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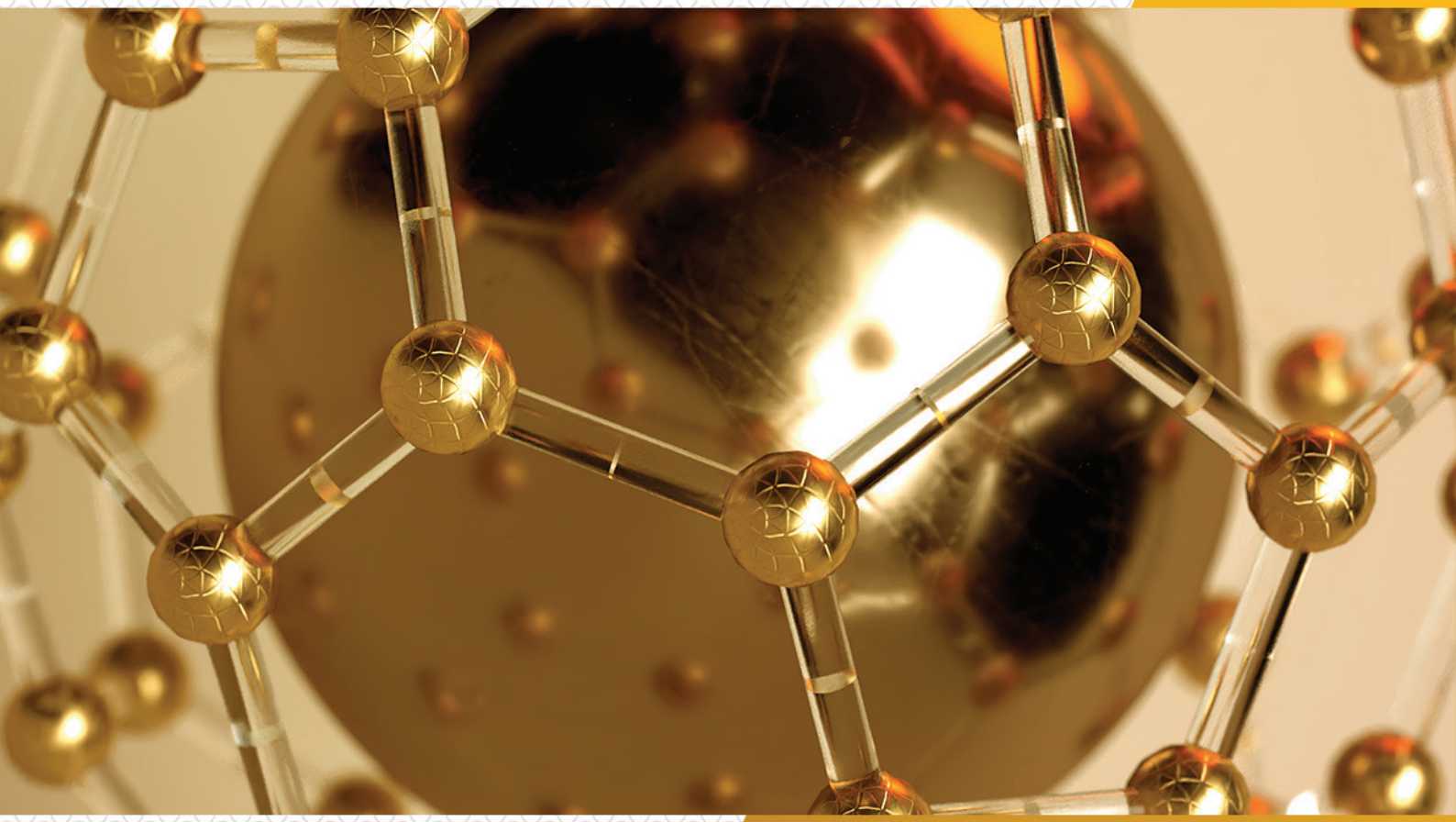

BOOK OF ABSTRACTS OF

INTERNATIONAL CONFERENCE ON ADVANCED MATERIALS AND THEIR APPLICATIONS 2021

FROM 7th TO 9th March 2022

THE COLLEGE OF SCIENCE AND HUMANITIES
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Book of abstracts the

International Conference on Advanced Materials and their Applications (ICAMA 2021)

7 - 9 March, 2022

PSAU, Al-kharj, Kingdom Of Saudi Arabia

Abstracts

PREFACE

This book contains all abstracts submitted before November 20, 2021 These abstracts were considered by the scientific committee for oral or poster session presentation at the International Conference on Advanced Materials and their Applications (ICAMA 2021). The abstracts are grouped by conference topics, and a complete author/page number index is provided after the abstracts.

ICAMA 2021 amounts to an optimal platform for researchers, engineers, academicians as well as industrial professionals from all over the world. The participants will have the opportunity to present their research results and development activities in advanced materials science and nanotechnology, aiming to promote the sustainable developments of Saudi Arabia .This conference provides opportunities for the participants to exchange new ideas and application experiences to establish research relations and to find global partners for future collaboration. The general conference topics for ICAMA2021 include (but are not limited to):

- Materials Characterization.
- Nanotechnology in Materials Science
- Advanced Materials for Water Purification.
- Materials for Renewable and Sustainable Energy.
- Catalysts in the Petrochemical Industry.
- Carbon Nanomaterials and Nanostructures.
- Advanced Ceramics and Composite Materials.
- Polymeric Materials.
- Plasma and its applications
- Nanomedicines
- Modeling and Computational Material Science
- Materials Engineering
- Waste management

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Newly synthesized poly(ionic liquid) functionalized silver nanoparticles stimulate unfolding but in contrary diminish thermal denaturation of human serum albumin

Mohd. Sajid Ali,* Hamad A. Al-Lohedan, Ayman M. Atta, Abdelrahman O. Ezzat

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Abstract

Poly(ionic liquid)s (PIL) are polymerized ionic liquids and have attracted the interests during the past few years. Herein we have synthesized 2-Acrylamido-2-methyl propane sulfonic acid and vinylpyrrolidone based poly(ionic liquid) which is characterized by ^{1}H and ^{13}C NMR spectroscopies. This PIL was used to synthesize PIL coated silver nanoparticles (PIL-AgNPs). Characterization of these nanoparticles has been carried out by using UV-Visible spectroscopy, transmission electron micrograph (TEM), dynamic light scattering (DLS) and zeta potential measurements. The particle size of PIL-AgNPs was found to be in the range of 12–42 nm with the more population of smaller particles. Interaction of the PIL coated AgNPs was studied with human serum albumin (HSA) by exploiting UV-visible, fluorescence (intrinsic and synchronous) and circular dichroism spectrophotomeries. UV-visible absorption studies suggested the complex formation between HSA and nanoparticles. PIL-AgNPs quenched the intrinsic fluorescence of HSA profoundly with a prominent blue shift in the wavelength of emission maximum which is attributed to the change in the microenvironment of fluorophores towards hydrophobic environment. From synchronous fluorescence spectroscopy it was revealed that the microenvironment of tryptophan becomes more hydrophobic whereas the overall tyrosine residues shifted towards the polar environments. From the CD and FTIR results it was confirmed that PIL coated silver nanoparticles caused the unfolding of the protein with a large decrease in its α-helical contents. Thermal denaturation studies were also carried out in presence and absence of PIL-AgNPs and it was found that the presence of nanoparticles prevented the protein to denature completely against the temperature.

Keywords: human serum albumin (HSA); PIL-AgNPs; Thermal denaturation; tryptophan

Influence of zinc and bismuth on the microstructure and physical characteristics of Sn-Sb lead-free solder bearing alloys for electronic packaging applications

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Abstract

The present study was undertaken to investigate the influence of zinc and bismuth additions to the Sn-5Sb binary composition for use as a Pb-free solder. The resulting properties of the binary system were extended to the Sn-based ternary systems Sn-5Sb-XBi and Sn-5Sb-XZn (X= 0 or ≤ 4 wt.%) solder. Ternary Sn-5Sb-Bi and Sn-5Sb-Zn alloys were prepared by rapid solidification processing (RSP) using melt-spun technique. The prepared alloys are metallographically examined and the equilibrium phases formed were identified on the basis of compositional determinations using scanning electron microscopy (SEM) and x-ray diffraction analysis (XRD) analysis. Binary Sn-Sb system doped with Bi exhibits good electrical resistivity =26x10^{-8} ohm.m, and high elastic modulus E=32.5 GPa. The alloy of composition Sn-5Sb-4Zn has the most suitable properties as a candidate alloy for lead-free solder. It has a lower melting point, 221 ºC, a lower value of internal friction Q^{-1} =5.5 x 10^{-2}, higher value of the Vickers hardness, Hv, 260 MPa. Sn-Sb binary system is suitable pasty range = 8 ºC which is very important property for solders alloys.

Keywords: Lead-free solder, Rapid solidification technology, Melting points, Electrical properties, Mechanical behavior.

Thermodynamic Parameters of Solvation for Alkyl Benzyl Dimethyl and Cetyl Trimethyl Ammonium Chloride Surfactants in Alcoholic -Water Mixed Solvents

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Abstract

The micellization and the solvation of both Alkyl Benzyl Dimethyl Ammonium Chloride (BAC) and Cetyl Trimethyl Ammonium Chloride (CTAC) surfactants at temperatures (25, 30, 35 and 40 °C) were studied from the conductivity and surface tension measurements in water and in alcoholic-water mixed solvents (methanol, ethanol, and glycerol) with different mole fractions of alcohols. The critical micelle concentration (CMC) of both (BAC) and (CTAC) was determined. The CMC was found to increase as the temperature and alcohol mole fraction increased. The association constant (K_a) of both (BAC) and (CTAC) was estimated using Shedlowsky equation from the conductivity values before the CMC. The values of the thermodynamic parameters (ΔG, ΔH, and ΔS) of the micellization and association processes were estimated and discussed. The association constant was found to decrease as the temperature and alcohol percentage increase. The association process was found to be spontaneous process. The density and refractive index of both surfactants under study in alcoholic-water mixed solvents (methanol, ethanol, and glycerol) with different mole fractions of alcohols, has been measured at 25 °C. The molal volume of both surfactants under study was calculated and discussed. Also the molar refraction and the polarizability of the surfactants under study was estimated and discussed from the refractive index values.

Keywords: BAC; CTMA; Micellization; Molal Volume; Polarizability.

Synthesis, Evaluation of asymmetric dicationic Ionic Liquids and studying their efficiency for Egyptian Base Oil improvement

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Abstract

In this work, three asymmetric dicationic ionic liquids, namely, 1-(2-(1-decyl-1H-imidazol-3-ium-3-yl)ethyl)-4-methylpyridin-1-ium bromide (IL101), 1-(5-(1-decyl-1H-imidazol-3-ium-3-yl)pentyl)-4-methylpyridin-1-ium bromide (IL102), and 1-(10-(1-decyl-1H-imidazol-3-ium-3-yl)decyl)-4-methylpyridin-1-ium bromide (IL103) were synthesized. Their structures were confirmed and characterized via, Elemental Analysis, Fourier Transform Infra-red spectroscopy (FT-IR) and proton nuclear magnetic resonance (1H-NMR). Their surface-active properties were recorded using surface tension parameters (critical micelle concentration (CMC), effectiveness (πCMC), efficiency (PC20), maximum surface excess (Γmax) as and minimum surface area (Amin). They were studied and tested as base oil improvers, especially oxidation stability, (through studying the change in total acid number [TAN] and viscosity), and foaming characteristics. The efficiency of these compounds is ranked as follows, IL103 > IL102 > IL101. Their theoretical quantum calculations were in good agreement with the experimental results.

Keywords: Ionic liquid, Surface parameters, Base oil, Oxidation stability, Total acid number, Foaming, Spectroscopy.

Preparation and Characterization of CMC/HA-NPs/Pulp Nano-Composites for the Removal of Heavy Metal Ions

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Abstract

The paper sheets nanocomposite of cellulose pulp/ carboxymethyl cellulose/ hydroxyapatite nanoparticles (CP/CMC/HA-NPs) were synthesis with different ratios of HA-NPs. Also the effects of the prepared paper sheets nanocomposite in the removal of Fe^{2+}, Cu^{+2} and Cd^{2+} ions were studied. Two types of pulps were used in this investigation, the recycled office wastepaper pulp (RWP) and the bleached sulfite wood pulp (BWP) to prepare RWP/CMC/HA-NPs and BWP/CMC/HA-NPs, respectively. The hydroxyapatite nanoparticles as well as the paper sheets nanocomposite were characterized using different techniques. In addition, the swelling of the paper sheets nanocomposite in aqueous solutions were studied, where it decreased by increasing the HA-NPs content in the paper sheets. The mechanical properties of the bleached wood pulp treated with HA-NPs are higher than that in recycled wastepaper sheets. It was also found that, increasing the ratio of removal heavy metal ions by increasing the ratio of HA-NPs in the paper sheets.

Keywords: Recycled wastepaper ; bleached wood pulp ; CMC, HA-NPs ; heavy metals removal.

Hybrid Materials of Gold Nanorods in an Organic Matrix for Smart Windows Applications

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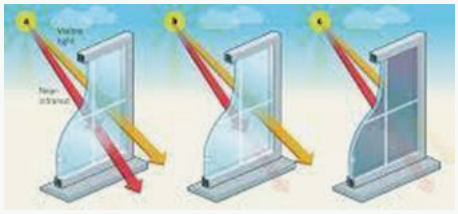
Abstract



Liquid crystals are a good candidate to work as a host medium for nanoparticles with different properties given their low cost and facile responsive characteristic to external stimuli such as voltages as low as one volt. Consequently, many organic-nonorganic hybrid composites emerge with specific properties such as optical metamaterials and other nanostructured metal dielectric composites holding a great potential for designing novel types of light–matter interactions. Here I will present an approach to fabricate composites with tunable pre-engineered properties via self-assembly of anisotropic nanoparticles co-dispersed in a nematic liquid crystal (LC) host. [1-3] Orientations of plasmonic nanorods of varying aspect ratios are controlled to align parallel or perpendicular to the nematic director and retain this relative orientation during a facile electric switching. The ensuing dynamic reconfigurability of the surface plasmon resonances of a composite enables a previously inaccessible means of controlling light. Overall utilizing LCs as a guest medium to these nanoparticles allows for unique features as well as promising properties through the design of novel self-assembly based hybrid nanostructures. This can give rise to potential and practical applications for the fabrication of optical or electro-optical devices such as climate dependent optimal solar gain smart windows.

Keywords: Liquid crystals Gold Nanorods; Smart Windows

Elaboration and Characterization of ceramic membrane made from local raw materials

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Abstract

Membrane elaboration from local raw materials has been done using casting technique. Characterization of prepared tubular samples have been studied by XRD, IMP, MEB and water permeabity plant. The obtained values of pores rayon (10 nm), water permeability (100 l/h.m^2) and stream potential (-65 mV/m^2) disernigly indicate the possibility of using this membrane in microfiltration, ultrafiltration and/or as pre-nanofiltration co-technique. Results from filtration operation applied to Chromium Cr(III) contamined water: retention R% = 80% and estimated surface charge -66.7 mC/m^2 clearly showing the important capacity to separate ions in water treatements.

Keywords: Ceramic Membrane, Porous microstructure, Permeability, Darcy's Law, Microfiltration, Ultrafiltration, Nanofultration.

Synthesis and characterization of chromium incorporated mesoporous silica materials Cr-SBA-16 for selective catalytic oxidation of benzyl alcohol

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Abstract

Cr-SBA-16 mesoporous silica heterogeneous catalysts (Si/Cr = 7, 14, and 28) were successfully synthesized by one-pot hydrothermal method at low acidic medium. The catalysts were characterized by means of XRD, N_2 adsorption-desorption at 77 K, XPS and UV-Vis (DRS) spectroscopies techniques. Herein, Cr-SBA-16 catalysts are evaluated in the selective oxidation of benzyl alcohol using H_2O_2 as oxidant. The novelty of Cr-SBA-16 catalysts is related to their superiority to traditional hazardous homogenous catalysts such as $KMnO_4$, CrO_3, SeO_2. Herein, an economical and environmentally benign process is developed. The N_2 adsorption-desorption measurements showed a developed surface area above 1000 m2/g and uniform pore size distribution. The XRD patterns of Cr-SBA-16 showed expansion of the unit cell parameters with respect to pure SBA-16 and confirms the successfully incorporation of chromium ions into the SBA-16 framework. From XPS and UV-Vis (DRS) spectroscopies the molar ratio between Cr^{6+}/Cr^{3+} are obtained and found to increase versus chromium loading following order: Cr-SBA-16(28) < Cr-SBA-16(14) < Cr-SBA-16(7). Hence the highest Cr^{6+} in tetrahedrally environment is observed for Si/Cr=7. In the present work, we demonstrated for the first time that the selective catalytic oxidation of benzyl alcohol using hydrogen peroxide over Cr-SBA-16 occurs through noncompetitive adsorption mechanism and the reaction is pseudo first order to BzOH. The activity of the reaction depends on the symmetry of chromium species, especially, high activity is observed for tetrahedral chromium in Cr-SBA-16.

Keywords: Nano-porous, SBA-16, Benzyl alcohol, noncompetitive adsorption, Kinetics.

Applications of composites as a radar absorbing materials: An overview

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Abstract

The present study is aimed at analyzing the properties and performance of different composites materials which are used as a radar absorber. Radar system serves various purposes to mankind such as ground traffic control, detecting fighter jets, weather forecasting, earth composition mapping etc. Use of composites have been increased in aerospace industries as a radar absorbing material (RAM) which helps the aircrafts to hide from the enemies radar systems. Many researchers have worked on polymer based composites, ceramic composites, CNT etc which may be used for the production of components of aircraft and other equipments. Some nano-composite coatings are also being used to alter the wave absorbing properties of surfaces. The microwave radiations absorbed by coating materials depends upon the thickness of coatings, their properties, wave incident angle and size of nano particles.

Keywords: Nano coatings, RAM, radar system, composites materials and radar cross section

Synthesis, Structural and Spectroscopic study of new organic inorganic hybrid $[NH_3\text{-}(CH_2)_3\text{-}COOH]SnCl_3$ thin films prepared by spin coating

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Abstract

The emerging photovoltaic technologies progress over the past two decades has been outstanding. Recently, a new family of materials collectors of solar energy based on organic - inorganic hybrid has fascinated the scientific community because of their physical properties, which make them promising in photovoltaic application. Also open a new area for low cost and height efficiency solar cell. In this topic, a new organic-inorganic hybrid like perovskite system has been synthesized and characterized. This compound crystallizes in the monoclinic with space group C2/c the unit cell parameters a = 32.071(5) Å, b = 5.827(2) Å, c = 11.596 (5)Å, β = 94.858(5)° and Z = 4. The unit cell consists of a combination of $[SnCl_3]^-$ anions and one organic $[^+NH_3(CH_2)_3CO_2H]$ cation to form a like perovskite system. Three dimensional hydrogen – bonding network is assuring the cohesion between these layers to stabilize the crystal. The micro-Raman spectroscopy measurement technique is used to probe vibrational modes of single crystal and thin film of the titled compound in order to study the effect of laser beam power on the intensity of Raman lines.

Keywords: Layered perovskite, organic-inorganic hybrid, single crystal structure, Micro-Raman spectroscopy, Spin coating

Preparation and characterization of eco-green geopolymer composites

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Abstract

Geopolymer cement with attractive mechanical properties was produced using untreated kaolinitic soil and alkali activators as precursors. The produced geopolymer matrix was characterized by its mesopore structure with pore sizes around 25nm. The microstructure is composed mainly from amorphous Al-Si-Na tectosilicates. Various fibers were added to the geopolymer cement as reinforcements to produce composites. Jute fiber-based geopolymer, Luffa cylindrica fiber-based geopolymer, and carbon fiber-based geopolymer composites were introduced, and their mechanical properties were studied. Finally, the date palm fibers (DPF) were extracted and used as reinforcements to produce the geopolymer composites. The synthesized composites were characterized by high mechanical performance with enhanced ductile behavior. The ultimate strength of the geopolymer-based materials increases from 3.4 MPa to 12 MPa, 13MPa, 14 MPa, and 20 MPa by introducing DP fibers, Jute fibers, luffa fibers, and carbon fibers respectively. Also, the formation of a mesopore network (nano-porous structure) as a result of geopolymerization results in a higher surface area, and thus high adsorption capacity. Therefore, in addition to the construction applications, these materials can be introduced for the adsorption of micropollutants and water purifications techniques.

Keywords: geopolymer, composites, natural fibers, kaolinite, stress-strain.

Polyethylene-based Silica Nanocomposites and Their Potential Applications

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Abstract

In an attempt to correlate properties of silica fillers and polymeric matrices, the modification of silica has brought revolution in the field of nanocomposites. Silica when used with polyolefins provides distinctive characteristics merging the superior properties of inorganic fillers, such as hardness, increased thermal stability along with the processability, elasticity, and plasticity of the polymeric matrice. Although Polyethylene (PE) and silica are the simplest and most common organic and inorganic polymers respectively, complete miscibility between the semicrystalline PE and the silica nanoparticles is still a great challenge due to the crystalline and amorphous domains of PE which likely promotes inhomogeneous nanoparticle distribution and aggregation. Up to now, the majority of polyethylene nanocomposites have been conventionally fabricated by extreme extrusion mixing of inorganic particles with the polymer in the melt, which in most cases lead to large aggregates and significantly decrease of reinforcement. To avoid the particle aggregation and achieve homogeneous dispersion, the surface functionalization constitutes a reliable fabrication method. Here, we use a combination of organic synthesis reactions and living anionic surface initiated polymerization (LASIP) technique to “grow” polyethylene chains along to the periphery of silica particles. Molecular characterization (GPC, NMR), thermomechanical analysis (DSC, TGA, DMA) and electron microscopy (TEM) are used to evaluate the intermediate components and final composite materials.

Keywords: Polyolefins, Elastomers, Composites, Surface Initiated Polymerization, Mechanical Properties.

Study the stability of perovskite solar cells in hot and Arid climate

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Abstract:

Recently, Perovskite solar cells (PSCs) achieved high photovoltaic conversion efficiency (>25%) and to compete with existing silicon-based solar cells commercially their stability need to be improved. The perovskite films are found to be very sensitive to external factors such as air, UV light, and thermal temperature. In this work, we study the stability of perovskite solar cells and improved their stability to be suitable for operation in the hot/arid climate of Saudi Arabia. In this study we made a comparison in terms of efficiency with looking at the stability of the cell by placing it under surveillance over a one day and a week. Given this, we observed that in the first days the efficiency was high and reached 16.9%, but unfortunately after a week the efficiency decreased since the perovskite has been affected by external factors such as air, UV light, light soaking, thermal stress, and others. We then put strategy to improve the perovskite layer stability by working in the perovskite layer to get promising stability for the future.

Keywords: Perovskite solar cells, Stability, efficiency.

Silver Exchanged Phosphomolybdic Acid Supported MCM-41 as an efficient solid acid catalyst: Acidity and Catalytic Activity

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Abstract

Herein Ag exchanged phosphomolybdic catalysts were synthesized by ion exchange method and characterized using numerous techniques such as XRD, TEM, FTIR and N_2 adsorption-desorption measurements. The surface acidity of the as-synthesized materials was examined through FTIR spectra of chemisorbed pyridine and non-aqueous potentiometric titration of n-butylamine. XRD analysis displayed the weakness of the amorphous peak related to MCM-41 and the appearance of well-defined diffraction lines of the heteropoly acid by the addition of Ag_xPMA to MCM-41, indicating that the Ag salts of PMA@MCM-41 have good crystallinity compared with MCM-41. TEM images displayed the homogeneous distribution of Ag_xPMA inside and outside the pores of MCM-41 and maintaining the hexagonal morphology of MCM-41 by the addition of Ag_xPMA. All the catalysts exhibited both Lewis and Brønsted acid sites; the Lewis acidity increased with increasing silver contents while the Brønsted acidity decreased as confirmed by FTIR spectra of chemisorbed pyridine. The catalytic activity of the prepared samples was studied through the preparation of 7-hydroxy-4-methylcoumarin and hydroquinone diacetate. The catalytic activity and the surface acidity were decreased by loading extra amount of silver ions due to the decrease in the protons of PMA. Reusability test of the prepared catalysts showed that the catalyst could be reused numerous times without losing its catalytic performance.

Keywords: phosphomolybdic, Ag_xPMA, MCM-41

Synthesis and characterization of pure and doped copper oxide nanoparticles

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Abstract

Copper oxide nanoparticles are relatively cheap, photocatalytic, and stable in regard to their chemical and physical properties. In the present study, we report the synthesis methods, optical and structural properties of pure and doped copper nanostructures prepared by CBD method. Synthesis of pure and doped CuO nanoparticles were done using Chemical bath deposition method, CuO NPs were prepared using zinc acetate as a precursor and methyl cellulose as a stabilizing agent. Characterization of the synthesized pure and doped CuO nanoparticles was done using instruments such as X-Ray diffraction , UV-visiblespectrophotometer, scanning electron microscopy, transmission electron microscopy, Raman scattering and Fourier-transform infrared spectroscopy.

X-ray diffraction (XRD) in the 2Θ range of 200 to 700 of the synthesized copper oxide, showing the presence of the various characteristic peaks which can be indexed on the basis of copper oxide (JCPDS card no. 801268). The TEM images reveal that the product consists of spherical nanosized particles with a regular morphology and relatively narrow size distribution. The presence of diffraction rings in selected area diffraction pattern supports the existence of cubic Cu_2O and monoclinic CuO structural phases in crystalline form in accordance with the XRD data. SEM images of the CuO nanoparticles show that aggregated nanoparticles with a regular morphology. The nanoparticles have significantly narrow size distribution with small particle size.The EDX spectrum of CuO nanoparticles displays the ratio of the atomic percentage of Cu and O, confirms the formation of CuO nanoparticles as observed from XRD, Raman spectra and FT–IR data.

Keywords: Nano- structural, CuO nanoparticles, synthesis, stabilizing agent, CBD.

Exiting Effect of Tannin Nanoparticles (NP99) Combined with Tamoxefin on ER+ Breast Cancer Cells

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Abstract

Background: Cancer is one of the leading causes of mortality in the world and it considers a major public health problem around the worldwide. Breast cancer is the most common type of cancer and the main cause of deaths between women globally. The disease is currently controlled by surgery and radiotherapy, frequently supported by adjuvant chemo- or hormone therapy. Tamoxifen (Tam) is the conventional drug for ER+ breast tumors prevention and treatment but its use is limited due to the toxicity and cancer cells resistance. Identification of new cytotoxic drug with special characterisations such as low toxic and side effects, no resistant and tumor targeting is being critical in medicine. Scientists and researchers have started to explore natural products in the form of nanoparticles to use against cancer, microbial infection, inflammation, and other diseases. One of the most important natural product compounds which can be formed as nanoparticles is tannin. Tannins are defined as naturally occurring water-soluble polyphenolic metabolites, and they are produced in a variety from higher plants. In this work the cytotoxic effect of Tam and Tannin nanoparticles extract (NP99) each alone and/or in combination together have been investigated on MCF-7 cells *in vitro*. **Methods:** The MTT assay, DNA Fragmentation and mRNA relative expression of apoptotic genes were applied. **Results & conclusion:** The results showed that both Tam and NP99 induced cytotoxic effect against MCF-7 cell line. They were able to reduce the cells viability and repressive activity of cells proliferation and induce apoptosis as indicated via increasing the DNA fragmentation percentage. The combined treatment of Tam and NP99 was more effective than individual drug. It could be concluded that NP99 is considered a promising natural anticancer agent and a new tool in therapeutic strategies.

Keywords: Condensed tannin; nanoparticles; tamoxifen; MCF-7 cells; anticancer.

The Use of biomaterials and tissue plasticity for regeneration of bone defect

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Abstruct:

Regenerative medicine can provide a novel approach for treating different conditions and for enhancing bone regeneration. Tissues Interconversion is governed not only by the cells interaction but also by the effect of micro-environmental changes and inductive extracellular cues. **Aim and Objectives**: This preliminary study was conducted to prepare Muscular Extracellular Matrix(MEM) and assessment of its osteogenic potentials and colonization of blood vessels. Then treated MEM was used to study bone regeneration in critical size defect. **Material and Methods**: MEM grafts were prepared using well established protocol[1]. Sub clone derived from immortalized human bone marrow stromal cells (TERT-hBMSCs) were used for graft characterization. Then Osteoblast differentiation was assessed using Alkaline phosphatase (ALP), Alizarin Red S. Then quantification of mineralization and histological assessment were performed for the induced MEM. Treated constructs of MEM were prepared using hBMSCs, bone cement (SCPC).In ex vivo 10 male nude mice were used, 4 mm calvarial defect were grafted with treated MEM. At 8 weeks, the regenerated tissue was assessed using microcomputed tomography (micro-CT) and histology. **Results**: Clinically, cortical bone regeneration was observed bridge the defects area in all study group The qualitative assessment of regenerated bone using micro-CT analysis reported thinner trabeculae, compared to normal native bone, with a high degree of anisotropy. Quantitative histomorphometrically assessment showed that a high median bone percentage surface area was reported for at 80.2±6.0% (26.9–90.3). **Conclusion**: This study confirms the in vivo osteogenic properties of treated MEM and suggests novel strategies for bone regeneration.

Keywords: Regenerative medicine, bone bioengineering, Muscle Extracellular matrix, bone defect

OLIVE WASTES VALORIZATION FOR PHARMACEUTICAL APPLICATIONS

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Abstract:

Olive cultivation and olive oil extraction have been associated with huge wastes generation, which posse serious environmental problem, particularly in Mediterranean areas. This biomass has been used primarily as animal feed, but their phytochemical richness and biofunctionality attract the interest of the scientific and industrial community to exploited them in many sectors such as feed, food, fuels, fertilizers, aromatic, cosmetic, and pharmaceuticals.

In the later field, olive wastes or byproducts showed great abundance and diversity in phenolic compounds and functional substances with proved health promoting benefits. The present review summarizes olive waste types, sources and phytochemistry, moreover discusses, all bioactive substances health effects and their related applications in pharmaceutical biotechnology.

Keywords: olive wastes, phytochemistry, bioactive substances, application, pharmaceutical biotechnology

Design of Optical Mesocaptor for Optical Recognition and Extraction of Uranium Ions from Real Samples

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Abstract: In the last decades, an increasing demand for an effective method for uranium detection and extraction to maintain nuclear growth for electricity production, the researchers is still working towards easy and inexpensive way for uranium detection and extraction/separation from its real samples. For this purpose, we report the synthesis of hybrid organic-inorganic mesoporous optical sensor/adsorbent for optical detection and separation/recovery of uranyl ions from aqueous samples. The uranyl ion-sensor was designed via direct template synthesis of highly ordered silica monolith starting from a quaternary microemulsion liquid crystalline phase. The produced silica monolith is subjected to further modifications by growing an organic probe, 3-[8-(acetylamino)-2-hydroxy-1-naphthalenyl[azo]-5-chloro-2-hydroxy-monosodium salt in the cubic cavities, and on the silica structure's outer surface, leading to create captured organic probe into orderly pores of the monolithic surfaces for the visual detection and separation/recovery of uranyl ions. The synthesized mesocaptor was characterized with FTIR, XRD, SEM, EDX, HR-TEM, zeta potential, elemental analysis, BET N_2 adsorption/desorption techniques. The results indicated that the optical sensing/removal of uranyl ions was powerfully submissive on pH value at 3.4 and appeared to follow Freundlich adsorption model with maximum capacity of 95 mg/g. The kinetics and thermodynamic behaviors of uranyl ions adsorption into the synthesized mesocaptor from aqueous solution were minutely studied. The synthesized mesocaptor can be regenerated using HNO_3 for further use that was tested up to seven cycles of operation. The adsorption mechanism and the ion diffusion behavior of U(VI) on/in the designed mesocaptor was further investigated by density functional theory (DFT) calculations.

Keyword: Uranyl ions; Mesoporous Materials; Sensor; Adsorption; Detection; Extraction.

Photocatalytic Removal of Persistent pollutant from water using Pure TiO_2 and $TiO_2/WO_3/g\text{-}C_3N_4$ Nanocomposites

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Abstract

A hybrid $TiO_2/WO_3/g\text{-}C_3N_4$ photocatalyst was synthesised using an elegant pulsed laser ablation in liquids (PLAL) technique. Advanced analytical techniques like UV-vis spectroscopy, scanning electron microscopy, Photoluminescence, X-ray diffraction spectroscopy, X-ray photoelectron spectroscopy were applied for the characterization of this novel catalyst. The attachment of TiO_2 and WO_3-NPs on the $g\text{-}C_3N_4$ was confirmed by the TEM analysis and the XRD spectra revealed the containments of peaks of all the components materials, which indicate effective creation of $TiO_2/WO_3/g\text{-}C_3N_4$ nanocomposite. For testing the performance of the synthesized $TiO_2/WO_3/g\text{-}C_3N_4$ nanocomposite for the removal of a persistent pollutant Methylene Blue dye from water, photocatalytic degradation experiment was conducted under visible light irradiation using a 300 W xenon lamp. Our photocatalytic degradation results proved that loading of TiO_2/WO_3 binary system with x-wt% (x=5, 10, 15, 20) of $g\text{-}C_3N_4$, excellently enhanced their photocatalytic performance. The stacking of $g\text{-}C_3N_4$ helps to increase the surface area of the $TiO_2/WO_3/g\text{-}C_3N_4$ nanocomposites for photocatalytic reaction, augments the light absorption capacity in the visible region and thereby enhancing the photocatalytic degradation efficiency in removal of a persistent pollutant, methylene blue dye from water.

Keywords: Photocatalytic, Persistent pollutant, wastewater, pure TiO_2, $TiO_2/WO_3/g\text{-}C_3N_4$, nanocomposites, methylene blue

Acknowledgement: Authors are thankful to KFUPM for supporting this work through DSR project and under KACARE fellowship scheme.

Future Enhanced Petrochemicals Production: Catalysts and Processes Challenges

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Abstract

Chemicals are one of the fastest-growing sectors for crude oil demand. The liquid hydrocarbons are the perfect feedstock for producing carbon-based goods which include polymers, pharmaceuticals, solvents, lubricants, and thousands of products that we use in our daily lives. The refineries focusing in the production of petrochemicals rather than fuels are expected to become much more profitable and sustainable due to the big price differences. The use of crude oil in the petrochemicals sector is expected to increase in the years to come. Direct crude to chemicals processes is expected to result in important cost savings, increased operational efficiency, valuable opportunities for future growth and long-term value-addition to the petrochemical industry. The first generation oil to chemicals processes are under commissioning now, mostly located in China and the Middle East. ExxonMobil is operating a pretreated light crude oil steam cracker in Singapore since 2014 with 76% conversion of naphtha and a maximum 50% chemicals yield, and the technology is under further development. In China, Hengli Petrochemical, Zhejiang Petroleum, Hengyi Industries, and Shenghong started new crude-oil-upgrading plants based on hydrocracking processes to maximize paraxylene production. In the Middle East, Saudi Arabia is planning to triple its petrochemical production capacity by 2030, with the first plant, projected to process 400000 barrels per day of Arabian Light crude via steam cracking in combination with high-severity FCC, expected to become operational by 2025. In addition, Saudi Aramco, is in partnership with Axens, Technip FMC, McDermott and Chevron Lummus Global to develop thermal and catalytic Crude to Chemicals technologies. This paper will present the developments in crude to chemicals technologies.

Keywords: Future Refineries, Catalytic Oil to Chemicals, Thermal Oil to Chemicals, Refineries-Petrochemicals Integration, Improved Catalysts, Less Severe Conditions, Profitability, Sustainability.

Design and Manufacturing of Electronic/Ionic Conductive Polymer for Solar Fuel Devices

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Abstract:

There has been a global interest in the manufacture of an artificial photosynthetic system which mimics the properties of thylakoid membrane found in natural photosynthesis system. However, significant amount of research still needs to be performed to determine the characteristics of membranes that can be potentially used in creation of these systems. The research discusses the manufacture of composite bipolar membranes that have the potential to be incorporated in an artificial photosynthetic system. Effective bipolar membranes can help in establishing an optimum pH difference between the oxidation and reduction reactions taking place in membrane-based systems. Such systems can work effectively under solar conditions and split water cells without having any effect on their thermodynamic properties. They should also possess the optical transparency, kinetics and electronic conductivity to be effectively integrated. The findings of this study can help in manufacturing, utilization and evaluation of such a bipolar membrane with commercial usage.

Keywords: Artificial photosynthetic system, Design, Manufacture, Membranes, Solar Fuel devices

Self-assembly of Mesoporous Nanostructured Catalysts for Boosting the Electrochemical Energy Reactions

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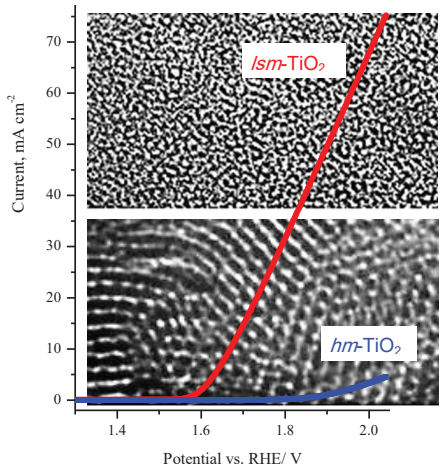
Abstract

Nanostructured mesoporous materials are of interest for a variety of applications for developing renewable and clean energy sources. This work presents the synthesis of entirely new classes of nanostructured mesoporous transition metal oxides, hydroxides and phosphate nanocatalysts with improved electrocatalytic properties of electrochemical energy reaction of hydrocarbon oxidation, water splitting, and fuel-cell reactions. Mesoporous nanocatalysts of nickel, cobalt, tungsten and titanium oxides, hydroxides and phosphates with high surface areas, mesoporosity, and different nano-architectures are prepared via the surfactant template chemical deposition and hydrothermal approaches. The compositions, periodicities, surface areas, pore diameters, and architectures of the nanocatalysts can be varied in a controllable way through changes in the template compositions and deposition conditions. The electrochemical and catalytic activity of the resulting mesoporous nanocatalysts investigated and screened for electrochemical energy reactions of hydrocarbon (urea, methanol) oxidation and water splitting reactions of hydrogen, oxygen evolution and oxygen reduction reactions.

Keywords: Mesoporous; Oxides; Phosphates; Energy Reactions.

Acknowledgements

This Project was funded by the National Plan for Science, Technology and Innovation (MAARIFAH), King Abdulaziz City for Science and Technology (KACST), Kingdom of Saudi Arabia, Award Number **13-NAN-1309-02**.



Thin film of low-symmetry mesoporous TiO_2 exhibits a significant electrocatalytic activity for oxygen evolution reaction in alkaline solution and more efficient than the highly ordered hexagonal mesoporous counterpart and very comparable to the state-of-the-art transition metal oxide catalysts.

Synthesis of a micrometric carbon material by polycondensation of pyrogallol and formaldehyde

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Abstract

With the development of the industrial and material requirements ever more efficient and specific, industrial world has a conscious way on the world of research in order to develop new materials with specific characteristics, perfectly controlled, reproducible and stable. To meet these requirements, however, it is necessary to know the structure and the microscopic characteristics of materials. We describe in this work the synthesis of a micrometric carbon material by pyrolysis of a carbon xerogel. This xerogel is prepared according to the sol-gel process by polycondensation of pyrogallol (P) with formaldehyde (F) in aqueous medium. The synthesis of xerogel P/F takes place in two steps. The first step is the preparation of the hydrogel by a polycondensation of pyrogallol (P) with formaldehyde (F) in an aqueous medium with a molar ratio F/P = 3, in the presence of perchloric acid as catalyst. The second step is the conventional drying of the hydrogel obtained in four temperature levels 60, 80, 100 and 120°C. The specific surface area and microporosity are determined by nitrogen adsorption-desorption. The microporosity varies between 0.23 and 0.32 $cm^3.g^{-1}$, while the specific surface area varies from 628 to 730 $m^2.g^{-1}$. They depend on the conditions of the polycondensation. The results obtained show that the P/F resins requires a washing step to remove the catalyst. Indeed, the IR spectra of unwashed P/F gels show a band around 625 cm^{-1} due to the catalyst ($HClO_4$). This band disappears by washing.

Keywords: Pyrogallol, Formaldehyde, Polycondensation, micrometric carbon.

Metal Oxide-Modified Clay Materials for Photocatalytic Degradation of Organic Compounds

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Abstract

This study explores the principles in synthesis, characterization and application of metal oxide-modified clay for photocatalytic reaction. The paper presents scheme of clay, especially smectite class of clay modifications as strategies to provide photoactive and surface active sites in catalytic reaction. The modifications consist of metal oxide pillarization, metal dispersed on metal oxide-pillared clay, complex-immobilized metal pillared clay, and porous clay heterostructure are discussed. The discussion highlights are the more effective mechanism for providing reusable catalyst for the reaction and the role of some important physicochemical parameters resulted in higher conversion and reusability in the mechanism. Moreover, green catalysis including intensification by using microwave-assisted conversion is also an interesting perspective in the discussion.

Keywords: Clay; Clay pillarization; Essential oil; Green catalysis.

Magnetic nanoparticles as an effective tool for isolation of polycyclic aromatic hydrocarbons from environmental samples

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are some of widespread organic pollutants in the environment being detected in all compartments (air, soil, food and water). Due to their adverse health effect and persistence in the environment, PAHs were listed by the United States environmental protection agency (US-EPA) as priority pollutants. Different extraction techniques have been applied for isolation of PAHs from environmental samples, among them include solid phase extraction (SPE) and liquid-liquid extraction (LLE) which were recommended by US-EPA. Although these techniques provide good accuracy and low limit of detection, they are often time consuming and generate large solvent wastes. Recently a new technique using magnetic nanoparticles (MNPs) have been successfully applied for isolation of PAHs as a target analyte from complex matrices. This paper offers a comparison between traditional methods used for isolation of PAHs, and the new techniques based on the use of MNPs which provide rapid extraction ability and excellent efficiency. The aim was to provide an overview of current sensitive and effective technique that can lead to an optimum analysis of PAHs.

Keywords: Polycyclic aromatic hydrocarbons, Magnetic nanoparticles, Nanomaterials.

Effect of Hybrid Water-Based Suspension of Al2O3 and Cu Nanoparticles on Three-Dimensional Double-Diffusive Natural Convection

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Abstract

This work numerically examines three-dimensional double-diffusive natural convection in a cubic cavity filled by Cu/water nanofluid, and Al_2O_3-Cu/water hybrid nanofluid which is a new advanced nanofluid with two kinds of nanoparticle materials.The governing equations are carefully modified employing vorticity-vector potential formulation and are solved by the finite volume method (FVM). Performance enhancement of Cu-Al_2O_3/water micropolar hybrid nanofluid is judiciously compared with the Cu/water simple nano-fluid. Besides, the effect of concentration of nanoparticles, Rayleigh number, buoyancy ratio, and micropolar vortex parameter on the flow field and heat transfer are critically analyzed. The results show that heat and mass transfer rates are lower for a micropolar nanofluid model when compared to the pure nanofluid model. The hybrid nanofluid exhibits more heat and mass transfer rates for thermal buoyancy dominated regime when compared with traditional nanofluid. Conversely, there shows an inverse trend in the case of the solutal buoyancy dominated regime. The enhancement of micropolar viscosity parameter results in a decrease of average Nusselt and Sherwood numbers which are more perceptible in the thermal buoyancy dominated flow. Three dimensional nature of the flow is deteriorated due to micropolar material parameter. Nanoparticle volume concentration mars both the strength and 3D features of the flow due to the enhancement of nanoparticles' volume fraction in thermal buoyancy dominated flow zones while it exhibits an inverse trend in the case of solutal buoyancy dominated zone.

Keywords: hybrid nanofluid, Double-diffusion, natural convection, Three-dimensional cavity, Micropolar nanofluid

Nanostructure and Property of Photocatalytic Electrospun TiO2-ZnO-CoO/ cPVDF Nanofiber Composite

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Abstract

Photocatalytic nanofiber composite is very important in advanced filtration applications. We have successfully synthesized photocatalytic electrospun TiO2-ZnO-CoO/cPVDF nanofiber composite using TiO2-ZnO-CoO nanoparticle, PVDF copolymer (cPVDF), and N-N DMAc as solvent by electrospinning process. Nanostructure and morphology of nanofibers were observed by scanning electron microscopy (SEM), nanostructure by Fourier transform microscopy (FTIR) and X-Ray diffraction (XRD). Nanofiber composite has no bead on nanofiber string, and diameter ranges between 43 nm to 444 nm. The average diameter of nanofiber composite was smaller than pristine PVDF copolymer nanofiber. The crystallinity of nanofiber composite and pristine PVDF copolymer nanofiber were 48.87 and 49.8, respectively. FTIR and XRD analysis showed that nanofiber composite has dominantly β-phase in cPVDF nanofiber composite. Nanofiber composite showed hydrophobic character. Spreading time on nanofiber surface of methylene blue water droplet was faster than methylene orange water droplet

Keyword: TiO2-ZnO-CoO/cPVDF, PVDF copolymer, TiO2-ZnO-CoO,

Synthesis, Characterization and Clinical Studies of Antibactericidal Porous Core Shell Silver – Zinc Oxide Nanorod

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Abstract

In this report, Synthesis, characterization of Silver (core) – porous Zinc-oxide (shell) and antibacterial effect of the nanocomposite rod were carried out on selected bacterial isolates from clinical origin. Ag and Ag - ZnO nanorod were synthesized using chemical reduction method, followed by calcination at 450oC. The synthesized nanocomposite was characterized using Scanning electron microscopy (SEM), X-ray photoelectron microscopy (XPS), Surface area energy dispersive spectrum (SAED), X-ray diffraction (XRD). SEM and TEM elucidate the surface morphology and confirms that the synthesized Ag-ZnO NC was truncated core – shell nanorod in which porous ZnO (11 nm) shell wraps Ag (56 nm) core. XPS measurement shows the elemental state of Ag and wurtzite structure of Ag-ZnO NC. XRD indicates the well-defined crystallinity hexagonal wurtzite structure. Antibacterial analysis test (antimicrobial susceptibility test, zone of inhibition of Ag- ZnO and minimum inhibitory concentration) was carried out on test organisms (Streptococcus spp, Citrobacter freundii, Methicillin-Resistant Staphylococcus aureus (MRSA) and Pseudomonas aeruginosa). These bacteriostat results can be used against the growth of microbes and can be used in diverse medicine practices for preventing pathogenic action of microbes and curing of diseases.

Keywords: anti-microbial agent, silver-zinc oxide nanorod, bacteriostat, minimum inhibitory concentration (MIC).

Synthesis and Structural Investigation of New Aceto Hydrazide Derivatives Using Microwave Irradiation

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Abstract

A New aceto hydrazide derivatives contain isatin ring were prepared through the reaction of Schiff base's ester with hydrazine hydrate. The procedure was carried out via Microwave irradiation (MW). The structures of obtained compounds were characterized by FT-IR, 1HNMR and 13CNMR spectroscopy. The reaction mechanism will be addressed.

Keywords: Isatin, Hydrazine Hydrate, Microwave Irradiation.

Amination of MWCNTs in RF-dielectric barrier discharge Ar-N_2-H_2 plasmas

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Abstract

In this work, simple route to introduce amine group on the surface of MWCNT using plasma technology has been introduced. The plasma treatment of MWCNTs has been performed at a fixed discharge power and treatment time of 6 min. The plasma was characterized by optical emission spectroscopy OES. The pristine and plasma-treated MWCNTs have been characterized by means of field emission scanning electron microscope FE-SEM, X-ray photoelectron spectroscopy (XPS), Raman spectroscopy and X-ray diffraction XRD. The results of OES shows beside the Ar ions, other bands related to species OH, N_2, CN, C_2 and $H_{\square}$, confirming the rich plasma environment and active interaction between the MWCNT and plasma species. The XPS results revealed that the nitrogen based functional groups (NH-C, NH-C=O) remarkably exists on MWCNTs-treated in Ar-N_2-H_2 plasma mixture. The Raman spectra analysis was found to be consistent with XPS results and confirm the functionalization of MWCNTs. The integrity of the MWCNTs treated in Ar-N_2-H_2 plasma mixture remained undamaged as observed by FE-SEM images and XRD results.

Keywords: Ar-N_2-H_2 plasma, MWCNT, plasma functionalization, XPS, Raman

One-pot Synthesis of Pd-based Bimetallic Nanostructures with Controlled Morphology and Dimensionality Evolution

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Abstract:

Controlling the morphology of noble metal-based nanostructures is a powerful strategy for optimizing their catalytic performance. Here, we report a one-pot aqueous synthesis of versatile NiPd nanostructures at room temperature without employing organic solvents or surfactants. The synthesis can be tuned to form zero-dimensional (0D) architectures, such as core–shell and hollow nanoparticles (NPs), as well as nanostructures with higher dimensionality, such as extended nanowire networks and threedimensional (3D) nanodendrites. The diverse morphologies were successfully obtained through modification of the HCl concentration in the Pd precursor solution, and the reaction aging time. An in-depth understanding of the formation mechanism and morphology evolution are described in detail. A key factor in the structural evolution of the nanostructures was the ability to tune the reduction rate and to protonate the citrate stabiliser by adding HCl. Spherical core–shell NPs were formed by the galvanic replacement-free deposition of Pd on Ni NPs which can be transformed to hollow NPs via a corrosion process. High concentrations of HCl led to the transition of isotropic spherical NPs into anisotropic wormlike nanowire networks, created through an oriented attachment process. Aging of these nanowire networks resulted in the formation of 3D porous nanodendrites via a corrosion process. The diverse structures of NiPd NPs were anchored onto acid treated-activated carbon (AC) and exhibited improved catalytic efficiency towards the hydrogenation of 4-nitrophenol (4-NP) to 4-aminophenol (4-AP).

Keywords: NiPd bimetallic nanoparticles, Shape control, Structural evolution, Core-shell structure, Hollow structure, Nanowire network structure, Dendritic structure, Reaction mechanism, Catalysts, 4-nitrophenol

Flexible Microfluidic Device with Nonplanar Interdigitated Microelectrodes

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Abstract:

Flexible lab-on-a-chip-based devices have improved significantly in recent years to meet global demand for various applications with the advent of new technologies. Though many advancements have been made, they still suffer from design limitations in terms of sensitivity and selectivity because they use rigid, fragile substrate materials and conventional electrodes. These limit the sensitivity and selectivity and suffer from a low signal-to-noise ratio (SNR). This work proposes a novel device architecture that uses flexible, transparent top and bottom substrates with (nonplanar interdigitated microelectrodes) sandwiching a microfluidic channel. The top and bottom substrates are transparent flexible materials such as polydimethylsiloxane, polyethylene terephthalate, or polybutylene adipate terephthalate (e.g., eco flex) with nonplanar interdigitated microelectrodes fabricated using standard techniques. In addition, the middle microfluidic channel is also made out of a transparent flexible, and stretchable material. This device architecture provides the following advantages over conventional devices: (a) a flexible design involving flexible materials that make it wearable and could be used in embedded systems and (b) high sensitivity resulting from nonplanar microelectrodes with different configurations that significantly improve the electric field penetration and SNR in the microfluidic channels. Furthermore, we packed the middle layer with various materials such as carbon nanotubes as transducers that further improved SNR and selectivity. We show that optical and electrochemical methods such as CV, EIS, and DPV can be implemented to create a multipurpose device or embedded system. Finally, we show the device's sensitivity and selectivity limits using single-stranded DNA and carbon nanotubes as the transducer.

Keywords: 3D nonplanar interdigitated microelectrodes, single-stranded DNA, wearable.

Poly(ethylene-co-vinyl alcohol) and Poly(ethylene-co-vinyl alcohol)/poly (δ -valerolactone) blend. Preparation, characterization and application as carrier in the in vitro aspirin delivery

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Abstract

Poly(ethylene-co-vinylalcohol) copolymer (PEVOH) and poly(ethylene-*co*-vinyl alcohol)/poly(δ-valerolactone) (PEVOH/PVAL) miscible blend were used as carriers to control the release dynamic of acetylsalicylic acid (Aspirin) as drug model from PEVOH/Aspirin and PEVAL/PVAL/Aspirin drug-carrier systems. To reach this goal, PEVOH/Aspirine and PVAL/PVAL/Aspirine with differente compositions were prepared by solvent casting route. The miscibility of these systems was studied and confirmed by using Fourier transform infrared spectroscopy, differential scanning calorimetry, X-ray diffraction, and scanning electronic microscopy methods. The dynamic mechanical properties of the blend with different compositions were examined by dynamic mechanical analysis and the results obtained showed intermediary mechanical properties between those of the two components. The tests of cell adhesion and growth on the pure PEVOH and PEVOH/PVAL specimens were performed using the 3-(4,5-demethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) method and the results obtained were the best performance in terms of cell viability, cell adhesion, and growth of the PEVAL/PVAL-50 material. In the light of the results obtained, the blend containing equal polymer compositions was chosen to carry out the study of the in vitro release of aspirin.This blend chosen as the best performing carrier was used to study the in vitro control of the release of Asperine from the PEVOH/PVAL drug-carrier system when administered orally. Different parameters influencing the dynamic release such as the Asprin content, the swelling rate and the pH media were investigated and the results were very promissing. Indeed, based on the data obtained and the gastrointestinal transit time reported by Beltzer et al., it was possible to estimate the distribution of the in vitro cumulative Aspirine released in different digestive system organs regardless of the actions of any enzymes and microorganisms and select the best-performing drug-carrier system.

Keywords: poly(ethylene-co- vinyl alcohol); poly(ethylene-co-vinylalcohol)/poly(δ-valerolactone)blend; acetyl salicylic acid, drug delivery; mechanical properties; cell adhesion and growth; distribution of cumulative aspirine released in different digestive organs.

Preparation and application of copolymers involving citric acid and glycerol as inhibitor of calcium carbonate deposition in water

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Abstract:

In this work, hyperbranched polyesters based on citric acid and glycerol was prepared by thermal polycondensation route.The new material obtained was characterized by different physicochemical techniques such as infrared Fourier transform (FT-IR) spectroscopy, carbon-13 nuclear magnetic resonance spectroscopy (^{13}C NMR) and differential scanning calorimetry (DSC). The study of the capacity of the prepared copolymer to inhibit the deposit of inorganic scales and more particularly calcium carbonate was carried out in different environments such as temperature, viscosity and pH media. The inhibition efficiency of this salt was examined using the inhibition method operating in static mode. The mechanism of inhibitor action was investigated by means of analysis of the growth solution, measurement of conductivity and analysis of $CaCO_3$ using FT-IR and scanning electron microscopy. The results obtained were very satisfactory and showed that the hyperbranched poly(citric acid-co-glycerol) was very effective at high temperatures in which 75% of efficiency was reached at 100 ° C in media pH 7.5 using a dose of 10 ppm of copolymer. On the other hand, using the same dose, the inhibition efficency (EI) reached 66% at 50 °C and in media pH10. It was also revealed that the copolymer did not chelate the calcium ions in the water, but led to a change in polymorphism and make them brittle and easy to slip off the surface. It turns out that its action mainly prevents the adhesion of calcium carbonate to the surface of the container.

Keywords: Poly(Citric acid-co-glycerol) hyperbranched polyesters; synthesis and characterization; inhibition of calcium carbonate deposition in domestic water; conductivity; static scale inhibition.

Poly(δ-Valerolactone) combined with/TiO_2 Nanohybrid Material with Pores Interconnected. Preparation characterization and Potential Use as Tissue Engineering

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Abstract:

Interconneced microporous nanohybrid materials involving titanium dioxide and poly (δ-valerolactone)(PVAL) have prepared by solvent casting and polymer melting methods. The interconnected pores sized between 80 and 150 µm homogenely dispersed in the hybrid materials were fabricated for the first time by sublimation of naphthalene microparticles used as porogen. The obtained materials were characterized by different techniques such as X-ray diffraction, differential scanning calorimetry, and scanning electron microscopy. The results obtained revealed a significant depression in the glass transition temperature and melting point compared to the samples prepared by solvent casting route. For the potential application of the prepared materials in the biomedical field, complementary analyses were performed to examine the dynamic mechanical properties, and cell adhesion (using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay), and the results obtained for the samples prepared by the two methods were compared. The results obtained were very promising. Indeed, among the results the very striking results obtained it was revealed from the comparative cell adhesion tests on the virgin polymer and hybrid materials revealed in general good viability and notably those containing 1% by weight of the TiO_2 nanofiller(PVL/TiO_2-1). A good compatibility between TiO_2 nanoparticles and the PVAL matrix was observed. The effect of TiO_2 nanoparticles on the viscoelastic properties of the prepared materials indicate that the dynamic mechanical properties of PVAL increased with increasing the nanofiller in the polymer matrix. The hardness parameters, Shore A and D values, of the nanohybrid material indicated a slight improvement in the polymer hardness after incorporation of nanoscale TiO_2 in the polymer matrix. Finally, through a comparative examination of these materials prepared by the two methods it was concluded that this study support the hypothesis that PVL/TiO_2-1 hybrid material can be an effective candidate for tissue engineering applications in the biomedical field, for improved cell adhesion and cell growth, notably so when this material is prepared by the solvent casting method.

Keywords: δ-valerolactone)/titanium oxide nanocomposite; naphthalene as porogen, cell adhesion; pore connection; Tissue Engineering; mechanical properties

Domestic poly(dimethylsiloxane)-based sealer as a pervaporation membrane used remove different organic volatile pollutants from waste water by pervaporation technique

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Abstract:

Domestic seal pol(dimethylsiloxane)(SILICONE1200) was used as a selective membrane for the first time in the removal of volatile organic fluids from supersaturated water by the pervaporation technique. Samples representing polluting volatile organic compounds released daily into water were chosen in this study. The compounds targeted by this study are alkyl halides, aromatics, aliphatic hydrocarbons, ketones, aldehydes and organosulfides. Different parameters influencing the efficiency of the separation such as membrane thickness, stirring rate and temperature were investigated. The mass transfer of these compounds and their mixtures through this economic membrane was evaluated to predict the results of the separation process. The results indicate that the mechanism of diffusion obeyed a Fickian model. The optimized parameters were then applied to the separation of an organic mixture from polluted water using the dynamic pervaporation process with promising results.

Keywords: : Domestic sealer poly(dimethylsiloxane) (SILICONE-1200), Organic volatile compounds, water supersaturated, pervaporation, selective separation.

Investigation into Properties of Polypropylene/Agricultural Waste and their Metal Oxide Hybrid Composites

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Abstract

Most of our polymers, a source to produce all sorts of plastic products nowadays are derived from non-renewable resources like fossil fuels. Reducing the consumption of these polymers and replacing them with wastes not only preserves natural resources but also protects the environment. In this work, an agricultural waste, rice husk (RH) was investigated to partially replace some amount of a common polymer in a sustainable polypropylene/rice husk (PP/RH) composites. An inorganic filler, titanium dioxide (TiO_2) was added to the composites and the effect on composites properties was investigated. These hybrid PP/RH/TiO_2 composites were prepared using a Brabender internal mixer. Tensile and thermal properties were investigated using an Instron universal testing machine (Model 3366) and a Mettler Toledo TGA/SDTA851, respectively. The results show that the presence of metal oxide, TiO_2 improved tensile properties of PP/RH composites. Tensile strength of hybrid composites was improved up to 21% (about 48 MPa) as well as higher than that of pure PP. Young's modulus of hybrid composites was significantly enhanced. The addition of TiO_2 into these plastics and agricultural waste composites improved the decomposition temperatures (Td) of composites but the temperature was slightly lower than that of pure PP. These findings reveal that partial plastics replacement with an agricultural waste and the presence of a metal oxide is another viable option to improve composite properties as well as to help preserve natural resources and protect the environment

Keywords: Polypropylene, Rice Husk, Titanium Dioxide, Hybrid Composite, Agricultural Waste

Inflammation Suppressing Nanoparticles for Enhanced Doxorubicin Uptake and Retention in Drug-Resistant Breast Cancer

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Abstract:

Multidrug resistance (MDR) and metastasis remain major challenges that account for the therapeutic failure against tumors. Currently, most efforts were focused on treating MDR symptoms rather than reversing it to restore the chemosensitivity of cancerous cells. This work reports a controlled nano-bio interface biomaterials to act as potent inflammation-suppressing nanoparticles (NPs), circumventing the resistance of breast tumor cells to chemotherapy. The inflammation-suppressing surfaces we developed for NPs consist mainly of hyaluronic acid (HA), a fine inflammation regulator generally recognized as safe materials by the FDA and integrative platform for CD44-mediated cell uptake of anticancer drug doxorubicin (DOX), as oppose to the pgp-membrane associated uptake. Alpha-1-acid glycoprotein (AGP), an anti-inflammatory glycoprotein, was functionalized onto the nanoparticles to boost the anti-inlfammatory effect followed by the robust cell apoptosis. The successful interaction between the HA NPs and the immobilized AGP not only creates a safe, yet stable spherical AGP-HA NPs with high dispersity, but also can suppress the inflammation of the tumor, resulting in a significant sensitization of drug resistant cancer cells. The findings showed synergistic antitumor effects between HA and AGP,where AGP-HA NPs can actively target MDR tumors and increase the cellular drug uptake and intranuclear drug delivery and retain effective drug accumulation inside the cells;as evidenced by the simultaneous inhibition of tumor proliferation and migration and the significantly enhanced efficacy of DOX post sensitizing MDA-MB-231. Hereafter, results suggest that AGP-HA NPs represent a viable and effective treatment option to strengthen the anticancer effects of chemotherapeutic agents and potentially improve patients' survival rate with metastatic breast cancer.

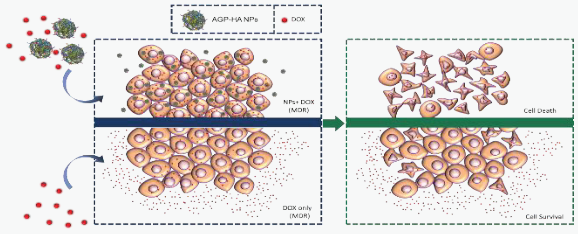

Figure 1. AGP-HA NPs can circumvent breast cancer cells and restore their drug sensitivity, and prevent their invasiveness.

Keywords: multidrug resistance (MDR), tumor metastasis, hyaluronic acid (HA) nanoparticles, alpha-1-acid glycoprotein (AGP), inflammation-suppressing nanoparticles).

Dye effect on the critical micelle concentrations of some surfactants in aqueous solution at 298.15 k

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Abstract

The present work aims to study the effect of cationic dye (methylene blue) on the critical micelle concentration of Alkyl Benzyl Dimethyl Ammonium Chloride (BAC) (50.0 %), and Cetyl Trimethyl Ammonium (CTMA) (30%) surfactants using conductivity measurements, surface tension and UV absorbance. The study will be taking place in aqueous solvents of methylene blue at room temperature (298.15 K).The conductivity measurements will be used to estimate the CMC and thermodynamic parameters for solvation process.

Keywords: BAC; CTMA; Conductivity; Surface tension; UV-Visible spectroscopy; Micellization.

Removal of basic fuchsine in aqueous solution via polystyrene modified with oleic acid

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Abstract

In the present work, we are interested in the study of removal of a cationic dye, Basic Fuchsin (BF), by polystyrene (PS) activated with Oleic acid (OA). This particular application was aimed at the purpose of wastewater treatment, which is part of the environmental field and contributes to the elimination and recovery of waste (dyes) resulting from industrial discharges, particularly textiles.

Polymeric films were developed using polystyrene as base polymer (PS) and acid extractant (OA). The polymeric films obtained are characterized by IR and DRX and then applied in the removal of a cationic dye (FB). After optimization of the parameters: OA / PS ratio, dye concentration, pH of the aqueous solution, stirring speed and temperature, an extraction yield of 93% was recorded. The thermodynamic study of the BF extraction reaction by the PS-AO matrix is exothermic and spontaneous.

Keywords: Polystyrène (PS), Acide Oléique (AO), extraction, Fuchsine basic (FB).

Chemical and mineral analysis of some marine organisms waste and possibility of their management

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Abstract

Nowadays, there is persistent industrial interest in natural compounds derived from marine organisms. Marine resources are organisms and attributes inhabit the sea that are considered to have value. the value may be intrinsic, or monetary. Currently, numerous medical compounds separated from marine resources. Shells of mollusca found in a huge amount in coastal regions of Egyptian Mediterranean sea and Red sea. The current study deals with studying the possibility of managing this waste. The salted bivalve *Donax semistriatus* (Common name: Om elkholol) is a common local sea food in Egypt. The proximate composition (on dry matter basis) of its shells revealed that the crud protein and fat were 0.46% and 0.47 respectively. While no carbohydrate was detected. Fibers and ash were 9.29% and 94.29% respectively .The minerals analysis of the clam shell indicated the presence of K, Zn, Fe, Mn, P in quantities of 472.13, 2.88, 19.75,14.38, 368.2 mg/kg respectively. Minerals are important for human and animals. The shells can be used in nutritional supplements industry especially with such a relatively large amount of phosphorous. Ca was present with a percentage of 16.52%. calcium supplements for lactating cows can be produced from clam shells. In addition, clam shells can be utilized in the production of bioceramic for human bone repair operations. Shells of bivalve can be used in many applications, such as the manufacture of feed for livestock and poultry. In addition, it can be used in the production of fertilizers. Heavy metals was also measured in the present study. Donax shells contains relatively high percentage of Pb (17%) while Cu and Co wasn't detected. So, the shells of bivalves can be used as bio-indicators for the assessment of pollution along a costal area.

Key words: Proximate composition, clam shells

Green accelerated solvent extraction (ASE) with solvent and temperature effect and green UHPLC-DAD analysis of phenolics in pepper fruit (Capsicum annum L.)

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Abstract

The study presents for the first time, a green and efficient accelerated solvent extraction (ASE) method for phenolic compounds (GA gallic acid, QT quercetin, RT rutin, LT luteolin) with simultaneous determination using a green and effective UHPLC-DAD method. The effect of solvents (ACE acetone, EtOH ethanol, and H2O water) and temperatures (60, 80, 100 ◦C) Vs extract yield and phenolic recovery was investigated. The scale-up for ASE-UHPLC method was accomplished in 27 food-grade samples of Capsicum annum/pepper fruit (PF). ASE-MD (method development) showed a high extract yield (198.23 mg/g) in water (33 mL) at 100 ◦C within a time frame of 19.5 min. UHPLC-DAD revealed more yield for GA in ACE whereas, for RT, QT, LT in EtOH at 60 ◦C. Binary solvent system (ACE: EtOH; 1:1) and 60 ◦C was optimized the extraction set. The UHPLC-MDMV showed a run time of 5 min with individual retention times of 0.667 (GA), 1.05 (RT), 3.24 (QT), and 3.78 (LT) in the linearity range (1–100 ppm). The average for phenolics (ppm) in 27 PF-food samples was; GA (19.46) > QT (10.19) > LT (4.06) > RT (2.41). SP4 (Spanish green bell pepper) sample showed more amount of total phenolics (32.52 ppm, 25.36 %) whereas, the order for individual phenolic amount (ppm) was; GA (53.39) > QT (13.58) > RT (10.04) > LT (4.62). Multivariate analysis resulted a significant correlation for solvent*temperature with extract yield but with a lack of correlation for phenolics amount. K-mean correlation was positive for solvent Vs phenolic yield ($P < 0.05$) whereas, extract yield and temperature were less significant for phenolics content. Solvent established a high significant role for extraction and phenolic recovery whereas, temperature was more significant for extract yield rather than phenolic amount.

Keywords: Pepper, Capsicum, Phenolics, Geographical origin, ASE, UHPLC.

Optimizing of Ibuprofen Removal Process by β-Cyclodextrins Polymer Using Response Surface Methodology

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Abstract

Response surface methodology was used to evaluate the adsorption capacity of a β-cyclodextrins biopolymer vis-a-vis a pharmaceutical residue: ibuprofen, chosen as a model pollutant. The polymer was synthesized by direct melt copolycondensation of β -cyclodextrins with a crosslinker, citric acid and without harmful organic solvents. Adsorption experiments were performed in a tubular fixed bed reactor operating in a closed system. A rotatable central composite design was used to investigate operatoire conditions that might affect ibuprofen removal from pharmaceutical waste water . The experimental design was done at five levels of the three operating parameters which were the initial ibuprofenconcentration, circulation speed and adsorbent mass. The polynomial second order model for ibuprofen adsorption yield (y) was developed and an optimizationstudy was done. The optimal conditions determined by using surface contour plots for initial ibuprofen concentration, circulation speed and adsorbent mass were 16.32 mg/L, 15.39 rpm and 147.50 mg, respectively. Under these conditions, the ibuprofen adsorption yield was of 78.54 %.

The obtained model showed that there are no interactions between the three factors chosen in the study domain. The adsorption kinetics follow a first order model, the Langmuir and Freundlich models fit the equilibrium data . The β-cyclodextrins polymer may be successfully used for the treatment of pharmaceutical waste water and for the removal of trace pollutant from drinking water.

Keywords: Ibuprofen, adsorption, β-cyclodextrins biopolymer, fixed bed reactor, response surfacemethodology.

Synthesis, Characterization and Photo-catalysis Activity of ZnO Nano-particles Synthesized by Co-precipitation Method

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Abstract

Synthesis of ZnO nanoparticles using co-precipitation method for photo-catalytic application has been presented. The physicochemical characterizations of the synthesized ZnO were investigated by scanning electron microscope SEM, X-Ray diffraction spectroscopy XRD and UV-Vis spectroscopy. Methylene blue dye was used as model of organic dye contamination. The synthesized ZnO nanoparticles size were ranging from 35-80 nm and has a hexagonal (wurtzite) structure. The UV-Vis absorption spectrum revealed narrow peak at 376 nm and the estimated band gap was 3 eV. The synthesized Zno nanoparticles shows excellent photocatalytic activity with MB degradation efficiency up to ~97 %.

Keywords: ZnO nanoparticle; water pollution; photo-catalysis; UV-Vis. absorption; XRD; Methylene blue

Structural, antibacterial activity and dielectric investigations of chitosan/ionic liquid composite films

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Abstract

Chitosan/ionic liquid (Cs/ILs) composite films have been prepared by casting method in an aqueous solution at different concentrations. Cs/1-butyl-3-methylimidazolium based ILs with tetrafluoroborate ([BMIM][BF_4]) and trifluoromethanesulfonate ([BMIM][TfO]) anions have been used as a model systems for our investigations. ATR-FTIR spectroscopy, UV-vis spectroscopy and scanning electron microscopy (SEM) have been employed to investigate the structure while thermogravimetric and differential thermogravimetric analysis (TGA/DTA) were used to study the thermal stability of the prepared films. The antibacterial activities of Cs/ILs composite films have been tested against gram-positive and gram-negative bacterial strains. Broadband dielectric spectroscopy (BDS) have been employed to probe the molecular dynamics and electrical conductivity of the films in broad temperature and frequency ranges. Structural investigations confirmed the interaction between Cs and ILs. The antibacterial results demonstrated that both ILs have antibacterial activity against gram-positive and gram-negative bacteria. Dielectric measurements revealed an enhancement in the dielectric constant and electrical conductivity with increasing the content of ILs.

Keywords: [BMIM][BF_4], [BMIM][TfO], ATR-FTIR spectroscopy, UV–vis. spectroscopy, antibacterial activity, Broadband dielectric spectroscopy (BDS)

USE OF MICROSPONGES AS A NOVEL DRUG CARRIER

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Abstract

Targeted Drug Delivery (TDS) has revolutionized drug therapy as it aims to target specific regions in the body and brings about cure effectively while also reducing potential side effects and reducing the need for repeated dosage. This study aims to study the role of microsponges for targeted drug delivery. Loperamide loaded microsponges were prepared using Quasi Emulsion Solvent Diffusion (QESD) method using three grades of Eudragit as polymer. Production Yield (PY), Encapsulation Efficiency (EE), Actual Drug Content (ADC), In-vitro release study and Kinetic Modelling was carried out. Particle size and porosity were determined through SEM. The microsponges ranged in size from 152.2µm to 257.7µm with pores that ranged from 1.520µm to 2.57µm. A mean production yield of 77.46% was obtained while encapsulation efficiency of M-1 formulation came out to be 86.22%. M-1 formulation showed a drug release of 77.16% over a period of 5 hours. M-1 formulation was used for kinetic modelling studies and they followed First order and Higuchi model. Korsmeyer-Peppas model suggested that the microsponges followed Fickian diffusion. The study concludes that microsponges can effectively be used for targeted drug delivery in a sustained manner.

Keywords: Microsponge, Loperamide, microsponges, Higuchi model, Korsmeyer-Peppas model

Soret and Dufour Effects on Heat And Mass Transfer By Unsteady Free Convection Flow of a Viscoelastic Fluid Past a Vertical Surface

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Abstract

The present investagtion concentrates on the heat and mass transport by unsteady magneto-free convection flow of a viscoelastic fluid past a vertical surface in the presence of chemical reaction, Soret and Dufour effects.The governing system of partial differential equations with favorable boundary conditions is first non - dimensionalised and then solved using the implicit Crank-Nicolson finite difference scheme.Numerical calculations were performed for various values of the different dimensionless parameters controlling the flow regime such as the the velocity, temperature and concentration distributions. Additionally the local skin-friction, Nusselt number and Sherwood number are also graphed and examined.It is concluded that increasing second grade parameter leads to reduce the skin-friction coefficient in the absence of chemical reaction effect, but the reverse trend happened in the presence of chemical reaction effect. In addition, it is found the Nusselt numberis enhanced as second gradeand chemical reaction are increased. Moreover, it found that the local Sherwood number is increased, while both the skin-friction coefficient and the Nusselt number as chemical reaction paramter raised.

Keywords: Soret and Dufour Effects, Crank-Nicolson finite difference scheme

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Magneto-Mixed Convection Flow and Heat Transport past a Solid Sphere in a Saturated Porous Media

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Abstract

The present study examines the magneto-mixed convection flow of anelectrically-conducting heat-generating or absorbing fluid around solid sphere with a constant surface temperature and embedded in a fluid-saturated porous medium in a stream flowing vertically upwards with internal heat generation. Both the cases of a heated (assisting flow) and a cooled (opposing flow) sphere are considered withcombined effects of the permeability of medium due to the solid matrix of non-Darcy porous medium and uniform magnetic field. An appropriate transformation is employed and the transformed equations are solved numerically using the second- level local non-similarity method. Comparisons with previously published work are performed and the results are found to be in excellent agreement. Numerical values of physical quantities, such as the local skin-friction coefficient and the local heat transfer are presented in tabular form for different values of magnetic field as well as the permeability of porous medium with heat source (sink) parameter against the mixed convection parameter at the lower stagnation point of the sphere. Effects of these physical parameters are conducted for different values of mixed convection parameter and a representative set of graphical results for the velocity and temperatureprofiles as well as the local skin-friction and local wall heat transfer coefficients are reported and discussed.

Keywords: skin-friction, Mixed convection, Porous medium, Solid sphere.

Erdosteine drug as a safe inhibitor for stainless steel 304L Corrosion in Hydrochloric Acid Solution

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Abstract

The effect of a new class of corrosion inhibitor, namely, Erdosteine drug on stainless steel 304L (304L SS) corrosion was investigated as potential corrosion inhibitor in 1 M HCl solution at 25°C. Measurements were conducted utilized weight loss (WL), electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization (PP) tests. Electrochemical results showed that this compound is efficient inhibitor for SS304L and the efficiency reached to 90 % at 300 ppm. The inhibition efficiency increases with the inhibitor concentration and decreases with increasing temperature. The adsorption of this compound on 304L SSL surface follows Langmuir adsorption isotherm. The polarization data showed that this extract decreased the corrosion current density by a mixed mode mechanism. The thermodynamic functions of activation and adsorption processes were calculated and discussed. The surface morphology of the 304L SSL specimens was evaluated using Atomic Force Microscopy (AFM), X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy (FTIR). Results obtain for all methods used are in good agreement.

Elastic and viscoelastic behavior of composite plates reinforced with synthetic and natural fibers for civil and aerospace engineering applications

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Abstract

Composites are used in civil engineering applications subject to low and medium loading frequencies and in aerospace applications of medium and high loading frequency. For this type of loadings, the viscoelastic behavior has a great importance on the behavior of composite structures. The study of viscoelastic behavior for composites is a critical element in the design of structures subjected to vibration or undergoing non-static, time-varying, loads. The objective of this paper is to study the static elastic, vibratory and viscoelastic behavior of an epoxy/carbon and an epoxy/natural alfa fiber composite by different analytical and numerical approaches. A symmetrical laminate and an anti-symmetrical 2mm thin laminate composed of 9 plies have been studied for the two types of fibers. The stresses and strains resulting from tensile stresses in the overall laminate were determined. Stresses and strains are calculated in each ply and for the overall composite plate. The numerical finite element models gave the same results as the analytical models, e.g., the deformation along the x-axis is equal to 8.11e-3 from the analytical model and 8.16e-3 from the finite element model for the symmetric laminate made from Epoxy/Carbon60% composite plies. The modal analysis shows that the first frequency of the symmetrical composite [0/+45/-45/60/0/60/-45/+45/0] is equal to 4.16Hz and higher than the first frequency of the anti-symmetrical composite which first frequency is 2.61Hz made from Epoxy/Carbon60%. Regarding the visco-elastic behavior, the relaxation test of a 2 mm plate shows fast stabilization of the stresses for the Carbon/Epoxy60% composite and a stabilization after 20 minutes for PMMA/Alfa45% composite. This leads us to conclude that for applications where the loading varies in less than 20 minutes, the effect of viscoelasticity cannot be neglected for the PMMA/Alfa45% composite plates. PMMA/Alfa 45% composite can be a good candidate for civil engineering applications.

Keywords: composites, viscoelasticity, PMMA/Alfa 45% composite.

Characterization of surface integrity produced by various finishing processes of AISI 52100 bearing rings

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Abstract

Surface integrity induced by finishing processes affect significantly the functional performance of machined components. In this work, three kinds of finishing processes, i.e., precision hard turning, grinding, and sequential grinding and honing processes were used. The surface integrity of AISI 52100 bearing rings induced from these finishing processes was studied via SEM investigations, roughness measurements, and residual stresses measurements. As main results, the SEM observations of the transversal cross-section show that precision hard turning and grinding processes introduce microstructural changes. Indeed, in precision hard turning a fine white layer (<1µm) is observed on the top surface followed by a thermal affected zone in the sub-surface; and in grinding only a white layer with 5 µm thickness is observed. However, no microstructural changes are found after sequential grinding and honing processes. Moreover, the investigations show that precision hard turning allows producing low surface roughness (Ra=0.1) and better functional performance that those obtained by grinding, and sequential grinding and honing processes where the surface roughness values are Ra=0.2 µm and Ra=0.05 µm, respectively.

Keywords: Surface integrity, AISI 52100, finishing processes, functional performance.

Structural and electrical Properties of the Nanocomposites PMMA/PANI Synthesized by in situ Polymerization

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Abstract

the novelties of this work in the fabrication of new PMMA/PANI composites by one step under well-studied operating conditions in order to obtain on another structure than the core-sell (to have the PANI a lain of the chains of PMMA). The originality of this work is the polymerization of aniline in the presence of malic acid (diacid carboxylic with hydroxyl function) as dopant and compatibilizing agent between PANI and the matrix, moreover, the in situ polymerization process took place in the presence of two solvents which are miscible, the polymerization was carried out in a continuous organic phase which could influence and improve the physico-chemical properties of the composites.

Poly (methyl methacrylate) (PMMA)/ Polyaniline (PANI) composites films were elaborated by in situ chemical oxidative polymerization. PANI was doped by malic acid (MA). This later was synthesized by interfacial chemical oxidation performed in an aqueous MA/aniline biphasic system in the presence of ammonium persulfate (APS) as oxidant agent, while the matrix PMMA was prepared by emulsion in the presence of sodium dodecyl sulfonic (SDS) as surfactant and APS as initiator. The samples prepared were analyzed by various characterization techniques: Spectroscopic (FTIR, ATR), thermal (DSC), structural (XRD), NMR and electrical conductivity by four points. The present paper reports the preparation of conductive composites combined by conducting polymer polyaniline with thermoplastic poly (methyl methacrylate) (PMMA) where in the composites retain the mechanical and optical properties of this conventional polymer used in our study and the electrical conductivity of the intrinsic conducting polymer. These optical conductive composites are promising for applications in the field of optoelectronic devices as sensor and optoelectrical fiber.

Keywords: Polyaniline, PMMA, malic acid, in situ polymerization

Structure, Optical and Spectroscopic properties of ZnO nano-flowers grown using hydrothermal Method

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Abstract

In this work, ZnO nano-flowers (with dia. 1-2 $\mu $m) have been synthesized using hydrothermal method at various growth time. The synthesized ZnO flowers have been fully characterized using scanning electron microscope SEM, X-Ray diffraction spectroscopy XRD, X-ray photoelectrons spectroscopy XPS, Raman spectroscopy and UV-Vis spectroscopy. As the growth time increase, the ZnO nanoflowr develop to resembles a full bloom flower. The nanoflowers composed of nano-petals irradiated out from center nucleus. The structure of ZnO nano-flower is trigonal with hexagonal axes as inferred from XRD pattern analysis. The XPS confirm the purity of the synthesized ZnO and the oxidation state of both Zn and O elements. The Raman spectra of ZnO nanoflower agrees well with XRD and XPS results and indicate the presence of oxygen vacancies. UV-Vis absorption spectrum peaked at 367 nm and the calculated band gap was 3.12 eV.

Keywords: ZnO nanoparticle; water pollution; photo-catalysis; UV-Vis. absorption; XRD; Methylene blue

Heat Generation of Fe_3O_4 Nanoparticles Under AC Magnetic Field for Breast Cancer Therapy

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Abstract

The sample of Fe_3O_4 magnetic nanoparticles (MNPs) were synthesized via co - precipitation method from ferrous and ferric solutions. X-Ray Diffraction (XRD) and Transmission Electron Microscopy (TEM) were used to characterize the powder synthesized of the sample. The average lattice parameter and the average size are; a = 8.4 Å and t = 12 nm. The Vibrating Sample Magnetometer (VSM) was used at room temperature to measure the saturation magnetization (Ms), coercive force (Hc) and remanence (Mr), Ms = 50 emu/g, Hc = 2 emu/g and Mr = 0 Oe. Induction heater was used to study the thermal properties of the sample. The maximum temperature (T = 46.5 ^{o}C), the heating rate ($\Delta T/\Delta t$ =19.4x10^{-3} ^{o}C/ sec) and the specific absorption rate (SAR = 40 W/g). These values of the size and thermal properties of the Fe_3O_4 MNPs sample indicating to use this sample in the magnetic hyperthermia treatment (MHT) for breast cancer therapy.

Keywords: Fe_3O_4, heat generation, hyperthermia.

Electrochemical studies of expired vancomycine drug forStainless steel 304L in aqueous acidic medium

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Abstract:

Vancomycin drug is considered a good inhibitor to protect the stainless steel 304L (SS304L) in one molar of hydrochloric acid from corrosion, as it was found from the results of chemical methodssuch as the method of weight reduction (WR) and also from the results of electrochemical methods [potentiodynamic (PP) and AC impedance measurements (EIS)] techniques, and surface checks were used to illustrate the importance of vancomycin compound to the corrosion protection process for SS304L. The tests displayed that the inhibition efficiency (IE%) of SS304L corrosion improved as the dosage of these drugs increased, and decreased as the temperature range increased. The adsorption of vancomycin on the surface of SS304L obeyed isothermic Langmuir adsorption. Scanning of electron Atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FTIR) and X-ray XPS studied the morphology of inhibited SS304L.

Brushite: synthesis, properties, and bone tissue applications

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Abstract

In this paper, besides its biomedical applications, the synthesis, and properties of brushite were investigated. Brushite consists two types of crystals, platy and needle-like, and their formation depends on the pH of the medium during precipitation. Platy crystals are formed in a slightly acidic medium, pH = 5, and needle-like crystals at a higher pH, 6.5-7. In this study, the monoclinic

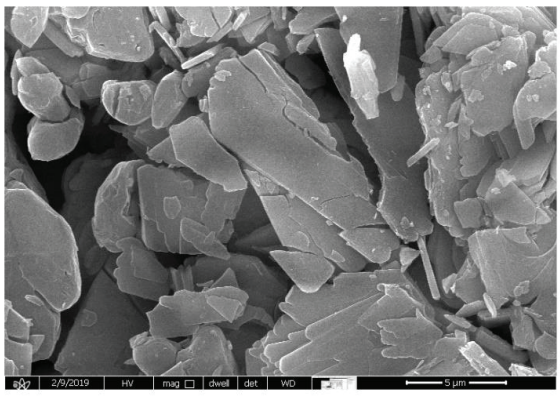

Figure1, SEM image of monoclinic brushite crystals

brushite crystals were synthesized using dissolution-precipitation reactions. It is found that the brushite crystal growth occurs mainly along the (020) crystallographic plane. The TG analysis confirms the presence of the two structural water molecules, which decompose at temperature range between 80 and 220 °C. Brushite was used in the preparation of tetra-calcium phosphate mineral, which is the powder component for calcium phosphate cement (CPC). CPC was subsequently prepared from TTCP and phosphate-based hardening solution. *In vitro* evaluation of the resultant CPC using Hanks' Balanced Salt Solution results in growth of nano fibrous crystals of Calcium-deficient hydroxyapatite (CDH) layers on the surfaces of the CPC. The cultured CPC exhibits new connective tissues and throughout the CaP matrix.

Key words: Brushite, Hydroxyapatite, Tetra calcium phosphates, bioactivity, Porosity.

Electrochemical and Quantum Chemical Studies for Expired Famotidine Drug as a Safe Corrosion Inhibitor for α-Brass in HCl Solution

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Abstract

Expired Famotidine was tested as a corrosion protection for α -brass in 1 M HCl using modified methods: weight loss (WL), Tafel polarization (TP), AC impedance spectra (EIS) and electrochemical frequency modulation (EFM). The polarization resistance (R_p) data increased with increasing famotidine dose. The inhibition efficiency (IE) improved with raising famotidine concentration. The maximum IE of 90% has been achieved at 300 ppm. On the other hand, the efficiency lowered with temperature increased. The outcome data obtained revealed that famotidine performed excellently as a corrosion inhibitor for □-brass in this medium at dissimilar temperatures. The surface of □-brass was tested utilizing scanning electron microscope (SEM), energy dispersion spectroscopy X-ray spectra (EDX), Fourier transform infrared spectroscopy (FT– IR), and atomic force microscopy (AFM analysis).

Keywords: Famotidine Drug, α –brass, Corrosion, SEM, EDX, AFM

New Novel Insulation Materials Produced from Agro Wasted Materials and Their Hybrids

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Abstract

The international trend nowadays is to use natural insulating materials in buildings to be safe for human beings and to lower the environmental impact. Fibers extracted from the pods of the Apple of Sodom (AOS) plant are confirmed to have lower thermal conductivity compared to those extracted from synthetic fibers and close to the ASME standard. Apple of Sodom is an environmental invasive and it considered as a weed and it usually controlled by several herbicides to be effective as foliar spray, cut stump, or basal bark methods of control. This presentation shows the other promising good side of such plant, since the fibers extracted from its seed pods can be used as a thermal insulating and absorbing sound materials in building. Thermal analysis, acoustic characteristics and the microstructure of the Apple of Sodom fibers will be presented. Sample specimens are developed from the fibers of such plants in the lab scale using cornstarch as a binder to determine its thermal conductivity and its applicability to be used as insulating material for buildings. Other specimens are made as hybrid between the Apple of Sodom fibers and other wasted materials such as palm tree surface fibers (PTSF). Thermogravimetric analysis (TGA and DTGA) are obtained showing the stability of both fibers. The differential scanning calorimetry (DSC) analysis is also reported for all fibers and shows a broad endothermic transition indicating the melting point of the fibers. Sound absorption coefficients are obtained for the hybrid samples and indicate the potential of using these samples for sound absorption. Results also show that the average thermal conductivity at temperature range 10^{o}C to 60^{o}C of the developed specimens has average values of 0.0418 - 0.0568 W/m K.

Keywords: Wasted palm tree surface fibers, Apple of Sodom fibers, Insulation building materials, Hybrid insulating materials.

Fig. 1. Apple of Sodom fibers as a new thermal insulating material

Fig. 2. Hybrid specimen made of Apple of Sodom and palm tree surface fibers as a new thermal insulating material

Synthesis and Characterization of Bimetallic Vanadium Oxides/oxyhydroxides Precursors

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Abstract

Bimetallic vanadium oxides/oxyhydroxides were successfully synthesized using low temperature single source molecular precursor. Infrared spectroscopy, thermal gravimetric analysis, and X-ray powder diffraction was employed to characterize the precursor compounds and the corresponding metal orthovanadates. The influence of the reaction time, temperature, and the precursor's stoichiometry on the decomposition temperature, particle size, and surface area of resulting metal orthovanadates will be illustrated.

Keywords: Bimetallic vanadium oxides, Low temperature single source molecular precursor Metal orthovanadates

Photoionization of Alkaline earth metal-ammonia complexes: combined experimental and theoretical study

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Abstract

Ionization energies have been determined using photoionization mass spectrometry for Ca(NH3)n, and Sr(NH3)n complexes first time. Ab initio calculations have been carried out on both the neutral complexes and their cations to assist the interpretation of the photoionization data. In this study results show that the inner solvation shell around the calcium and strontium atoms can accommodate a maximum of eight ammonia molecules, although in both cases a two-shell structure is energetically preferred for $n \geq 9$.

Keywords: Photoionization, mass spectrometry, Alkaline earth metal-ammonia complexes

Mn^{II}, Co^{II}, Ni^{II}, Cu^{II} - oxaloyldihydrazone complexes: Structure, morphology and electrical conductivity investigation

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Abstract: Organic ligands or carbon containing compounds are predominatingly nonconductive / weak conductors. Addition of transition metals to organic ligand is expected to improve their electrical properties. We aim to upgrade the electrical conductivity of bis(2-hydroxybenzaldehyde)oxaloyldihydrazone ligand by adding some transition metals to its structure. General condensation methodology was utilized to prepare the ligand derived from the 2-hydroxybenzaldehyde and oxaloyldihydrazide. The structure of examined ligand / complexes have been established based on the spectral (FT-IR, ^{1}H-NMR, mass, UV-Vis.), elemental analyses, thermal (TGA) and magnetic measurements. Scanning electron microscope (SEM) helped to portray the surface morphology of the metal complexes. Oxaloyldihydrazone ligand was coordinated to the Ni^{II} and Co^{II} ions in a bi and tetra-dentate way, respectively, giving mono-nuclear complexes. Meanwhile, it was linked with Mn^{II} and Cu^{II} ions in a penta and hexa-dentate mannar, respectively, forming bi-nuclear complexes. Except for the tetrahedral nickel complex, all complexes have octahedral arrangements. The DC and AC conductivity of the separated compounds were researched in the temperature ranges 303–573 and 300–625 K (in the frequency region of 1–100 kHz), respectively, and impact of Mn^{II}, Co^{II}, Ni^{II} and Cu^{II} ions on the conductivity rate has been inspected. Concerning DC electrical examinations, all species have positive temperature coefficients of electrical conductivity ($d\sigma/dT$). Therefore, all species have semiconducting behavior. Further, both DC and AC conductivity of all species revealed a quick increasing rate at high temperatures and a little increasing rate at low temperatures reffering the conductivity is a thermally activated process at high temperatures. Worthy mention, the Mn^{II}-complex exhibited higher conductivity compared with other samples. The dielectric permittivity was measured at various frequencies (100, 10, 1 kHz) in the temperature range 300–625 K and diminished with raising the frequency indicating a typical behavior of electrical insulators. Promising features of the electrical estimations suggest that Mn^{II}-complex is recommended for electronic applications.

Keywords: Diydrazone complexes, Structural studies, Electrical activity, Dielectric permittivity.

New gold 2D-MX2 nanocomposite based chemical sensor

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Abstract

After the isolation of graphene, transition metal dichalcogenides (TMDCs) materials have gained tremendous attention thanks to their outstanding features as indirect-direct bandgap crossover, high surface to volume ratio, high carrier mobility… Thus, they become an alternative solution for many issues such as fire detection, purifying polluted water… Molybdenum disulphide (MoS_2) and tungsten disulphide (WS_2) belong to the TMDCs family are chosen due to their important features. Thes are considered one of the best candidates for Raman enhancement techniques known as surface-enhanced Raman scattering (SERS) and photo-induced Raman scattering (PIERS). They are specific and sensitive for the detection of analyte traces. Hence, these substrates are promising in the sensing field such as chemical, biological, humidity sensors. Until now, the specific origin of the enhancement occurring is still in debate. Howerever, two mechanisms behind this enhancement are proposed; electromagnetic mechanism (EM) and the charge transfer (CT) . The EM enhancement factor (EF) can reach over 10^8 while that of CT is on the order of 10^1 to 10^3. Herein, the PIERS and SERS substrates are a heterostructure MoS_2 and WS_2 decorated with the gold nanoparticles (AuNPs) because their inert and stainless, making it the best candidate for biological and chemical sensors. These platforms are used for 4-mercaptobenzoic acid (MBA) detection. The EF of both substrates was found on the order of 10^6 that is in the known range. The pure MX_2 Raman data are used to estimate the number of layers of our samples, which was equal to 5 for MoS_2 and 4 for WS_2. Finally, using UV-Vis data the electron density and the recovery time of our PIERS sensors are determined.

Keyword: TMDCs, Tungsten disulphide, Molybdenum disulphide, Surface-enhanced Raman scattering, Photo-induced Raman scattering, Electromagnetic mechanism

Clinopodium acinos extract as green corrosion inhibitor for mild steel in hydrochloric acid solution

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Abstract

Clinopodium acinos extract used as anti-corrosion for mild steel in 2M hydrochloric acid solution. The mass reduction, electrochemical impedance, and potentiodynamic polarization were carried out to demonstrate the performance of Clinopodium acinos extract as corrosion resistance for mild steel. Polarization revealed that the Clinopodium acinos extract is mixed type inhibitor with superiority to inhibiting the cathodic reaction. The inhibition percentage reaches 98% at 150 ppm extract. Adsorption of the extract on mild steel surface is regular with temkin adsorption model. Thermodynamic factors for adsorption and activation processes for mild steel dissolution were estimated and discussed. Furthermore, the mild steel surface is characterized using different techniques. The surface morphology of mild steel was tested utilizing several techniques.

Keywords: Clinopodium acinos, corrosion, temkin adsorption model

Study the Modulational Instability with Two-Temperature Dusty Plasmas and Nonthermal Ions in Saturn F-rings.

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Abstract

In this work, we study the modulational stability (MI) and the properties of nonlinear dust-acoustic waves in an unmagnetized collisionless four-component dusty plasma system consisting of electrons, nonthermal ions, hot and cold dust species have been investigated. The basic set of fluid equations is reduced to a nonlinear Schrödinger equation via the derivative expansion method. The conditions on the coefficients of dispersion and nonlinear terms of this equation have been checked for both stable and unstable regions in our plasma system. It is found that the negative sign for the product of the coefficients of dispersion and nonlinear terms is required for the modulational stability of the waves while positive sign is allowed for a random perturbation of the amplitude leading to growing and a very huge wave may be created. Accordingly, the modulational instability, modulational instability growth rate and rational solution for rogue waves are discussed.

Keywords: Nonlinear Schrödinger Equation; Modulation Instability, Nonthermal Ions, Dusty Plasma.

Utilization of Local Silica Sand and plastic Wastes for Developing a Greenhouse Materials

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Abstract

The exploitation of recyclable, natural and environment friendly materials is rapidly increasing for various industrial applications. These materials include both agricultural and plastic wastes. This is due to certain characteristics such as abundance, ease of processing, low density and cost as well as environmental conservation. In this project, efforts have been made to take advantage of plastic waste and natural sand. The later collected from Hail city, north of Kingdom of Saudi Arabia. It was cleaned, grinded to nanosized using mechanical treatment followed by a heat treatment in present of carbon materials to remove oxygen. This reduction into small sizes without any chemical treatment is feasible choice from both commercial and environmental point of view. On the other hand, plastic bottles made from high density polyethylene were collected from private home in Riyadh. It was cleaned and then recycled mechanically to be mixed with sand at different loading. The obtained raw materials compounded together using an extrusion process followed by hot press technique to obtained a flexible films. Physical, thermal and mechanical properties of obtained composite materials characterized by a wide range of analytical and testing techniques. The results showed that the initial thermal decomposition of composite materials > 180 ºC, density ~ 1.2 g/cm^3 and tensile strength ~ 30 MPa. Also, these materials are well known as resistant materials to ultraviolet rays. These results indicate that the investigated composite materials could be utilized as protect greenhouse in term of strength and thermal stability.

Keywords: Silica, Hot press technique, greenhouse

Structural, dielectric, electrocaloric properties, and energy storage density of $Ba_{0.95}Ca_{0.05}(Ti_{0.95}Zr_{0.05})_{1-x}(Zn_{1/3}Nb_{2/3})_xO_3$ lead-free perovskite materials

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Abstract:

The ferroelectrics materials have attracted great attention thanks to of dielectric, piezoelectric, electrocaloric properties, and more recently energy storage [1]. Among these materials, $PbTiZrO_3$ (PZT) represents one of the most important ones that are used in the production of electronic devices [3]. However, concerning materials toxicity, various research works have focused on finding new lead-free ferroelectric materials. Barium titanate $BaTiO_3$ (BT) is one of environment friendly lead-free materials studied for applications, such as the piezoelectric transducer, the sensors, the refrigeration, and the capacitor [2]. This compound presents a polymorphic phase transition (PPT) (i.e. rhombohedral–orthorhombic (R-O) at 200 K, orthorhombic–tetragonal (O-T) at 279 K, and tetragonal–cubic (T-C) at 400 K) [4]. An approach to generate the best physical properties in BT consists of the addition in site A or/ and B for shifting the T-O phase transition boundary close to the room temperature (RT).

It is this context that this study lies to explore the effect of the substitution of Ti^{4+} by Zn^{2+} and Nb^{5+} on the physical properties of $Ba_{0.95}Ca_{0.05}(Ti_{0.95}Zr_{0.05})_{1-x}$ $(Zn_{1/3}Nb_{2/3})_xO_3$ (BCZTxZN), with $0 < x < 0.020$. The compositions were synthesized by solid-state. The Morphotropic phase boundary (MPB) region, from the tetragonal to orthorhombic symmetry (O-T) at room temperature (RT), was identified of all samples by X-ray diffraction analysis (XRD). The maximum of permittivity changed with the introduced of Zn2+ and Nb^{5+} in the matrix of BCZT ceramic. The optimal ferroelectric properties were $P_r = 5.89\ \mu C/cm^2$ and $E_c = 4.82$ kV/cm in the BCZT10ZN material (Figure 1).

Besides, this sample exhibited energy storage density properties at RT ($W_{rec} = 66.69 mJ/cm^3$ and = 37%). Furthermore, an electrocaloric effect ($\Delta T = 0.33$ K at 30 kV/cm) was determined using an indirect method near the RT for the sample x = 0.020.

keyword: dielectric, electrocaloric properties, and energy storage

Removal of Crystal Violet from waste water using micro-nanoclay as Natural Adsorbent

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Abstract

The study designed to assessing the efficiency of utilizing nanoclay as cheap material for Crystal Violet dye adsorption from wastewater. The effect of various factors (like contact time, pH, adsorbent's dosage, temperature, initial dye concentration) on adsorption process have been carried out. Nanoclay samples were obtained by treating natural clay materials compiled from numerous places at Albaha region-Saudi Arabia. The shape and structure of micro-nanoclay adsorbents were characterized by several methods like SEM-EDX, FTIR, XRF, XRD, and ICP-MS. The XRF revealed that the main ingredients of nanoclays were found to be SiO_2, Al_2O_3, Fe_2O_3, K_2O, CaO, MgO, and the rest are impurities. The Thermodynamic experiment indicated that the adsorption process is spontaneous, physisorption, and exothermic. Hence, the examined natural nanoclay adsorbent is an effective adsorbent for dye removal from wastewater.

Keywords: Natural micro-nanoclay; crystal violet; adsorption; kinetic models; adsorption isotherm; biological activity.

Synthesis and characterization of rod-like Nano-hydroxyapatite for biomedical applications

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Abstract

Calcium phosphate powder consisting nanocrystals of rod-like calcium deficient hydroxyapatite (CDHA) was prepared using homogeneous precipitation method. This nano-powder exhibits similar biological characteristics to osteoconductive calcium phosphates. The synthesized rod-like hydroxyapatite crystals have a length of approximately 300 nm and a diameter of some 70 nm. The hydroxyapatite crystals consisting molar ratio of Ca/P is about 1.62, while the standard ratio is 1.67. Reducing the calcium contents improves the bioactivity of this bio-mineral. Rod-like hydroxyapatite is known to exhibit high mechanical properties, i.e. tensile strength, due to a synergy of the rods, toughness, and pullout characteristics. The nano CDHA was used as precursor to produce bioceramics after sintering at 1100 °C. Sintering the powder at 1100°C for 4 h caused a morphological change in the crystals structure; equal-axed macro calcium deficient hydroxyapatite (CDHA and Tricalcium phosphate (TCP) are formed.

Keywords: Hydroxyapatite, Nano powder, Bioactivity, Calcium Phosphates, rod-like crystals.

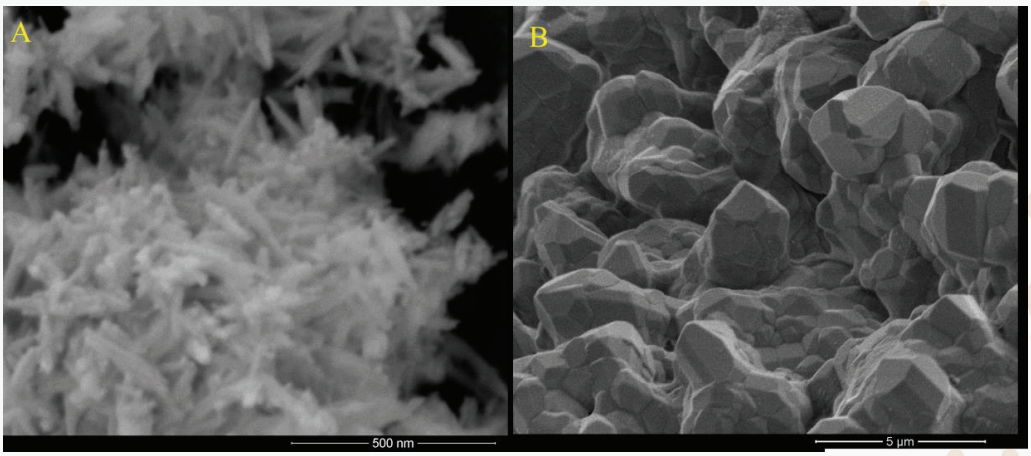

Figure1, SEM image of rod-like Nano-hydroxyapatite crystals, (A), and bioceramics (B)

Using waste glass in the fabrication of reflective glaze for ceramic roof tiles coatings to mitigate urban heat island effect

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Abstract

Through our PhD ongoing research, the project aims at the manufacturing of eco-friendly solar reflective glaze for roof tiles using waste glass (WG) to mitigate urban heat island effect, and raw materials extraction. The urban area presents 2% of the earth's surface yet consumes 75% of the world's energy resources. A portion of this energy is dissipated as anthropogenic heat, increasing ambient temperature in the urban areas. Consequently, alongside with climate change, associated environmental challenges and public health problems have taken place such as urban heat island effect (UHI). The need to tackle UHI effect urges the incorporation of solar reflective materials in the sustainable vision of construction materials production. In the other hand, the increase of WG generating incites more sustainable techniques of waste management and recycling possibilities, which gains the interest of the ceramic industry. The efficient integrated WG management into the industrial production chain induces environmental gains related to landfilling avoidance, recovery of co-products, and an eco-friendly use of energy through the production process. In accordance to circular economy principles, equilibrium must be settled between citizens, municipalities and solid waste recycling companies to create a closed-loop supply chain and serve all profits. The non-biodegradable nature of glasses makes them anti-environmental waste; hence, creating options for recycling WG alleviate the pressure from disposal procedures and raw material extraction. According to the academic literature, promising results were deduced from recycling WG in the fabrication of eco-friendly ceramic materials regarding physical, mechanical and thermal properties. However, the solar reflectance evaluation of coating materials containing WG was poorly discussed, especially in the near infrared (nir) radiation spectrum. Therefore, this project affords a valuable data concerning the solar reflectance characterization and behavior of ceramic roof tiles covered with WG glaze layer. Moreover, it could create an eco-friendly industrial line for the production of real scale reflective roof tiles, combining the interests of waste glass collecting plants and roof tiles production plants.

Keywords: Waste glass, Solar reflectance, Cool roof, Reflective coating.

Antioxidant activity and nutrient composition of *Sorghum bicolor l.*and *Secale cereale l.*in Algeria

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Abstract:

Whole grain products are recommended for healthy diets as being recognized sources of dietary fibers. In the present study, two types of secondary cereals (rye and sorghum) which are adapted to the growth conditions of Algeria were evaluated for their composition in dietary fibers, sugars, proteins, total phenols and antioxidant properties. Antioxidant activity was evaluated by radical DPPH scavenging capacity, ferric reducing power assay (FRAP) and β carotene-linoleate bleaching assay . The adapted rye grains exhibited better nutritional quality compared to sorghum. Sorghum was exceptionally high in antioxidant activities followed by rye. The nutritional data obtained suggest that the selected grain, particularly sorghum, is promising as healthy food.

Keywords: secale cereal, antioxidant activity, dietery fiber, DPPH, FRAP.

Study Of Optimization Of The Containing Matrix Of Ion Exchange Resins Used By Portland Class 45 Cements With Callovo-Oxfordian Clays: Preparation And Characterization

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Abstract

At the end of this work, conducted as part of the JRU between CNESTEN and UHIIC, which aims to explore new formulations for the containment of used ion exchange resins. These resins are considered as low and medium-level radioactive waste with a long life span. Currently, they are confined by the CNSTEN according to the formulation: 510 g of cement, 200 g of sand, 83 g of resin and 207 g of water. For this purpose, a cementitious package was made using Class 45 Portland cement, sand, resin, and water. And others are prepared by replacing the sand with Callovo-Oxfordian clay chosen as a potential host rock by Andra (National Agency for Radioactive Waste Management), in the following proportions: (2%, 4%, 6%, 8% and 10%).
The packages obtained were measured for their mechanical resistance to compression and porosity. The analysis of the results obtained shows that the incorporation of Moroccan Callovo-Oxfordian clay by substitution with sand has positively contributed to the development of mechanical strength and to the decrease in porosity of the cemented packages of the used IER, it has also increased the quantities of cemented used IER to 18% by formulation, without the package losing its mechanical resistance to compression.

Keywords: Callovo-oxfordian clay, Cemented packages, Compressive strength, Containment, Portland cement C45, Radioactive waste, Ion exchange resin ;

Electronic transport and calculation of premature fracture of splat cooled Pb-Sn solder alloys for high performance applications

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Abstract

Splat cooled technique was used to produced ribbons of $PbSn_{2.5}Sb_x$ (x=0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 wt.%). The structure of rapidly solidified Pb-Sn-Sb has been studied by, means of an x-ray diffraction technique. Form x-ray analysis a crystalline intermetallic compound phase of SnSb is detected. The formation of Intermetallic compound phase and refinement of evaluated particle size causes a pronounced increase in dynamic elastic modulus and hardness indentation. Premature fracture of alloy free antimony and alloy with addition o 2.5 wt.% antimony is calculated. Desirable values of internal friction (Q^{-1}), Young's modulus (E), Vickers microhardness H_v and electrical properties are critically evaluated and sensitive to change in temperature.

Keywords: lead based solder alloys, electronic packaging, mechanical properties, rapid solidification technology

Nature-inspired microparticles with high flowability for enhanced pulmonary drug delivery

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Abstract

The aim of this work is to build a Computational Fluid Dynamics (CFD) model to study the flowability of fungal spores and pollen grains to predict their ability to flow to the deep lung in order to relate this to the potentiality of allergies, and predict the possibility of using spores/pollen grains-mimicking microparticles for pulmonary drug delivery. The CFD model was designed using COMSOL Multiphysics to calculate the drag forces exerted on the pollens and spores by the air in the upper and lower lung bronchioles. Experimental verification was conducted by comparing the aerosolization of *Aspergillus* spores and spherical microparticles, as a control shape, using Next Generation Impactor as a lung-simulation device. The CFD model showed that the drag force exerted on the spores and pollen grains can affect their pathogenicity. In addition, the shapes of some spores (e.g. *Alternaria, Drechslera* and *Aspergillus*) or pollens (e.g. *Quercus* and *Eucalyptus*) have low drag and can be used for drug delivery to the deep lung. The experimental results coincided with the CFD model and showed that the shape of Aspergillus spores can reach the deep lung with about 1.6-fold higher dose than the spherical shape. The obtained results indicate that shapes of some spores and pollen grains are drag-minimizing allowing them to spread and to be inhaled to the deep lung; so they can be used for the development of dry powder inhaler formulations.

Keywords: Computational Fluid dynamics (CFD); Spores; Pollen grains; COMSOL; Drag force; Pulmonary drug delivery

Fabrication of a Wet Electrospun Nanofibers-Fortified Hydrogel as a Single-Dose Nanocomposite Biomimicking Skin Substitute

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Abstract

Here we report the development and evaluation of a new series of well-designed single-dose extracellular matrix (ECM)-mimicking nanofibers (NFs)-reinforced hydrogel (HG)-based skin substitute for efficient wound healing. The HG matrix of the proposed skin substitute is composed of gelatin (GE) and sodium alginate (SA), and incorporates hyaluronic acid (HA) as a key component of the natural ECM as well as the antimicrobial *Punica granatum* extract (PE). This HG matrix was crosslinked by the biocompatible N-(3-dimethylaminopropyl)-N′-ethylcarbodiimide hydrochloride (EDC) crosslinker, and it was reinforced with fragmented *trans*-ferulic acid (FA)-loaded cellulose acetate/polycaprolactone (PCL/CA) NFs. The NFs were obtained by wet electrospinning into polyvinyl alcohol (PVA) coagulating solution to closely resemble the highly porous structure of the ECM fibers, which facilitates cell migration, attachment and proliferation. The proposed design of the skin substitute allows adjustable mechanical characteristics, outstanding physical properties (swelling and biodegradability) as well as an excellent porous microstructure. The developed skin substitutes were characterized using FTIR spectroscopy, differential scanning calorimetry and electron microscopy imaging. Besides, the biodegradability, biocompatibility, bioactivity, mechanical, and *in-vitro* drug release characteristics were all investigated. Moreover, an *in-vivo* excisional full-thickness defect model was conducted to assess skin tissue regeneration and healing effectiveness. The average diameters of the plain and FA-loaded NFs are 210±12 nm and 452±25 nm, respectively. The developed ECM-mimicking skin substitutes demonstrated good antibacterial activity, free-radical scavenging activity, cytocompatibility, porosity, water absorption ability and good biodegradability. *In-vivo* application of the ECM-mimicking skin substitutes revealed their excellent wound-healing activity and their suitability for single-dose treatment of deep wounds with reducing the wound diameter to 0.95 mm after 15 days of treatment. Moreover, the histological investigation of the wound area demonstrated that the applied skin substitutes have not only enhanced the wound healing progress, but also improved the quality of the regenerated skin in the treated area via facilitating collagen fibers regeneration and deposition.

Keywords: Nanofibers; Hydrogel; Nanocomposite; Wound healing; Skin substitute

Enhancement of Niclosamide and Methotrexate Bioavailability via Nanoformulation and in Presence of Piperine for the Treatment of Breast Cancer

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Abstract

Breast cancer is one of the most prevalent cancers and of the main causes of deadly metastatic complications as pulmonary metastasis. Piperine (pip), niclosamide (nic) and methotrexate (mtx) have been proven to be effective in the treatment of myriad of cancers including breast cancer. However, the adverse effects and the development of resistance are the incitement to search for new approaches as the use of drugs mixtures with synergism and encapsulation inside nanoparticles. The enhancement of pip on the bioavailability of both nic and mtx was investigated in MCF-7 cell line. The first mixture is pip/nic and the second one is pip/mtx. The IC_{50} values of nic and mtx were identified for each drug individually and for the mixtures. The IC_{50} values of both mtx and nic in the mixtures decreased to the quarter of their values when compared to the IC_{50} value of each drug alone. Moreover, each of the three drugs were encapsulated inside pluronic F-127 nanoparticles (nic-plu, mtx-plu and pip-plu). The IC_{50} values of nic-plu and mtx-plu were identified in addition to the mixtures too (pip-plu and nic-plu) and (pip-plu and mtx-plu). The pip-plu enhanced the efficiency of mtx-plu and nic-plu five and seven folds respectively in the mixtures when compared to each of mtx-plu and nic-plu.

Keywords: Breast cancer Piperine, niclosamide, methotrexate , MCF-7 pluronic F-127 and nanoparticles

Sequential and Mitochondrial Targeting of Breast Cancer Using Core-Shell Nano Drug Delivery Systems

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Abstract

Hypothesis: Targeted therapy exploits cancerous niches' properties including acidic extracellular environment, hypoxic tumor core, and tumor-specific surface antigens. The present study aims to develop and evaluate a sequential targeted core-shell nanoparticulate (NPs) system for treatment of breast cancer. Hierarchical (sequential) targeting was firstly achieved at the cellular-level through employing the CD44-receptor cognate ligand, hyaluronic acid (HA), as an outer- shell for the NPs. Secondly, subcellular drug-delivery was accomplished through the synthesis and incorporation of a mitochondrion penetrating triphenylphosphonium-conjugated doxorubicin (DOX-TPP+) into the core of NPs. **Experiments:** NPs were prepared through incorporation of the electrostatic-complexes of DOX.HCl/DOX-TPP+ with tripolyphosphate (STPP-) into chitosan (CS) forming the core that was further coated with HA shell. Next, physicochemical characterization namely FTIR, DSC, DLS, morphological evaluation and spectroscopic assessments were implemented. Moreover, the drug entrapment efficiency (EE%), loading capacity (LC%), drug release profile and kinetics were investigated. Moreover, to validate the biological efficiency of the developed NPs, *in-vitro* cytotoxicity activity and mechanism were evaluated. Lastly, *in-vivo* biological assessments employing solid Ehrlich carcinoma (SEC) bearing mice were also implemented. **Findings:** Physicochemical characterizations' results affirmed the successful formation of core-shell NPs possessing a spherical shape with a mean size of 220-280 nm, while attaining high EE% and LC%. Additionally, *in-vitro* cytotoxicity evaluations using MCF-7 cell line demonstrated an apoptotic mediated cell- death along with cell-cycle abrogation. Lastly, findings obtained from *in-vivo* studies confirmed the efficient anticancer activity of the mitotropic DOX-TPP+-loaded NPs. **Conclusion:** The developed core-shell NPs proved efficient in sequential targeting of DOX to breast cancer cells. The obtained results emphasize the potential applicability of sequential targeting in the fields of pharmaceutical industries through the discovery and synthesis of novel targeted drug conjugates. Moreover, our work supports the integration of sequential targeting approaches in the fields of nanomedicine and clinical treatment protocols to achieve superior prognostic outcomes.

Keywords: Sequential targeting; Mitochondria targeting; Triphenylphosphonium cation; Hyaluronic acid; Doxorubicin; Nanocomplex; Chitosan; Nanoparticles.

Switching Indication of PEGylated Lipid Nanocapsules (PEG-LNCs) Loaded with Rolapitant (RP) and Deferasirox (DFO) against Breast Cancer

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Abstract

Breast cancer (BC) is considered the leading cause of mortality and morbidity among adult women worldwide. BC is associated with many factors whether genetic or hormonal one. Despite the advanced therapeutic and theranostic strategies for BC treatment, cancer metastasis and relapse is often observed among the patients which leads to therapeutic failure. Accordingly, among the repositioned medication against BC proliferation is neurokinin receptor anatagonists and iron chelating agents especially rolapitant HCl (RP), deferasirox (DFO), respectively. However, RP and DFO are classified as class II with low aqueous solubility. Both drugs loaded into PEGylated lipid nanocapsules for enhancing their aqueous solubility. The RP-LNCs, DFO-LNCs and their combinations were evaluated according to particle size (P.S, nm), zeta potential (ZP, mV) polydispersity index (PDI) and surface morphology. Importantly, the antitumor effect of these novel molecules evaluated against the suppression of Ehrlich Ascites tumor model using female mice. Results revealed that RP-LNCs, DFO-LNCs and RP/DFO-LNCs exerted PS ranged from 45.23 ± 3.54 to 60.1 ± 3.32 nm with PDI around 0.20. Also, RP-LNCs, DFO-LNCs and RP/DFO-LNCs displayed surface charge just +16.6 ± 6.9, -13.3 ± 5.82 and -20.2 ± 5.40 mV, respectively. The in-vivo pharmacodynamic effect of these nanoformulations showed superior antitumor effect for the individual drugs rather than their combinations in comparison to the control group. The novelty and originality of the current study reveal the potential outcomes of both RP and DFO loaded into LNCs as a promising therapeutic drugs for BC treatment.

Keywords: PEGylated Lipid Nanocapsules; Rolapitant; Deferasirox; Breast Cancer

Metal Organic Framework Polyethyleneimine Core/Shell-Structured as Novel Nanoplatform for Targeted Hepatic Cancer Therapy

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Abstract

In the last decade, Metal-organic frameworks (MOFs), are being actively reported as multifunctional nanoscale drug delivery system as they introduce tunable structure with high cargo loading. These facilitate their functionalization for targeting and enhancing physiological stability. However, notable drawback in designing effective targeting drug delivery system still need to be further researched. Herein, we design MOFs/ligated Polyethyleneimine (PEI) nanocomposites from Zr-based MOF, NH_2-UiO-66 as core and PEI decorated with active tumor targeting moieties glycyrrhetinic acid (GA), (PEI-GA) as shell to serve as a novel drug delivery system (DDS) for hepatocellular carcinoma (HCC). The characterization of the core/shell nanocomposites using TEM, SEM, HNMR and BET analysis confirmed the successful fabrication of core shell nanocomposites. Evaluation of drug loading and drug release profiling of doxorubicin (DOX)-loaded core shell proved the proper entrapment of DOX inside the porous structure alongside enhanced release in the tumor acidic environment. Although, the UiO-66-NH_2@PEI-GA nanocomposite exhibited significant low cytotoxicity to HepG2 IC_{50} (*312.4 ± 14.98 µg/ml*) as estimated by the MTT method, the DOX loaded UiO-66-NH_2@PEI-GA nano-system show superior killing effect on HepG2 with IC_{50} *(6.89± 0.38 µg/mL).* As well as, their superior cytotoxicity further confirmed through apoptosis induction and halting cell cycle progression. These findings could be a potential platform in active targeting of hepatic cancer to achieve precise therapy.

Keywords: Zr (IV)-based metal organic framework; HCC; PEI; Targeting moieties; Drug delivery

Novel Polymeric Nanoparticles-in-Nanofibers Transdermal Patches for Smoking Cessation

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Abstract

Chewing gums, nicotine patches, lozenges, mouth sprays, inhalers, and nasal sprays are some of the nicotine-replacement therapies (NRTs) used to help people quit smoking. They are usually used for 8 to 12 weeks. Varenicline (VAR) is a highly selective and FDA-approved partial agonist of the nicotinic acetylcholine receptor that inhibits its nicotine binding and stimulates dopamine synthesis in the brain. The preparation of nanoparticles-in-coaxial nanofibers (NFs) scaffolds for VAR transdermal administration for is described for smoking cessation. Polyethylene oxide, VAR-loaded pluronic F127 nanoparticles (NPs), and free VAR make up the cores of the prepared coaxial NF structures, while the shell is made up of a 1:9 (w/w) blend of cellulose acetate and polycaprolactone. In addition, there is a free VAR (50% by weight) in the NF shell. TEM, SEM, and fluorescence microscopy were used to analyze the morphology and coaxial structure. The scaffolds' physicochemical and mechanical properties were investigated using FTIR, DSC, TGA, and a universal testing machine. The size of pluronic F127 NPs was determined, by dynamic light scattering, to be 161 and 372 nm for plain and loaded NPs, respectively. Furthermore, the apparent zeta potential of plain and loaded NPs was -15.7 and -14.4 mV, respectively. NFs with sizes ranging from 793 to 325 nm were shown in SEM micrographs. For free VAR, VAR-loaded NPs, and composite NPs-in-NFs scaffolds, in-vitro VAR release approaches about 100% after 3, 9 and 28 days, respectively. To investigate the release kinetics, DFT calculations and mathematical release kinetic models were used. Ex-vivo cumulative release was studied on albino rats skin for 60 days and found that VAR was released at a level up to 94%. In the case of plain and VAR-loaded NFs, the percent cell viability of HSF cells was 75.09 and 32.11 percent, respectively. The innovative manufactured NPs-in-NFs transdermal patch for VAR delivery is regarded as a successful, cost-effective, safe, and long-acting nicotine replacement therapy (NRT) for smoking cessation.

Keywords: Smoking cessation; Coaxial nanofibers; Electrospinning; Nanomicelles; Varenicline

Novel Antimicrobial Film Incorporating Nano-sized Polyphenolics for Smart Meat Packaging

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Abstract

Recently, biodegradable polymers have a great attention to be alternatives for plastic materials that cause ecological problems. Moreover, imparting antimicrobial activity of biodegradable polymers would find strong workability in the field of active packaging. So, this work represents nanocapsule preparation containing active compounds extracted from natural resources and the prepared nanoparticles were included in the carboxymethyl cellulose (CMC) films to improve their characteristics. The prepared nanocomposites film showed a great enhancement in the physicochemical and barrier properties. Furthermore, antimicrobial examination findings showed high activity against food pathogens that usually cause food poisoning. Nevertheless, a real application was performed by packaging fresh meat samples with our developed films and the changes were monitored over the storage time. Amazingly, the sample meat was maintained fresh and safe to eat over two weeks of storage at 4°C compared with the control sample that couldn't sustain even up to 72 hrs *i.e.* extended shelf life of the meat products. This innovative food packaging would improve the environmental sustainability of food packaging systems. Ultimately, this study and pave the way for the next generation of high barrier and bactericidal packaging films with economic impacts.

Keywords: Polyphenol compound; Nanoencapsulation; Antimicrobial activity; Barrier properties; Active packaging.

Combining Metformin with Doxorubicin as Adjuvant Therapy in Core-Shell Poly (Lactic-co-Glycolic Acid) Nanocapsules for Treating Breast carcinoma

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Abstract

Breast cancer is the most invasive and life-threatening cancer in women. However, doxorubicin (DOX) is one of the most commonly used drugs for breast cancer treatment, it is known to have many harmful adverse effects including its cardiotoxicity. Hence, recent reports used metformin (MET), an anti-diabetic drug, as an adjuvant therapy to decrease the severity of DOX's adverse effects and to improve its ultimate therapeutic outcome. The current study is aimed at co-encapsulation of DOX and MET in newly-developed core-shell poly (lactic-co-glycolic acid) (PLGA) nanocapsules (NCs) as adjuvant therapy for breast cancer treatment. To optimize the developed NCs, PLGA (50:50) of different molecular weights were used followed by various physicochemical characterizations. Besides, the *in-vitro* release profiles of loaded drugs were obtained, and the cytotoxicity, apoptosis/necrosis and cell cycle arrest analysis were tested against breast cancer cell line (MCF-7). The obtained DOX/MET-loaded NCs showed size and PDI of 203.0 ± 3.4 nm and 0.081 ± 0.03, respectively with surface charge of -6.15 ± 1.2 mV. The entrapment efficiency of DOX and MET were about 93.7% ± 2.9 and 70% ± 1.6, respectively. The developed PLGA core-shell NCs successfully sustained the DOX/MET release for more than 30 days. The *in-vitro* results showed a significant enhancement in DOX cytotoxic effect as well as a duplication in its apoptotic effect upon addition of MET for both free DOX/MET combination and DOX/MET-loaded PLGA NCs against MCF-7. Besides, flow cytometry demonstrated that the DOX/MET-loaded NCs possess their antitumor effect through preventing DNA replication and cell division.

Keywords: Doxorubicin, Metformin, Nanocapsules, Breast Cancer.