of aliquots of photodegradation products at various interval times on a Synergi Max-RP C12 column (4.6 × 250 mm, 4µm, Phenomenex) at detection wavelength of 205 nm under isocratic conditions of 20% water and 80% acetonitrile with a flow rate of 0.8 mLmin⁻¹ for 10 min. The half life of metolachlor was found to be 29 min in the presence of 5 mg/L of metolachlor. By using ionchromatography, chloride and nitrate were separated on Ion[®]Pac AS11-HC (2x250 nm) column and a conductivity suppression detector and were found after irradiation of 15 min. This work demonstrated that the M-TiO₂ is a potential catalyst for metolachlor degradation under simulated solar light due to its high surface area and photoreactivity.

Keywords Metolachlor; Mesoporous titanium dioxide; Simulated solar light

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Microstructure and Photocatalytic Performance of Magnetically Separable CoFe₂O₄ Photocatalysts

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The magnetic cobalt ferrite (CoFe₂O₄) nanoparticles were synthesized via a simple hydrothermal method using FeCl₃•6H₂O and CoCl₂•6H₂O as precursors and glycerol as a stabilizing agent. The effect of pH on the microstructure was investigated. The prepared samples were characterized by X-ray powder diffraction (XRD), diffuse reflectance UV-vis spectroscopy (DRS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), and measurement of the surface area using N₂ adsorption-desorption. A vibrating sample magnetometer (VSM) is used for measuring the magnetization of samples. From our results reveal that the prepared CoFe₂O₄ samples at various pH of reaction have different microstructure. The CoFe₂O₄ samples prepared at pH 4.0 and 6.0 existed in the rhombohedral phase of α-Fe₂O₃ structure while samples prepared at pH 8.0, 10.0 and 12.0 existed in the CoFe₂O₄ cubic spinel structure. The photocatalytic degradation of indigo carmine dye (IC) was evaluated under visible irradiation. The CoFe₂O₄ synthesized at pH 10.0 gave the highest photocatalytic efficiency due to the good optical absorptions in UV-Vis region with a lower band gap energy and a larger surface area giving rise to a higher photocatalytic performance.

Keywords Cobalt ferrite; photocatalyst; degradation of dye

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Synthesis of Nanocomposite CuO/GO for Degradation of Rhodamine B

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The synthesis of nanocomposite CuO/GO and utilization in dye degradation from aqueous media were reported in this paper. Nanocrystalline CuO was decorated on graphene oxide (GO) sheet via one-step immersing Cu²⁺ precursor in basic solution of dispersed GO at high temperature. The effects of the thermal aging, basic media, and the initialize with microwave radiation on the nanocomposite synthesis were investigated. The powder X-ray diffraction, Fourier-transform infrared spectroscopic (FTIR) and scanning electron microscopic techniques indicated that monoclinic CuO was successfully decorated on the GO sheet. The microwave-assisted synthesis resulted in an increase of nano-CuO seeds covering on the GO sheet. The photocatalytic efficiency of as-synthesized CuO/GO was twice higher than that of nano-CuO for degradation of Rhodamine B under the artificial daylight.

Keywords CuO/Graphene; Oxide/Photodegradation

Synthesis and Growth of ZnONanorod on Nylon 6 and Its Photocatalytic Activity

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ZnOnanorod was successfully synthesized from wet chemical synthetic route. Reaction of ZnNO₃ and triethanolamine was conducted and its thermal property was investigated by thermogravimetric analysis (TGA). After that, it was calcined at 700°C for 2 hours. The ZnO powder was investigated by X-ray diffraction (XRD). ZnO powder was suspended in water and it spin-coated on Nylon 6. Morphology was evaluated by scanning electron microscopy. Preliminary experiment on photocatalytic property was determined.

Keywords ZnO nanorod, Nylon 6, Photocatalytic property

Fabrication, Characterization and Photocatalytic Efficiencies of AC/TiO₂/Rubber Composite Sheets

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In this present, AC/TiO₂/Rubber (ACTR) composite sheets were fabricated by simply mixing of fixed TiO₂ suspension and natural rubber latex (60% HA) with the varying amounts of activated carbon (AC) dispersion (0 %wt (AC/TiO₂), 3.3 %wt, 6.6 %wt, 9.9 %wt, 16.5 %wt, and 33%wt), followed by stirring, pouring into a petri dish mold, then drying at room temperature (RT), after that taking out from a mold, reversing, and drying again at RT. The as-fabricated ACTR composite sheets were characterized by SEM, EDS, FT-IR, and XRD techniques. The photocatalytic efficiencies of the ACTR composite sheets were evaluated by degrading of methylene blue (MB) dye solution under UV light irradiation. The results showed that the photocatalytic activity of 9.9 %wt ACTR sheet sample has the highest efficiency for the photodegradation of MB dye than the other sheets. The reason of this is due to the fact that it is relatively with the synergistic effect of well-combined titanium dioxide catalyst and activated carbon particles on the sheet surface, enhancing the photodegradation of this dye.

Keywords TiO₂/Rubber composites; Activated carbon-TiO₂ photocatalyst; Synergistic effect

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Electrical and Mechanical Properties of Polypropylene/ Poly(methyl methacrylate) Blends Filled with Conductive Carbon Black

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In this study, the composites of polypropylene (PP)/poly(methyl methacrylate) (PMMA) blends filled with carbon black (CB) were prepared, following by the compression moulding. The effects of carbon black quantity (varied from 0 to 30 wt%) on the surface resistance and volume resistance of the film were measured by Electrometer. Thermal properties were measured by Differential Scanning Calorimeter (DSC) and Thermogravimetric Analyzer (TGA), and mechanical properties were measured by Universal Testing Machine (UTM). It was found that addition of CB reduced the percolation threshold, and the electrical conductivity values were greater than those of the CB-filled PP composites. The surface resistance of the composites was as low as 10^4 ohm per square. Moreover, the addition of CB also increased the glass transition temperature, degradation temperature and flexural modulus.

Keywords Conductive polymer composite; Carbon black; Percolation threshold; Electrical properties

Physical and Chemical Properties of Carbon Black Derived from Plastic Wastes Pyrolysis Process from Municipality

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Carbon black, obtained from plastic wastes pyrolysis process from municipality, was physically and chemically characterized. Effect of the activation condition on carbon black properties was also determined including temperature, residence time in furnace and types of chemical activation. In this work, Iodine Adsorption Number (IAN) standard method was studied to indicate its physical properties. Brunauer Emmett Teller (BET) was used to analyze the surface area; Scanning Electron Microscope (SEM) was used to analyze the morphology investigation and Fourier Transform Infrared Spectrometer (FTIR) was also used to analyze the functional group of carbon black. The results indicated that the activation of carbon black affects to the increase the IAN. The optimum furnace temperature, time with activation reagent for this carbon black was 300 °C for 15 minutes with 15% ZnCl₂, resulting in high IAN of 257 mg/g compared to the non-activated carbon black and surface area was closely with commercial carbon black.

Keyword Carbon black; Iodine adsorption number

The Enzyme Protease Extracted from the Intestine of Tilapia to Decrease the Protein Allergens in Natural Rubber Latex

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Natural latex is an important economic product in Thailand which transformed into many products. The statistics of natural rubber latex allergy has increased. Cause of allergies is "Rubber Elongation Factor" that protein allergens are in natural rubber latex. The symptoms range from a rash to death. This paper studied the enzyme Protease extracted from the intestine of Tilapia to decrease the protein allergens in natural rubber latex. The proteins that are small enough to dissolve in rubber serum will not cause allergy. The activity of enzyme protease is 15.50 ± 1.785 mU/mg protein by $U = \text{Abs} / \text{min}$. The procedure includes tested enzyme protease with skim milk agar it activated. Film of rubber to detect nitrogen from natural latex and the nitrogen content is 0.478 % while the natural latex mixed enzyme protease is 1% the nitrogen content is 0.026 %. It is 0.452 decreasing. Tested the protein content by SDS-PAGE in both serum and cream. The serum of natural latex with enzymes is 0.1-1.0 % and cream mixed with enzymes is 0.1-1.0 %. Compared the protein content in natural rubber latex protein. The gel showing the protein bar color fade. And decreased when the enzyme is increasing continually. The protein content in the cream was the minimum when the latex was mixed with enzymes at 1.0 %.

Keyword Enzyme protease; Intestine of tilapia; Natural rubber latex

Melt Spinning of Poly(lactic acid) Fibers: Influence of Spinneret's Shape

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Poly(lactic acid, PLA) has been widely used for its biodegradability. Melt spinning of PLA fibers having varied cross-sectional shapes was conducted to improve the fibers' properties such as surface area, hand touch and luster. However, spinning PLA fibers of different cross-sectional shapes, using the same spinning condition, tend to cause fiber breakage during spinning and defect in fibers' shape. In this study, melt spinning of Poly(lactic acid) was conducted, using three spinneret profiles—circular, star and 4-lobed shapes, to investigate effects of spinning conditions on cross-sectional features of the obtained PLA fibers. From results, circular shaped PLA fibers could remain their shapes resembling the original spinneret's shape, whereas star and 4-lobed shaped PLA fibers exhibited variations in cross-sectional shapes with spinning conditions. The complex 4-lobed shape was highly sensitive to spinning conditions such that the obtained fibers tended to lose the original spinneret's shape. Spinning temperature was a major factor in determining shape profile of the obtained fibers. The study implied the possibility to manipulate fibers' features and properties by selecting appropriate geometry of spinneret's orifice and spinning conditions.

Keywords Fiber melt spinning; Shaped fibers; Poly(lactic acid)

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Preparation and Characterization of α -Fe₂O₃ Nanoparticles by Emulsion Precipitation Method

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α -Fe₂O₃ (hematite) nanoparticles were prepared by emulsion precipitation method using FeCl₃, kerosene, SPAN-80 as the precursor and sodium hydroxide as the precipitating agent. The characterization of the samples by XRD (X-ray diffraction) technique confirmed the formation of α -Fe₂O₃ (hematite). Analysis by SEM (scanning electron microscope) and TEM (transmission electron microscope) was carried out to study the morphology and particle size. α -Fe₂O₃ (hematite) was studied by calcining the precursor in the temperature range of 500 to 850°C. Formation/transformation of phases at different temperatures was confirmed by XRD studies. Images, obtained by SEM and TEM showed the morphology and nanoparticles formation of hematite. The crystallite sizes of α -Fe₂O₃ were found to be ranging from 50 to 100 nm. Room temperature rheological behaviour of the synthesized α -Fe₂O₃ nanopowder has been studied.

Keywords α -Fe₂O₃; Nanoparticles; Emulsion; Rheological.

Cube Texture Formation of Cu-33at%Ni Alloy Substrates and CeO₂ Buffer Layer for YBCO Coated Conductors

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Cube texture formation of Cu-33at%Ni alloy substrates and CeO₂ buffer layer prepared by chemical solution deposition on the textured substrate were investigated by electron back scattered diffraction (EBSD) and XRD techniques systematically. The results shown that a strong cube textured Cu-33at.%Ni alloy substrate with the cube texture fraction of 99.8 % ($< 10^\circ$) was obtained after annealing at 1000°C for 1 h. The full width half maximum (FWHM) values for the X-ray (111) phi-scan and (002) omega-scan in this substrate were 7.31° and 5.51°, respectively. Furthermore, the cube texture fraction of epitaxially grown CeO₂ buffer layer was 95 % ($< 10^\circ$), and the FWHM values of phi-scan and omega-scan being 6.98° and 5.92°, respectively.

Keywords Cu-33at%Ni alloy substrates; Cube texture; CeO₂ buffer layer; EBSD

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