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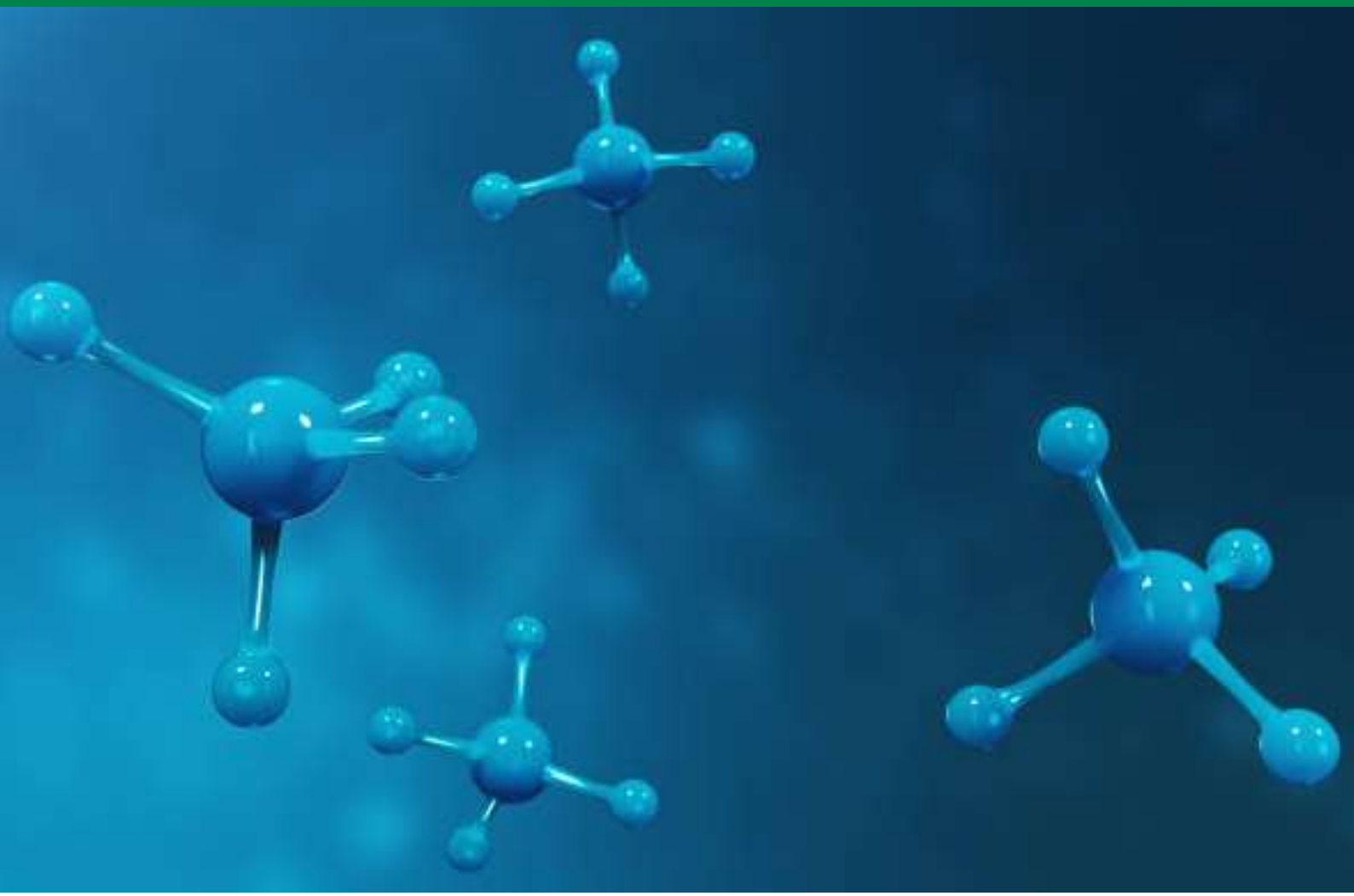
PolyScience2022

2nd Global Summit on Polymer Science and Composite Materials

September 19-21, 2022 Barcelona, Spain



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FOREWORD

Dear Colleagues,

It is a great pleasure to announce that The Scientistt will host the 2nd Global Summit on Polymer Science and Composite Materials (PolyScience2022) will be held in Barcelona, Spain during September 19-21, 2022.

PolyScience2022 aims to bring together the renowned researchers, scientists and scholars to exchange ideas, to present sophisticated research works and to discuss hot topics in the field and share their experiences on all aspects of Polymer Science and Composite Materials.

The PolyScience2022 will be a 3 days event that means to gather the key players of the Polymer Science and Composite Materials community and related sectors. This event is launched with the aims to become an established event, attracting global participants, intent on sharing, exchanging and exploring new avenues of Polymer Science and Composite Materials-related scientific and commercial developments.

A wide-ranging scientific program consisting of plenary lectures, keynote lectures, Invited lectures, parallel sessions, as well as poster sessions for young scientists covering all topics in Polymer Science and Composite Materials will be scheduled. This conference provides a wonderful opportunity for you to enhance your knowledge about the newest interdisciplinary approaches in Polymer Science and Composite Materials.

Moreover, the conference offers a valuable platform to create new contacts in the field of Polymer Science and Composite Materials, by providing valuable networking time for you to meet great personnel in the field.

We look forward to seeing you at PolyScience2022 in Barcelona, Spain.

COMMITTEES

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Plenary Forum
Day-1

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September 19-21, 2022 | Barcelona, Spain

J. Texter*

Coating Research Institute, School of Engineering, Eastern Michigan University, Ypsilanti, MI 48197, USA
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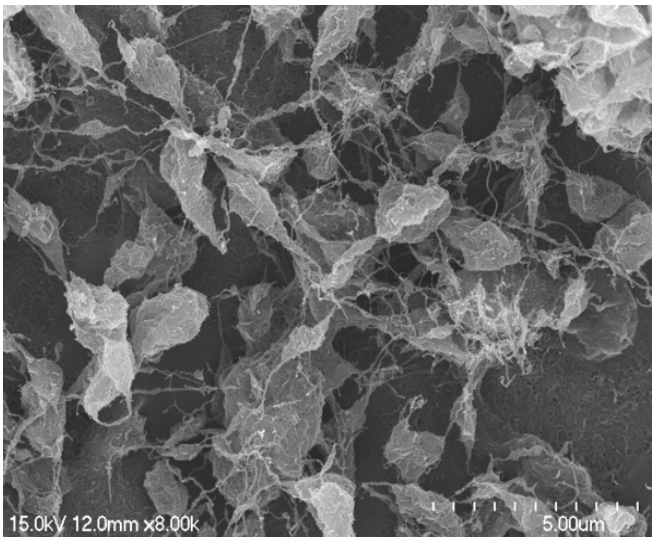
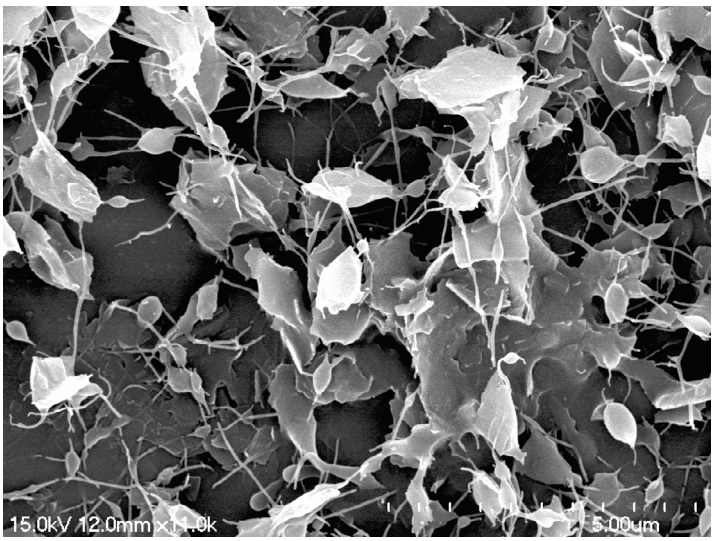
Polymerized Ionic Liquids as Stabilizers and Binders in Composites

Abstract

Polymerized ionic liquids (PIL) are foundational in forming a new branch of soft materials science,1 and some of these new PIL-materials are finding innovative applications as thermodynamically stable nanoparticulate dispersions and as dispersing aids with tunable solubilities. They include radical chain-polymerized nanolatexes and block copolymers and condensation polymers (polyurethanes, polyureas, and polyesters) that provide biodegradability pathways for composite materials. Their materials performance features include providing thermodynamic stability to dispersions of all forms of nanocarbon and diverse high performance composite coatings.

Simple sedimentation and shear-coating produce MWCNT and graphene electrodes suitable for conventional and advanced applications and facilitate making thermally conductive hydrothermal carbon coatings (25 W/m/K), thermally conductive MWCNT coatings in the mid-diamond range (0.5–3 kW/m/K), and alternative coating methods to replace ITO with graphene in displays. Transformational heterostructured electrodes produced by electrospinning (Fig. 1) of MWCNT and graphene2 are also made possible by PILs serving as stabilizers and binders.





Keywords

Electrospinning, Graphene, Coatings, MWCNT, Polymerized ionic liquids

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Biography

John Texter is Professor Emeritus of Polymer and Coating Technology at Eastern Michigan University. He has been Editor-in-Chief of the Journal of Dispersion Science and Technology, Associate Editor of the Journal of Nanoparticle Research, and Section Editor for Applications of Current Opinion in Colloid and Interface Science. He has worked for and consults through Strider Research Corporation, and he has worked for Eastman Kodak Company in various areas of dispersion and emulsion technology. He received his undergraduate engineering education and his PhD in Chemistry from Lehigh University, where he studied at the Zettlemoyer Center for Surface and Coatings Research. He is an experienced lecturer, organizer, and technical project manager. He is an inventor, editor, and author of over 250 publications including five books, 47 issued U.S. patents, and many research and review articles. He has received numerous awards and honors, and he is a Fellow of the American Physical Society, the American Chemical Society, and of the Society for Imaging Science and Technology. He has served as Chairman of the ACS Division of Colloid and Surface Chemistry, Chairman of the Chemistry at Interfaces Gordon Research Conference, Chair of the Chemistry of Supramolecules and Assemblies Gordon Research Conference, and organizer of many international symposia. He is a visiting guest Chair Professor at the School of Chemistry, Chemical Engineering, and Materials Science of Soochow University and has been a visiting professor at the Colloid and Interfaces Max Planck Institute in Potsdam (Golm), at the Graduate School of Science and Technology, Kumamoto University, and at the Fachhochschule Esslingen. His research focuses on stimuli responsive polymers, particles, and materials and the general area of dispersion science and practice.

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Cutting-Edge Diamond FET and MEMS Devices

Abstract

Diamond is a candidate material for next-generation power electronics and integrated circuit (IC) and micro-electro mechanical systems (MEMS) devices which operate under extreme environment. In order to use an advantage of high-density hole channel of hydrogenated diamond (H-diamond) surface, we have developed the high-k stack gate dielectrics and AlN heterojuction gate for H-diamond FETs, such as HfO2/HfO2, LaAlO3/Al2O3 Ta2O5/Al2O3, and ZrO2/Al2O3, AlN/Al2O3[1] prepared by a combination of sputter-deposition (SD) and atomic layer deposition (ALD) techniques. In addition, we developed the routine ion-implantation process for preparing the diamond cantilever with a resonant frequency quality factor as high as one-million. Recently, we demonstrated the artificial diamond Fin-FETs with high-current level and the nanolaminate insulator gate metal-oxide-gate FETs (MOSFETs) with k value as high as 100, and the new transistor concept named by metal-insulator-metal-semiconductor field-effect transistor (MIMS-FET)to achieve normally-off operation by combining the advantages of MOSFET and metal-semiconductor FET. In this presentation, we will show the comprehensive work on the diamond FET and MEMS devices.

Acknowledgements

This work was in collaboration with J-W. Liu, M. Imura, and M-Y. Liao in NIMS and partly supported by JSPS KAKENHI Grant Number 20H00313.

Keywords

Diamond, Field-Effect-Transistor, MEMS, Heterojunction, high-k

Reference

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Biography

Yasuo Koide received his Ph.D. degree from Prof. Isamu Akasaki, Nobel laureate in 2014, at Nagoya University in 1988. His PhD work was MOVPE growth of AlxGa1-xN alloy and optical and electrical properties. He fabricated the original MOVPE apparatus with special reactor design, which provided success of the highest-quality GaN and AlxGa1-xN epitaxial layer using the low-temperature buffer layer technique, together with Prof. Hiroshi Amano, Nobel laureate in 2014. After Dr. Koide became an assistant professor at Nagoya University and an associate professor at Kyoto University, in 2002he moved to National Institute for Materials Science (NIMS) for focusing research on diamond epilayer growth and optical and electronic device applications, Japan. He has more than 400 publications including technical articles, invited reviews, monographs, and books in semiconductor materials and devices. His research interest is diamond and III-nitrides hybrid electron devices and their transport

physics and surface and interface physics.

Fernando Muzzio
Rutgers University, Piscataway, NJ, 08854, USA

Polymeric Surfactants: The Key Building Block of a New Generation of Pharmaceutical Composites

Abstract

Many new pharmaceutical products require the use of drug substances with poor dissolution characteristics. Traditional methods for addressing this problem, including micronization, spray drying, and hot melt extrusion, are expensive, cumbersome, and create intermediate materials with poor manufacturability, often requiring the use of large amounts of excipients which results in low drug loading. This is particularly inconvenient for high dose products, including many antibiotics, antivirals, etc.

A new approach to solve this problem based on surface modification of drug substances is rapidly attracting interest. In this emerging technique, small drug particles are simultaneously coated and granulated using small amounts of a polymeric surfactant to create granules that are highly wettable, flowable, and compressible. Minimum amounts of other ingredients are added to the external phase, enabling the compounding of tablets that contain more than 80% drug substance and that are endowed with any desired drug release profile.

Selection of physical and chemical attributes of the polymeric surfactant enable a wide range of processing conditions, including dry or wet processing, low temperature processing, and low humidity processing. The process completely avoids organic solvents.

Biography

Dr. Fernando J. Muzzio is a distinguished Professor of Chemical and Biochemical Engineering at Rutgers University. His research focuses on pharmaceutical product and process design, continuous manufacturing, powder mixing, powder flow, segregation, compression, mixing and flow of liquids and suspensions, capsule filling, tablet dissolution, and tablet coating. He is the author of over 300 peer-reviewed scientific articles and book chapters. He is the director of the National Science Foundation Engineering Research Center on Structured Organic Particulate Systems and also the chair of the faculty committee of the National Institute for Pharmaceutical Technology and Education (NIPTE).

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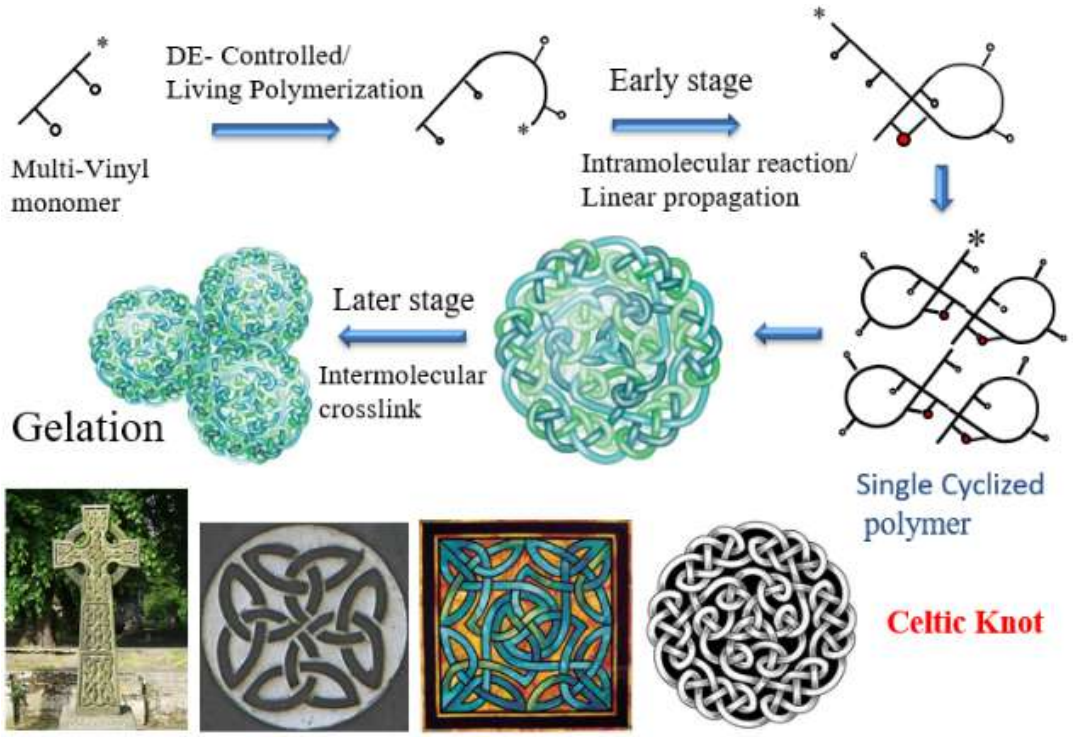
Single-chain Knot/Cyclized Polymers from Controlled Multivinyl Monomer Polymerisation and Their Biomedical Applications



Abstract

Classical theory has long claimed that the polymerizations of multi-vinyl monomers (MVM) lead to insoluble cross-linked materials, as defined by P. Flory and W. Stockmayer 70 years ago (F-S theory)1. Therefore, the (homo) polymerization of MVMs is still considered as a formidable task in chain growth polymerization. We first proposed a deactivation enhanced ATRP (DE-ATRP) method to homopolymerize MVMs2. This approach has broken through two barriers for the polymerization of MVMs: uncontrollable homopolymerization and highly diluted reaction conditions, and successfully achieved the controlled homopolymerization of MVMs in concentrated conditions. Via this approach, a new class of single-chain knot/cyclized polymers can be formed due to the enhanced promotion of intramolecular cyclization and the suppression of intermolecular crosslinking3.Our breakthrough lies in the ability to alter the growth manner of polymerization by controlling the kinetic chain length together with manipulating chain growth conditions to achieve different polymer structures, which opened an efficient and practical road for the design and synthesis of knot/cyclized polymers from economical available monomers. The produced knot/cyclized polymeric materials have demonstrated

the great potentials in biomedical applications4.

Keywords
controlled/living radical polymerization, multi-vinyl monomers, single-chain knot/cyclized polymers, biomedical applications

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Biography
Prof Wenxin Wang is Full Professor in Skin Research and Wound Healing at the Charles Institute of Dermatology, School of Medicine, UCD. His scientific contributions and achievements are reflected from over 200 peer-reviewed publications, 5 book chapters, 136 conference associated publications, 22 patents, 107 invited lectures, significant fundings (over €11 million), 26 organized international conferences, 55 times reported by public media. He has been selected as an expert reviewer and panel member by 25 international research councils and funding bodies. He has launched 3 companies and licensed 7 new technologies and commercialized 5 newly developed technologies onto the market.

Keynote Forum
Day-1

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I. Rezić[1*]

I. Rezić[1*], M. Majdak[1], and M. Somogyi Škoc[1]

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State-of-the-Art in Functionalization of Antimicrobial Polymers

Abstract

World Health Organization has emphasized that the problem of antimicrobial resistance is one of the most important issues in protection of the global population health. Moreover, the WHO has encouraged researchers and scientist to strive in detecting more powerful and more innovative solutions in producing antimicrobial materials. Therefore this presentation will bring the state-of-the-art iniciatives that enable efficient functionalization of antimicrobial polymer surfaces. The most powerful activity against microorganisms that are resistant to antibiotics are nanoparticles of metals and metalo oxides. Therefore, this study will introduce to the scientific community the methodologies and procedures that we use for functionalization of 3D printed polymers, as well as textile surfaces. Such coatings can contain pure nanoparticles, or their combination with other active species. Moreover, in specific cases the antimicrobial substances can be filled materials that will enable their slow release into the environment. Lastly, the presentation will show the most important characterization methodologies needed for successful monitoring of the antimicrobial reagents. To conclude, the presentation will summarize the state-of-the-at technologies used in functionalization of antimicrobial polymers, to be shared in the scientific community for the benefit of all.

Keywords

antimicrobial resistance; microcapsule; silver; medicine textile; coatings;

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Biography

Assoc. prof. Iva Rezić PhD was until the October 2020 a Vice-dean for scientific research at the University of Zagreb, Department of Applied Chemistry, Faculty of Textile Technology, where she leads a group of scientists in the field of chemical analysis and material sciences, and teaches in courses: “Analytical Chemistry”, “Instrumental Analysis Methods”, “Physical Chemistry”, “Textile Chemistry” and “Computer Method Design of Experiment”. She is a double doctor of science - in the field of natural sciences (analytical chemistry) and technical sciences (textile engineering). Professional competences she applies in management of projects and teams, with current focus on development of antimicrobial coatings and antimicrobial biodegradable products. She published 56 scientific papers, university textbooks and 5 chapters in scientific books.

Rosangela B. Z. L. Moreno

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Laboratory Data and Polymer Flooding Planning - Recent Advances

Abstract
Enhanced oil recovery by polymer flooding has been considered for onshore and offshore fields, sandstone and carbonate reservoirs, using synthetic polymers and biopolymers. Albeit that wide range of possibilities, before implementation in the field, a screening process, experimental investigations,and simulations need to be conducted. On top of that, the experimental conditions need to be as close as possible to the field ones and many laboratory data need to be obtained to reproduce the physical phenomena of polymers flowing through the reservoir rock. A suitable workflow should include polymer bulk-rheology and stability, in-situ rheology and retention, flooding performance, and data integration for simulation. Upsizing and upscaling allow respectively forecasting degradation and heterogeneity effects on polymer flooding. The change of flooding geometry provides the transference between Cartesian one-dimension core-flooding to multi-dimensional flooding that characterizes the wellbore net at the target reservoir. Ideally, comparative analysis against conventional water-flooding and history matching should be conducted on all scales, laboratory, pilot, and field ones. Finally, the evaluation of several injection schemes provides the best polymer utility factor or other optimized conditions ranked by the exploitation company.

Keywords
Oil Recovery, Polymer Rheology, Polymer Retention, Core-Flooding, Performance Parameters, Simulation

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Biography

Rosangela B.Z.L. Moreno holds a degree in Civil Engineering (1989), a specialization in Petroleum Engineering (1990), a Master in Petroleum Science and Engineering (1993), and a Ph.D. in Mechanical Engineering (2000), all from the University of Campinas (UNICAMP). She is an associate professor and coordinates the Laboratory for Oil Reservoirs at the School of Mechanical Engineering - UNICAMP. Rosangela is highly interested in Petrophysics and Fluid Flow, Well-Reservoir Coupling, and Oil Recovery, especially Chemical EOR. She has coordinated eight R&D projects and participated in nine others. She has mentored and advised 30 graduate students to the completion of their degrees, and she published more than 100 papers.

N. Guarrotxena*

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Hybrid Nanostructured Systems Based on Plasmonic Nanoparticles with Tunable Smart Properties for Biomedical Applications

Abstract

Polymer hybrid materials have attracted considerable academic and industrial research interest, not only for their fascinating structural characterization, but also for their potential functional applications. Thus, investigations on multifunctional polymer hybrid materials result an important task for polymer science. Polymer hybrid materials generated via the combination of functional polymers with other nanostructured compounds, with the latter exhibiting size-dependent physical and chemical properties, have become a major area of research and technological development owing to the remarkable properties and multifunctionalities derived from their nanocomposites/ nanohybrid structures. Appropriate fabrication strategies and the choice of nanoparticles, along with a smart and functional matrix, may lead to enhanced physicochemical features and material performance. The polymer hybrid materials also provide the ability to modulate the properties of the materials through the combination of the functional and stimuli/optical response components. This presentation will provide insights on the potential of hybrid polymer-nanoparticle materials for advanced applications, an understanding of the physicochemical properties and the growing utility of hybrid polymer materials. The effect of nanostructuring in the multifunctionality of different studied nanomaterials by covering functionalization approaches, and assembly methods to enable interesting biomedical applications (detection, imaging, therapy, delivery and antimicrobial systems) will be discussed.

Acknowledgements

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Keywords

Multifunctional Materials, Smart Polymers, Nanohybrid Materials, Core-shell/JanusNPs, Biomedicine/Health/Therapy

Biography

N. Guarrotxena is Research Scientist at ICTP-CSIC (Spain) and External Expertise Consultant on I+D+i Management and Policy for National and International Agencies. She was vice Director of ICTP-CSIC (2001-2005) and visiting professor at UCSB-USA and UCI-USA (2008-2011 and 2019).

Her research focuses on synthesis and assembly of hybrid nanomaterials, smart nanomaterials, nanoplasmonics, and their nano-biotechnology applications.

Invited Forum
Day-1

Raed Abu-Reziq

Institute of Chemistry, Casali Center of Applied Chemistry and Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem

Polyurea based Microcapsules Prepared via Non-Aqueous Emulsions

Abstract

Microencapsulation processes, in which core-shell particles can be produced by interfacial polymerization, have been investigated intensively. These processes are utilized usually for the controlled release of bioactive substances or for the protection of functional materials. In addition, microencapsulation has been reported as a promising method for the catalyst immobilization. The size of these catalytic microcapsules is several tens of microns, and this could facilitate their separation using conventional filtration techniques. In most cases, the microcapsules prepared for catalytic applications are formed using oil-in-water (o/w) emulsions, and because of that moisture sensitive catalysts cannot be immobilized by this method. In order to circumvent such limitation, we focus on developing a method for the preparation of polyurea microcapsules using oil-in-oil (o/o) emulsions. Oil-in-oil emulsion systems consist of a polar organic phase dispersed in a non-polar organic solvent containing a proper surfactant. In our study, polyethylene glycol (PEG) or an ionic liquid (IL) were chosen as the polar organic phase. The process of preparation the polyurea microcapsules is based on emulsification of PEG or IL in non-polar solvent such as heptanes or toluene and then the polymeric shell around the PEG or IL droplets is created by interfacial polymerization of isocyanate and amine monomers. In our presentation we will describe the preparation method of these capsules, their characterizations and applications.

Biography

Prof. Abu-Reziq completed his doctorate at the Hebrew University in catalysis and sol-gel chemistry. After receiving his Ph.D. degree in 2004, he moved to Ottawa University, Canada, to do his postdoctoral research in the field of nanocatalysis. In 2006, he joined the company Sol-Gel Technologies as Senior Researcher and spent two years in developing micro and nano-encapsulation systems based on sol-gel process as drug delivery systems. In 2008, He was appointed as Senior Lecturer at Casali Center for Applied Chemistry and Institute of Chemistry and on 2015 he was promoted to Associate Professor. His research focuses on nanocatalysis, magnetic materials, green chemistry and developing micro and nanoencapsulation methods.

Veronique Lachaize PhD
A5 Science, FRANCE

Atomic Force Microscopy used to Explore Cardiac Cells Surface

Abstract

The Atomic Force Microscopy (AFM) is an atypical approach used to study biological samples in physiological conditions and Cardiology remains a scientific field where AFM is not extensively established. Heart diseases are a major human threat, and cause the death of millions of people each year. The AFM offers a new perspective to get a better understanding of pathologies or drug effects. The aim of this presentation is to give a comprehensive interest in the biophysical approach made possible by AFM studies. We will expose how AFM has been be used to study the impact of pathologies or active ingredients on cardiac cells surface properties. A specific AFM method called cell cell adhesion which allows to analyze the intercellular cardiac communication will be highlighted.

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Universal Adhesives in Non-Carious Cervical Restorations: USPHS 2-Year Clinical Report

Abstract

This prospective, double-blind, six-arm parallel randomized controlled trial (NCT02698371) aimed to compare the performance of two universal adhesives (UAs) in non-carious cervical lesions (NCCLs), using the United States Public Health Service (USPHS) criteria [1]. Thirty-eight 18- to 65-year-old participants were seeking routine dental care at a university clinic. At baseline, 210 NCCLs were randomly allocated to six groups (35 restorations' each). The UAs tested were FuturabondU (FBU) and AdheseUniversal (ADU) applied in either etch-and-rinse (ER) and self-etch (SE) modes. FuturabondDC (FBDC) in SE and in SE with selective enamel etch-ing (SE-EE) modes were controls. NCCLs were restored with AdmiraFusion. The analysis included nonparametric tests, Kaplan-Meier and log-rank tests ($\alpha = 0.05$). At 2-years, of 191 restorations, ten were missed due to retention loss (all groups, $p > 0.05$). FBDC performed worse ($p=0.040$) than FBU in SE mode. FBU showed lower performance ($p= 0.035$) than ADU when applied in ER mode. FBU and ADU adhesives, independently of adhesion mode, showed similar ($p>0.05$) overall clinical performance.

Keywords

dental bonding; humans; adhesives; tooth cervix; randomised controlled trial as topic; composite resins

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Optimization of Milling Procedure for Synthesizing Nano-Calcium Carbonate from Snail Shell using Supermasscollider

Abstract

This study focuses on the supermasscolloider wet milling process for synthesizing calcium carbonate nanoparticles from the AchatinaFulica using the optimal (custom) design. The snail shell particle size of 150 µm obtained from dry milling was wet-milled to obtain smaller particle sizes. The response surface design method was used to investigate the effect of independent parameters such as consistency (amount of microparticle loading in calcium carbonate suspension) and the number of runs on the particle size of calcium carbonate produced using a supermasscolloider. Results show that the microparticle loading in calcium carbonate suspension and the number of runs had a significant effect on the particles synthesized. The increase in microparticle loading reduced the effectiveness of the supermasscolloider blade, resulting in the production of particle sizes ranging from 105-244nm. A higher number of runs with a small amount of microparticles in calcium carbonate suspension offered a fine particle size of 89.2 nm. The experimental data quartic polynomial models gave a coefficient of determination (R2) of 0,9552. The optimum milling runs of 300 and 1% consistency microparticle loading produced a calcium carbonate nanoparticle size of 89.2 nm. This technique has shown that calcium carbonate nanoparticles can be produced at low cost, less period, with low agglomeration from AchatinaFulica shell using supermasscolloider

Keywords

AchatinaFulica Shell, Particle size, Nano-CaCo3, Supermasscolloider, Milling process, Design expect.

Dr. Oluwatoyin Joseph Gbadeyan is a postdoctoral researcher at theUniversity of KwaZulu-Natal and his research interest lies in material development (composite, biocomposite, nano-composite), Nanotechnology, additive manufacturing, and tribology.

Professor Sarp Adali is a full professor in the discipline of mechanical engineering at the University of KwaZulu-Natal and his research interest includes the design ofcomposite structures and the uncertainty analysis ofnanostructures.

Professor Bright is the Dean and Head of the School of Engineering. He is a Professor of Mechatronics, Robotic, and Advanced Manufacturing Systems, and his research interest includes Mechatronics, Robotics, and Advanced Manufacturing Systems.

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Mechanical Properties and Absorption Shielding Efficiency of Rubber Composites

Abstract

In the past few decades, the modernization in the field of science and technology has created a new kind of pollution, i.e. electromagnetic interference (EMI). EMI is the interference of one electromagnetic signal produced or received by another electronic device. As a consequence, one electronic element adversely affects the other's performance. With the rapid development and rejuvenation of gadgets, there is a steady increase in the electromagnetic pollution. In order to alleviate these problems, there is an active quest for effective EMI shielding materials. Composites based on rubber matrices filled with magnetic soft ferrite fillers are currently the subject of ongoing research due to their ability to effectively shield electromagnetic radiation.

The study is aimed at the preparation of rubber composite materials and evaluation of the influence of magnetic soft ferriteon physical–mechanical properties and EMI shielding performance of composites based on acrylonitrile-butadiene rubber. The results showed that although the tensile strength showed decreasing trend with increasing content of magnetic filler, the composites are able to efficiently shield harmful electromagnetic radiation in the tested frequency range. The biggest preference of these materials is their ability to shield EMI by absorption mechanisms, which means that electromagnetic radiation is absorbed by the shield and not emitted back to the surrounding.

Keywords

Rubber composite, magnetic filler, electromagnetic radiation, absorption shielding

Ackowledgement

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Benchmarking DFT Calculations for the Energetic and Vibrational Properties of Pyridine Adsorption in H-ZSM-5 Zeolite Cavity

Abstract

The theoretical study of the adsorption and protonation of pyridine (PY) on Brønsted acid sites (BAS) of H-ZMS-5 zeolite cavity by cluster approach and periodic model, both using the PBE functional (including the dispersion forces) in the density functional theory calculations has been investigated. The effect of the Si/Al ratio of 32T quantum clusters with different positions and distributions of 1 to 4 aluminum atoms (generated 32 adsorption complexes) on the energetic and vibrational properties of PY adsorption in the intersecting and narrow regions of the straight channel of H-ZSM-5 has been thoroughly examined and compared with that of the periodic model.

Irrespective of the calculation method, as well as the size and Si/Al ratio of the zeolite system, the protonation of PY during its adsorption on the BAS occurs spontaneously leading to the formation of monodentate ion pair complex PYH+/ZO-.Although the contribution of the dispersive van der Walls interactions to the adsorption energy for 32T cluster model is almost identical for the periodic model, the calculated adsorption energy for 32T cluster is 4-7 kcal/mol smaller than periodic model value for all complexes, due to the slow convergence of long-range electrostatic effects.The adsorption in the intersection region is energetically more favorable than in the narrow region owing to the predominance of dispersive interactions over steric constraints exerted by confinement effect. Whatever the Si/Al ratio, the Al distribution and the size of the zeolitic system, the most affected vibrational modes are the ring stretching modes 19b, 8b and 8a.

Biography

Martine Castellà-Ventura has completed her Ph.D in 1987 from Paris-Saclay University. She has been working at the “Laboratoire de ChimieThéorique” at Sorbonne University in Paris since 2010. She is mainly concerned by the acido-catalytic properties of microporous metal oxide materials. Particularly, she studies the adsorption of aromatic molecules in zeolite cavities by Quantum Chemistry methods (description of the reactivity of adsorbed molecules on the Brønsted acid sites of zeolitic surfaces, energetic and vibrational characterization of the adsorbed complexes) in order to understand the mechanisms governing the adsorption processes in these materials. Her works have been published in reputed journals.

Invited Forum
Day-2

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New Understanding of Pectin as an Exceptional Health-Promoting Agent

Abstract

Pectin is a very well-known heteropolysaccharide for its application as ingredient in the food industry due to its excellent technological properties. In addition, in the 2000s different scientific studies revealed that pectin has numerous positive health and nutritional effects as a dietary fibre and prebiotic. Since that moment, an enormous quantity of in vitro and in vivo investigations have highlighted that pectin is rather more than an exceptional food ingredient. In 2010, pectin was accepted by the European Food Safety Authority (EFSA) as nutritional supplement in the decrease of post-prandial glycaemic response, the keeping of blood cholesterol level and the increase in satiety. Obtaining pectin is also of interest to the scientific community due to the effect exerted by the severe extraction process from plant by-products on its very complex structure and, therefore, on its functionality. In this sense, emergent technologies such as ultrasound has been proved to be an efficient, fast, and reliable method facilitating the release of extractable compounds and improving the penetration of the solvent. Within the objective of searching new sources of pectin with new functionalities extracted by friendly environmentally methods, in this work we have carried out the optimization of pectin extraction from “Degla- Beida” date variety using ultrasonic assisted extraction (UAE). In addition to an exhaustive structural characterization, date pectins obtained by UAE in comparison to that obtained by acid treatment, presented improved antioxidant activity (24.3 and 61.0 mg/g DW for DPPH and FRAP assays, respectively), and in vitro antidiabetic properties, with higher glucose adsorption capacity (4 mmol g-1 at 200 min), as well as α-amylase inhibition (73.7%) and potential capacity to drop glucose diffusion (1.4 mmol g-1 at 150 min), which could improve the ability to retard starch digestion (0.1 mmol g-1 at 150 min), providing potential health-promoting properties. Though the complicated mechanisms need additional investigation, antidiabetic experiments seem to indicate that ultrasound obtained pectin could be a potential better antidiabetic agent than that extracted without ultrasound.

Keywords

antidiabetic properties, date pectin, ultrasound extraction

Biography

Mar Villamiel PhD. Institute of Food Science Research (CIAL, CSIC-UAM), Madrid (Spain) PhD in Pharmacy by the Complutense University of Madrid (Spain), Research Scientist at the CSIC and Director of the Institute of Food Science Research. She has made stays at the NIZO Food Research in the Netherlands and at the Institute of Food Research in Norwich (UK). Author of more than 155 scientific publications (h-index 40WoS; h-index 41 Scopus; author ID: 7003744305; http://orcid.org/0000-0001-6847-8359), 1 book, 5 patents and she participates in numerous national and international projects with highly competitive companies and prestigious institutions. Her main research lines are framed within the obtainment, structural characterisation and evaluation of functional ingredients based on carbohydrates. Currently, she is working on pectin obtained from agri-food by-products (citrus, sunflower) using clean and environmentally friendly methods (combination of high-intensity ultrasound and enzymatic treatments). Her studies have afforded relevant data on pectins with diverse structures and excellent techno-functional and biological properties.

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Thiol-Ene Ionogels Modified with Polymerizable Ionic Liquid Monomers

Abstract

Polymerizable ionic liquid monomers (ILMs) are ionic liquids containing functional groups capable of polymerization reactions. As a result, during the polymerization process, they are incorporated into the polymer structure, which allows the anion or cation of the ionic liquid to be trapped in the polymer matrix. Such a polymer combines the unique physical and electrochemical properties of ionic liquids with the mechanical and thermal properties of polymers. As polyelectrolytes, these materials can be used as electrolytes for batteries and capacitors, but also where immobilization and controlled release of active particles is important, i.e. in drug delivery systems, agriculture or biomedicine. The use of polymerizable ionic liquids for the synthesis of polyelectrolytes has many advantages over the use of ionic liquids, such as e.g. increased stability, reduced leakage, and improved mechanical properties. Despite these advantages, the disadvantages of such polyelectrolytes are also observed, the greatest being the decrease in ionic conductivity as a result of limiting the mobility of the ions after their incorporation into the polymer structure. Thus, addition of ionic liquid to such material, can allow to obtain ionogel(IG) with high ionic conductivity, good mechanical properties, as well as without leakage of IL from the polymer matrix.

One of the methods of IG synthesis using ILMs is thiol-ene photopolymerization. This method has many advantages, including the fast course of the process, the formation of a polymer with a homogeneous structure, or the lack of sensitivity to oxygen. The thiol-en polymers are characterized by high flexibility and good mechanical and thermal properties. This reaction proceeds by the radical step polymerization mechanism of multifunctional thiols with multifunctional enes.

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grant number 2017/27/B/ST8/00762

Biography

Agnieszka Marcinkowska is an Assistant Professor in the Department of Polymers at Poznan University of Technology. She received a Masters Engineering (2003) and Doctorate degrees (2007) at Poznan University of Technology in Chemical Technology. Her research interests are focused on polymer synthesis by photopolymerization, currently mainly thiol-ene polymerization of ionogels as well as hybrid organic-inorganic and composite materials, drug delivery systems, soft actuators, and cosmetic varnishes.

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Synthesis and Textural-Surface Analysis of Carbon Monoliths for Sorption of Pollutants

Abstract

Sorption processes are of key importance in environmental protection and engineering. An important issue is the synthesis of suitable porous materials that will effectively sorb pollutants from the gas and liquid phases. A strongly interconnected macroporous network is essential to ensure efficient gas mass transfer, a process in adsorption and desorption kinetics. Mesopores were introduced into the material with a microporous structure. However, their presence did not satisfactorily increase the adsorption and desorption kinetics of the material in fast sorption processes. Carbon monoliths are synthesized from powdered carbon materials characterized by good porosity and a suitable binder. The resulting mixture is formed into a suitable shape. The disadvantage of using some binders is that they block the porosity of the carbon material and reduce the mass proportion of carbon in the resulting monoliths. The authors recognized the need for the development of adsorption and desorption processes taking place in rapid cycles undertook research on synthesis of activated carbon monoliths based on activated carbon cured with resin-formaldehyde and selected polymers. The monoliths were prepared in various ways: by adding silica to the carbon and then removing it with hydrofluoric acid, and by activating them with nitrogen or carbon dioxide at high temperature. The resulting monoliths were subjected to surface-textural analyses such as nitrogen sorption and porosimetry. This made it possible to determine the size and distribution of pores and the specific surface area of the materials. On this basis, the sorption capacity of the prepared materials will be evaluated.

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Biography

Gabriela Polak graduated with a master's degree in Chemical Technology and Fuels and Environment in 2021. She is currently a PhD student at the AGH University of Science and Technology in Krakow in the Adsorption and Environmental Engineering Group led by Professor KatarzynaZarębska. Among other things, the team deals with: sorption processes, synthesis and analysis of geopolymers, and management of waste from the energy sector within the concept of closed-loop economy. The team publishes its research results in reputable scientific journals.

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Mechanism of Radical (Homo) polymerization of Multivinyl Monomers: Applicability of Flory-Stockmayer Theory

Abstract

Flory and Stockmayer (F-S theory) defined that the free radical polymerization of multivinyl monomers (MVMs) inevitably leads to gelation even at low monomer conversion based on two assumptions: (1) independent and equivalent vinyl groups, (2) no intramolecular cyclization.[1, 2] However, until now its applicability to FRP and reversible deactivation radical polymerization (RDRP)is still controversial, especially regarding the prediction of the gel point and the extent of intramolecular cyclization. In this work, we found that the F-S theory can successfully predict the gel points of FRP of MVMs,[3] however, is not sufficient for predicting ATRP of MVMs.[4]This inapplicability is not only due to neglecting intramolecular cyclization, but also due to spatial restrictions which cause the reactivity and accessibility of vinyl groups becoming non-equivalent in ATRP of MVMs. This work has finally resolved the controversial understanding regarding the fundamental mechanism of the FRP and RDRP of MVMs. The new insights provided by this work will rectify the traditional impression on the applicability of F-S theory to different polymerization systems.

Keywords

FRP, ATRP, multivinyl monomers, F-S theory, intramolecular cyclization, Monte Carlo

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Biography

Dr Jing Lyu is a Postdoctoral Researcher in Prof. Wenxin Wang's group at University College Dublin (UCD), Ireland. Dr Lyu has published over 10 peer-reviewed journal papers (such as Advanced Materials, Macromolecules and Nature Reviews Chemistry co-authored with the world-wide leading researcher Prof. Krzysztof Matyjaszewski), 1 book chapter, 3 conference abstracts and presentations and 1 fellowship/funding (72,000 EURO) - the IRC Employment Based Postgraduate Programme. She has also co-supervised 7 Ph.D./master/undergraduate students and acted as a teaching assistant in the School of Mechanical and Materials Engineering, UCD contributing to

various teaching activities for Master students. In addition, Dr Lyu has been working as a Product Development Scientist in Blafar Ltd (a biotechnology company, committed to produce functionalised biopolymer products for cosmetic and medical devices industry around the world) and has built up good collaborations with world-wide leading researchers in both academia and industry.

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Alkali Activated Slagconcrete with Recycled Aggregates made Recycled Concrete

Abstract

Alkali-activated materials (binders) are one of the fastest-growing alternatives to replacing Ordinary Portland cement due to the reuse of industrial waste [1] and lower CO2 emissions during production [2].In this study the development of sustainable concrete was investigated. The binder was made from alumino silicate precursor: ground slag, zeolitic by-product and phosphor gypsum which were activated with the aqueous solution of sodium hydroxide. Aggregates (fine and coarse) of concrete were made from crushed demolition waste of ordinary Portland cement concrete. The aim of the research was to investigate an alkali-activated slag composite (concrete) using some types of by-products/waste. Different compositions of hardened cement paste and concrete were investigated including, mechanical, physical properties, new chemical compounds form during hydration and microstructure was investigated. Based on the obtained results, the recommended content of zeolitic by-product in the precursor mixtures was from 3.7%to 8.1% (calculated from the amount of slag). Higher strength values were reached the samples of hardened cement paste which were cured at 60℃ for one day (39.1 MPa) compared to the samples hardened at room temperature (18.2 MPa).Similar situation was with concrete samples: almost three times higher compressive strength (14.9 MPa) was achieved for the samples cured at the elevated temperature to comparing with samples cured at room temperature (4.8 MPa). By comparing the aggregates for concrete, it could be concluded that similar strength values were reached for the concrete samples with natural aggregates or made it from recycled concrete. It could be concluded that sustainable concrete could be produced by using ground slag, zeolitic by-product and phosphogypsum and recycled aggregates which recommended to harden at 60℃ for one day.

Keywords

alkali activated concrete; ground slag; zeolitic by-product; phosphogypsum.

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Biography

Prof. Dr. Danutė Vaičiukynienė studied Chemical technology at the Kaunas University of Technology, Lithuania. She received her PhD “Use of Technogenic Materials for Zeolite Synthesis and CSH Thermal Insulation Materials” degree in 1998 at the same institution. Research interests: Technological Sciences, Civil Engineering, Materials Engineering, Environmental Engineering. She has experience in the research areas such as alkali activation of different by-product materials to obtain geopolymers, phosphogypsum research and cement composite systems. She is co-author of 4 books, 1 laboratory book, 2 monographs; member and participant in organizing committees of international conferences. The number of scientific publications (including conference papers) is over 100. Participates in COST activities and Erasmus + program. For more information, see the researcher’s account: https://en.ktu.edu/scientist/danute.vaiciukyniene/

Poster Presentations

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Evaluation of Porcine Gastric Mucin - Diamond Nanoparticles Interactions

Abstract

Aim: Nowadays, nanoparticles are widely used in various domains starting from electronics up to drug delivery systems. In particular, nanodiamonds (NDs) are increasingly used in biomedical filed being known to possess the highest biocompatibility among all the other carbon nanospecies [1]. The main objective of the present work was to evaluate interactions that take place when NDs come together with porcine gastric mucin (PGM) or methacryloyl PGM.

Materials and methods: To better understand how NDs-COOH interact with PGM and methacryloyl PGM, a quartz crystal microbalance with dissipation monitoring (QCM-D) study was performed as follow: (1) 0.1 mg/ml glycoprotein solution prepared in carbonate-bicarbonate buffer was adsorbed onto the gold sensor surface, (2) after rinsing, 0.1 mg/ml NDs-COOH was perfusedonto the glycoprotein previously adsorbed layer for 15 minutes and let to interact for another 15 minutes (3) then, another rinsing is followed by protein perfusion and (4) a final washing step. Circular dichroism (CD) was used to evaluate the structural changes of glycoprotein in presence of NDs. Zeta potential (ZP) and contact angle (CA) measurements were also performed.

Results and discussions: Both, PGM and methacryloyl PGM were adsorbed onto the sensor surface as indicated by frequency decrease with a higher adsorption recorded for PGM. Interestingly, the addition of NDs-COOH lead to a higher decrease in frequency and to an increase in dissipation suggesting that NDs interacts with protein probably with rearrangement of macromolecule in such manner that the composite layer became softer (Fig1.B). The rearrangement of glycoprotein might lead to higher capacity of buffer molecules absorption with the formed layer. Up to the end of QCM-D measurement, the mass continuously increased, and the rigidity of the layer decreased (Fig1. A.). When compared, all results showed more pronounced interactions of the nanospecies with PGM when compared with methacryloyl PGM without affecting the secondary structure of glycoprotein in neither case.

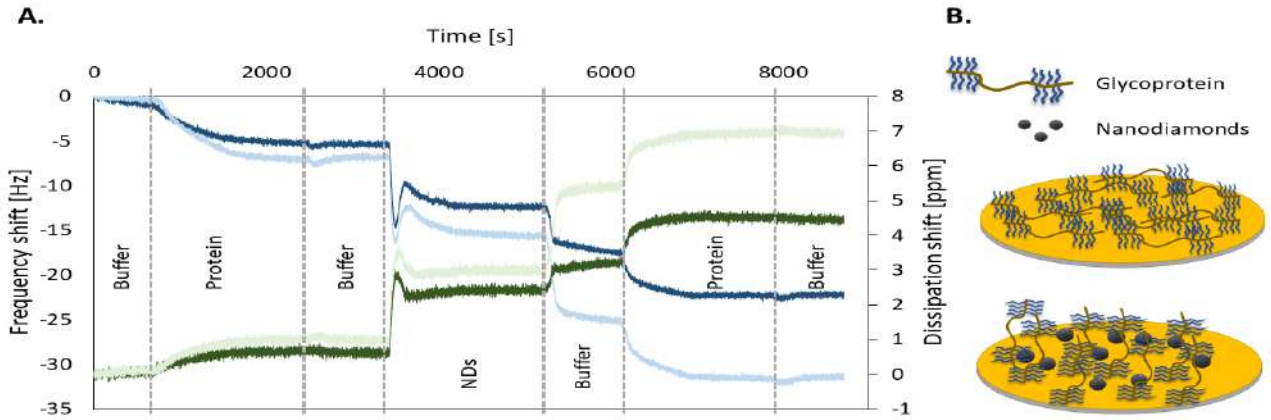

Fig. 1: A. Frequency (blue lines) and dissipation (green lines) shifts of the PGM-NDs (light colors) and methacryloyl PGM-NDs(dark colors), as observed by 7th overtone;
B. Schematic representation of possible rearrangements of glycoprotein macromolecules during QCM-D experiment

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Electromagnetic Properties of Soft Magnetic Composite Materials

Abstract

Today's life and, in particular, the everyday life of people is linked to the latest advances in science and technology. All electronic devices produce electromagnetic radiation – electromagnetic smog, which makes electromagnetic pollution a growing problem. This smog has a negative impact on human health in particular, but it also disrupts the functioning of other electronic devices.

One way to eliminate electromagnetic radiation is shielding. Metals are the most common materials used for electromagnetic shielding. The main mechanism of their shielding is the reflection due to the free electrons in them. Attention is particularly related to ferrites, as commonly used magnetic fillers. Composite materials filled with ferrite particles based on polymer matrix materials are currently the subject of research due to possible applications. Polymer composites filled with soft ferrites are able not only to reflect electromagnetic radiation but they can also effectively absorb it. Polymer composites filled with a suitable type of ferrite fillers are able to achieve a high proportion of total protective effect by the absorption mechanism. A unique feature providing their broad prospects in various areas of research is a strong dependence of magnetic properties on the magnetic field used. Elastomeric magnetic composites combine a unique pattern of suitable magnetic and elastic properties.

Keywords

Elastomeric composites, soft magnetic ferrites, electromagnetic radiation shielding; absorption

Ackowledgement

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Antibacterial Additives and Coatings of Melt-Blown Polymer Filter Media for Extended Life-time

Abstract

The filtration process is an important unit operation involved in almost every water treatment technology. Although its technical realization is quite straightforward (forced flow through reasonable porous bed: granular, fibrous or a membrane), the diversity of contaminants requires proper media selection and sizing for a long-term reliable operation. The filtration is always an unsteady process followed be regeneration or filtration media replacement after a certain amount of solid contaminants is collected. However, the experimental observations show that blocking of the filter element can be significantly accelerated by the microorganism colonization in the filter media. This process is widely observed in majority of water filtration application as the water containing a minimum amount of nutrients supports life of many species. Apart from filter clogging, the microorganisms such as bacteria, fungi or algae can be reentrained from the filtration cartridge and contaminate the filtered water [1].Over years various modified filtration materials which contain antibacterial additives have been developed to prevent these detrimental effects (including also other daily use devices made of polymers) [2]. A wide range of compounds have been confirmed to have good bacteriostatic properties. However, the challenge is to introduce them into fibrous structure (create uniform and robust coatings, and maintain structural properties) and to quantify the antibacterial effect depending on filter properties (e.g. additive type, its surface concentration and immobilization method).

In this work, a modified filters have been developed and experimental verification methodology has been devised, which allows to determine the bacteriostatic effect against Escherichia Coli (strain Castellani & Chalmers ATCC 8739) present in the filtered water. Two groups of additive have been considered: (i) zeolites containing metal ions (Ag, Cu, Zn), which were blended with the polypropylene and processed using the melt-blown technique, and (ii) metallic oxides, which were introduced on the external cylindrical surface of the filter cartridge (i.e., on the inlet surface) using the magnetron sputtering, which belongs to the low temperature plasma processing methods. The plate testing confirmed bacteriostatic properties of the fibrous filter material with the additive, and filtration experiments in a multipass mode showed different behavior of the dP increase during the testing for unmodified and treated materials. Moreover, the bacteria elimination from water has also been verified.

Acknowledgements

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Keywords
water filters, polymer filter media, biofouling prevention, bacteriostatic additives, antibacterial filters testing

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Biography
Prof. Andrzej Krasiński holds Ph.D. in chemical engineering obtained in 2005 at Faculty of Chemical and Process Engineering of Warsaw University of Technology, and in 2018 the D.Sc. (habilitation) for the comprehensive research on emulsion separation using the coalescence filtration method. Currently he has been employed as Associate Professor in Chair of Integrated Processes Engineering (initially in Process Equipment Department).He is an author of more than 50 publications in peer reviewed journals, over 30 conference presentations, and 2 patents. His research track is related to the separation processes, with focus on the coalescence of droplets and separation of gas-liquid and liquid-liquid dispersions, water and wastewater treatment technologies, and gas cleaning techniques. Based on experience the area of his expertise covers also aggregation of particles in turbulent flows, precipitation, CFD modeling of reactive and multiphase flows, and rheology of dense suspensions.

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Functional Polymer Fibrous Media Coated with Metallic Oxides

Abstract

Development of filtration materials covers various modifications towards obtaining improved separation performance (i.e., high efficacy and low-pressure drop), extending the filters lifetime (increasing the regeneration interval or reducing the change out frequency), and providing filtration materials with other special features corresponding to specific process needs. In recent years many research activities have been done and published in the field of fibrous media modification [1-3]. The involved processes comprise various techniques, including dip-coating or spray-coating, hydrothermal treatment, etc., to introduce chemical or physical modification onto the fiber surface. The major challenge is to obtain a uniform and robust deposition bonded with the base material chemically or with strong low-range physical forces. To those modification materials belong metallic oxides, which can play an important role in the integrated process next to the filtration. For example, silver, copper, and zinc oxides are known for their activity against bacteria, fungi, or algae, while titanium oxides dopped with some metals can perform well as a photocatalyst when exposed to light. One of the possible routes to introduce those species on the polymer fibers is a low-temperature plasma processing such as magnetron sputtering. In this process, a uniform layer of active additive can be easily introduced, without thermal degradation or damaging the original structure of the melt-blown filters.

In this work, the potential of the developed technology is presented, and some prospective applications of filters modified with metallic oxides are discussed. The known antibacterial features of silver, zinc, and copper oxides have been studied, firstly on the polypropylene flat samples to confirm their bacteriostatic properties. Successful results were prerequisite for coating the melt-blown filter media made of the same polymer – the inlet surface of the cylindrical filtration element was subject to deposition (it is the inlet surface of the filter for out-to-in flow arrangement, which is mostly exposed to biofouling). The antibacterial activity was confirmed to be active against gram-negative (Escherichia coli) and gram-positive (Staphylococcus aureus) bacteria strains, typically encountered in surface waters. Another application of metallic coatings covers modification of the drain layer of the oil coalescers (flow direction in-to-out), where the polypropylene filters revealed a tendency of forming foam-like oil/water structure. This elongated film of oil was easily entrained by water, which caused a significant reduction of the separation efficacy. The metallic coatings applied on the polypropylene coalescence media significantly improved the performance of the water deoiling process.

Acknowledgements
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Keywords
fibers coating, physical deposition, metallic oxides layers, modified filter media

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Biography
Leon Gradoń has a diploma in chemical engineering from Warsaw University of Technology (WUT) in 1969, a diploma in mathematics from Warsaw University in 1975, and a Ph.D. from WUT in 1976. He was a postdoc at the University of Houston (1978-1979). Visiting professors at the US, Japanese, and European universities. He has been a professor at the WUT since 1990. His main field of research is filtration, polymer processing, transport processes in the human respiratory system, particle technology, spray-drying, spray-pyrolysis processes, and nanocatalysis.
Leon Gradoń is the author and co-author of 21 monographs and chapters, 7 academic books, over 230 peer-reviewed papers in scientific international journals, over 250 presentations on International Conferences, and author and co-author of 65 patents and utility models. He is also the author of several filtration technologies introduced into the world market.
Recipient awards, among them Smoluchowski's, Fulbright, Rockefeller Awards, and Cummins Filtration Endowed Professor.

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Thiol-Ene Ionogels with Mixture of Triazolium Ionic Liquids and Propylene Carbonate

Abstract

A polymeric ionogel (IG) is essentially a three-dimensional polymer network through which an ionic liquid (IL) percolates while retaining the properties of solid-like materials. ILs ensure high ionic conductivity and high thermal and electrochemical stability, while polymer matrices provide good mechanical properties. Due to these properties, IGs can be used as gel polymer electrolytes (GPEs) in electrochemical capacitors (EC).Depending on the compatibility of polymer matrix with liquid electrolytes, such as IL or a mixture of IL with propylene carbonate (PC), there may be a risk of electrolyte leakage from the IG, which is undesirable and significantly limits its use as a GPE. In this study, a mixture of IL and PC was used as the electrolyte. PC use provides higher conductivity, but unfortunately causes electrolyte leakage from materials. To avoid electrolyte leakage, triazolium ILs which increase the compatibility of GPE components were used.1,4-dialkyl-1,2,4-triazolium IL with different alkyl chain lengths was synthesized by alkylation of 1,2,4-triazole. GPEs were obtained by in-situ photopolymerization reactions of thiol pentaerythritol tetra(3-mercaptopropionate (PETMP) and ene 1,3,5-triallyl-1,3,5-triazine-2,4,6 (1H,3H,5H) – trione (TATT) in the presence of a mixture of 1,4-dialkyl-1,2,4-triazolium IL and PC. The polymerization kinetics of the photocurable mixture was determined by photo-differential scanning calorimetry. The ionic conductivity of the GPEs was investigated by the EIS method and the mechanical properties by the puncture resistance test. Glass transition temperatures were investigated by the DSC technique, and material morphologies by scanning electron microscopy.

The obtained GPEs have good mechanical properties and can be twisted and rolled up without suffering damage. The use of triazolium IL sallowed materials to be obtained without leakage. This improved compatibility between components of ionogels is also manifested in the lack of leakage of the electrolyte from their structures. The GPEs have a high ionic conductivity of 3.3 - 4.7 mS·cm-1 and can be used in ECs.

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grant number 2017/27/B/ST8/00762

Biography

Aneta Lewandowska is a PhD student in the Department of Polymers at Poznan University of Technology. She received Masters Degree (2017) at Adam Mickiewicz University. Her research interests are focused on hybrid organic-inorganic materials synthesis by photopolymerization; synthesis and application of ionic liquids in polymer materials.

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Biotechnological Addition of β-Glucans from Cereals in Foods

Abstract

Cereals are considered as the major sources of β-glucans. Several extraction procedures have been applied in order to recover these valuable naturally occurring polysaccharides. The rheological and molecular properties of β-glucans can be utilized by incorporating them into various foods, since they exhibit beneficial properties to human health. Their functional properties are mainly determined by their molecular and structural characteristics [1]. Consumption of fortified foods with β-glucans, can contribute to the treatment of certain chronic diseases. Reduced cholesterol, cardiovascular and diabetic risk as well as moderate glycaemic response of foods, have been recorded after the consumption of these biologically active compounds [2]. It must be noted that, there has been observed an interaction between β-glucans and foods, after their incorporation to them. Overall, this study aims to discuss recent applications concerning the quality and nutritional results of β-glucans incorporations in foods such as beverages, dairy, bakery, meat, and pasta products, as well as their uses in other fields like medicine [3].

Keywords

β-glucan; dietary fiber; beneficial health effects; metabolic health parameters; cereals;

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Biography

Dr. Dimitrios Arapoglou is an Agriculturist and Dr. Chemical Engineer and since 2015 is a Senior Researcher (Grade B) at the Institute of Technology of Agricultural Products of HAO-DEMETER. He had worked as Researcher at more than 25 European and Greek projects, 3 of them as coordinator. His work has been focusing on the field of waste management of agricultural industries, as well as the treatment of this type of waste/by-product with micro-organisms for the production of high-value biotechnology products. He has also dealt with the β-glucans extraction - characterization from mushrooms and cereals as well as its addition to food and feed. He is the author of 35 peers reviewed articles (h-index: 13, 850 citations), 1 book chapters and he has more than 110 presentations in international and national conferences. He has served as reviewer in several International Journals of SCI.

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Rapidly Biodegradable Polyesters Comprising Metal Fertilizer Ions

Abstract

Although plastics are indispensable to modern civilization, they face strong opposition owing to concerns related to post-consumer waste and littering. One strategy to resolve this issue is the replacement of non-degradable plastics with biodegradable alternatives. Despite the growing interest and investment in the production of biodegradable plastics, synthetic biodegradable polyesters are prone to undergo slow biodegradation under ambient conditions. In this work, the preparation of polyesters exhibiting enhanced biodegradability, and containing fertilizer components was demonstrated. The polyesters were generated through combining the old controversial macromolecule with aggregate theories. More specifically, the H3PO4-catalyzed diacid/diol polycondensation enabled the formation of polyester chains bearing −CH2OP(O)(OH)2 and (−CH2O)2P(O)(OH) groups. Then M(2-ethylhexanoate)2 (M = nutrient elements essential for plant growth, e.g., Zn, Mg, Mn, and Ca) is used to form ionic aggregates. The prepared ionic aggregates showed significantly faster biodegradabilities under controlled soil conditions at 25 °C than those prepared using the conventional method, where polyester chains were further connected with urethane linkages; both showed comparable rheological and mechanical properties.

Keywords

Biodegradable polyester, Ionic aggregate, Fertilizer ingredient, Biodegradability

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Double Metal Cyanide Catalysts by using H3Co(CN)6 for Epoxide/CO2 Copolymerization

Abstract

Double-metal cyanide catalyst (DMC) is heterogeneous coordinative catalyst with activity in epoxide homopolymerization and the copolymerization of Epoxide/CO2. The prepared polymer is called polyol as an important raw material for the manufacture of polyurethane. Activity of the DMC catalyst is sensitively affected by the preparation method and conditions. The conventional DMC catalysts are prepared by mixing of K3Co(CN)6 with excess ZnCl2. Then, a tedious washing process is required. In this work, a 100 g scale preparation of H3Co(CN)6 is proposed and structure is determined using X-ray crystallography. A new type of DMC catalyst is prepared by mixing H3Co(CN)6 and Zn(EH)2 (EH = 2-ethylhexanoate). The catalyst exhibited high activity in PO homopolymerization with propylene glycol (PG) as a starter. A conventional DMC was inactive in the presence of such a simple PG starter. The prepared DMC was also active in PO/CO2 copolymerization. However, substantial amount of cyclic carbonate was generated (~30 wt%) in the presence of polypropylene glycol (PPG) as starter.

Keywords

Epoxide/CO2 copolymerization, Double metal cyanide complex, Carbon dioxide

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Silylene-Bridged ansa-Metallocene Complexes synthesis with Thiophene-Fused Cyclopentadienyl for High-Performance Supported Catalysts

Abstract

A series of Me2Si-bridged ansa-zirconocene complexes coordinated by thiophene-fused cyclopentadienyl and fluorenyl ligands were prepared for develop supported catalysts adoptable in commercial process. Fluorenyl anion is more basic than thiophene-fused cyclopentadienyl, and sequence of addition to Me2SiCl2 was crucial to achieve high yield; successive addition of fluorenyl-Li and thiophene-fused cyclopentadienyl-Li to Me2SiCl2 resulted in high yield (87%) whereas addition in the reverse sequence afforded the ligand precursor in low yield (27%). X-ray crystallography studies of 9 showed that fluorenyl ligand adopts an η3-binding mode. Related Me2Si-bridged ansa-zirconocene complex 15 was also synthesized replacing fluorenyl ligand in 9 with 2-methyl-4-(4-tert-butylphenyl)indenyl ligand, although obtained as a mixture of diastereomers. Furthermore, ansa-metallocene complexes 20 and 23 containing tBuO(CH2)6-tether as well as a dinuclear congener 26 were synthesized by replacing Me2Si-bridge in 12 and 15 with tBuO(CH2)6(Me)Si-bridge and connecting two complexes with –(Me)Si(CH2)6Si(Me)– spacer, respectively. Silica supported catalysts prepared with 12, 20, and 26 containing bulky 2,7-di(tert-butyl)fluorenyl ligand showed two times higher productivity than the one prepared with the conventional (THI)ZrCl2 (21−25 vs. 12 kg-PE/g-(supported catalyst)), polymers with comparable molecular weight (Mw, 330−370 vs. 300 kDa) but containing higher 1-hexene content (1.3 vs. 1.0 mol%) being produced, though the bulk density of generated polymer particles was rather inferior (0.35 vs. 0.42 g/mL).

Keywords

Ethylene polymerization, Metallocene catlyst, Thiophene-fused cyclopentadienyl, Supported catalyst

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α-Olefin Trimerization Catalyst for Lubricant Base Oils

Abstract

α-Olefin trimers are used at a bulk scale as well known lubricant base oils, with putative future applications as diesel fuels obtainable from renewable ethylene. α-Olefin trimers are usually obtained in the cationic oligomerization process, during which a scope of n-mersarenow generated alongside severe skeleton rearrangement. In this paper, catalysts that can selectively convert α-olefin to its trimers are worthy. But, few examples have been informed. Herein, we report selective α-olefin trimerization catalysts formed via the modification of the Chevron-Phillips ethylene trimerization catalytic system and it can avoid the use of high-priced activators, such as methylaluminoxane (MAO), B(C6F5)3.The original Chevron-Phillips system is inactive for α-olefin. A catalytic system Cr(acac)3/[2,5-Me2C4H2N-Al(iBu)3]−Na+/(iBu)3Al showing high turnover numbers (TONs) over 10000 (31 kg/g-Cr for 1-decene), generating trimers selectively without other unwanted fractions, was developed. We checked by simulated distillation gas chromatography (SimDisGC) analysis. The assumedη5-pyrrolide chromium active species was partly confirmed by the constitution elucidation of [η5-Me2C4H2N-AlMe3]Cr(Me)[CH2C6H4(ortho-NMe2)-κ2C,N]. The prepared 1-decene trimers (after hydrogenation) showed an advantageously higher viscosity index (VI) than the widely used product PAO-4.0 (128 vs. 123). Fluids showing similar lubricant properties as either the 1-decene trimers or 1-decene derived PAO-4.0 were obtained by using 1-octene/1-dodecene blend.

Keywords

α-Olefin trimerization, lubricant base oil, Chevron-Phillips system, PAO

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Management of Fly Ash in the Process of Carbonization

Abstract

In recent years, many environmental issues have changed. It has become necessary to modernize the system of municipal waste management and ways of obtaining energy from fossil resources. The effect of thermal processing of municipal solid waste and fossil fuels is the production of thousands of tons of combustion by-products, including fly ash. These consist mainly of oxides of silicon, magnesium, calcium and aluminum. With environmental protection and the idea of a closed-loop economy in mind, industrial fly ash samples were directed to be further processed by mineral carbonation to reduce the amount of harmful carbon monoxide. Mineral carbonation occurs to a small extent spontaneously in nature. It involves the reaction of calcium or magnesium oxide with carbon dioxide to produce non-hazardous carbonate salts During the study, selected fly ash samples were tested for adsorption against CO2. The tests were conducted over a wide range of pressure and temperature. The original volumetric apparatus, designed to study gas sorption at elevated pressure, was used for measurements under static conditions. Real density measurements, Fourier transform infrared spectrometry and X-ray diffraction analysis of initial and post-carbonation samples were performed. An increase in equilibrium pressure caused an increase in the amount of stored CO2, while an increase in the temperature of the system caused a decrease in the amount of accumulated gas. The results obtained are favorable both ecologically in terms of the possibility of disposed carbon dioxide, as well as economically due to the higher efficiency of the process at a lower temperature

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Polymeric Nanocomposite Membranes for Clean Energy and Clean Water Applications

Abstract

Clean water, clean energy, global warming and affordable healthcare are four major concerns globally resulting from clean water shortages, high fluctuations of oil prices, climate changes and high costs of healthcare. Clean water and public health are highly related, while clean energy is essential for sustainable prosperity. Among many potential solutions, advances in membrane materials and technology are one of the most direct, effective and feasible approaches to solve these sophisticated issues. Membrane technology is a fully integrated science and engineering which consists of materials science and engineering, chemistry and chemical engineering, separation and purification phenomena, environmental science and sustainability, molecular simulation, process and product design. In this presentation, we will introduce and summarize our efforts on nanomaterials for membrane development in the fields of clean water and clean energy production. Various material and fabrication strategies to enhance membrane performance will be discussed. We will also discuss other emerging membrane technologies for water reuse, seawater desalination, osmotic power generation, H2 production and CO2 capture.

Keywords

Membrane technology, seawater desalination; osmotic power generation;
H2 separation, natural gas purification, CO2 capture

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Biography

Prof. Neal Tai-Shung Chung is a Jade Mountain Chair professor at Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology (NTUST), Taiwan. Before joining NTUST, he was a Provost's Chair Professor at the ChBE dept of National University of Singapore in 2011-2021. His research focuses on polymeric membranes for clean water, clear energy and pharmaceutic separation. In 2005-2008, he worked as a Senior Consultant for Hyflux, led and built its membrane research. He became a Fellow in the Academy of Engineering Singapore in 2012 and received IChemE (Institute of Chemical Engineers, UK) Underwood Medal for exceptional research in separations and Singapore President's Technology Award in 2015. His H-index = 114 (Scopus) or 130 (Google Scholar). He is an editorial board member of more than 20 journals including J. Membrane Science, Env. Sci. & Tech., AIChE J, Separation & Purification Techno., I&EC Research, and many others.

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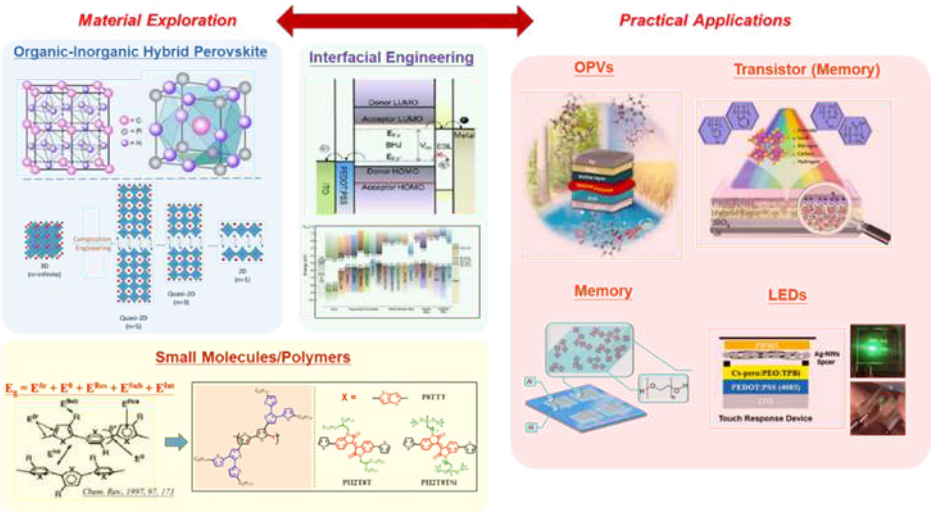
Improving Thermal/Photo/Underwater-Stability of Polymer Solar Cells by Interface Engineering

Abstract

Our research group focuses on the development of functional polymer interlayers for various kinds of optoelectronic devices, including thin-film transistor (TFT), (photo-) memory, light-emitting diode (LED), and solar cell devices. We are particularly interested in exploring the structure-performance relationship of polymers. Besides the advances in controlled synthesis of organic semiconductors, we also explore innovative interfacial and device engineering to optimize the device performance. Herein, we focus on introducing our recent works regarding interface engineering for polymer solar cells. In this presentation, an integrated study of combining material synthesis, interface engineering, and morphology analyses will be introduced and discussed to explore the full promise of the devices, especially focusing on device's long-term stability.



References: http://chuehslab2016.wixsite.com/ccchueh

Keywords
Interface engineering; bulk-heterojunction morphology; polymer solar cells; thermal stability; photostability

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Organic Nanoparticles for Sensing, Imaging, and Therapy

Abstract
There is an increasing trend of using organic nanoparticles and especially light-harvesting conjugated polymer nanoparticles as active materials for sensing, imaging and therapy applications. The recent results show that conjugated polymer nanoparticles could be fabricated to have tunable sizes and emission, with over 10-fold brightness as compared to inorganic quantum dots with a similar dimension. In addition, their large absorption cross-sections have also enabled them to be used as photoacoustic contrast agents and for photothermal and photo dynamic therapy. In this talk, I will discuss different strategies to form water-dispersible conjugated polymer nanoparticles and their applications as signal reporters or signal amplifiers for chemical and biological sensing/imaging and therapy. In addition, I will also briefly introduce our recent progress in organic nanoparticles with aggregation-induced emission features as replacement for quantum dots in various applications.

Ch M Rozita Ahmad
Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia

Utilisation of Zinc Layered Hydroxide Nanomaterials in Forestry and Agriculture Application

Abstract
Prolong use of agrochemicals to enhance forestry and agriculture production has causes concern to the environment. These chemicals are not fully absorbed by plants because they are lost through leaching in soil, evaporation, degradation which can lead to pollution and economic losses. Slow release formulation through nanotechnology application able to maintain nutrient availability by releasing nutrients for effective plant growth. However, some of the material used in the controlled release formulation (CFR) have limitation because they contain additives that are left behind after the application is accomplished. A suitable CRF that is environmentally friendly is needed to minimise the environmental issue. Zinc layered hydroxide (ZLH) is a layered metal hydroxide comprised of one type of divalent metal cation, zinc. ZLH carries high positive charge densities which can hold anionic compound within the interlayer spaces to form high stability materials. It is also known as anionic clay, can undergo anion exchanged reactions. Due to its high charge densities and possess large interspacing, ZLH can become host for higher number of guest anion of different sizes. This makes it potential to be used as carrier and slow release delivery system for many chemical agents in agriculture applications. Furthermore, ZLH can provide useful supplement to the environment as zinc source, which improve soil nutrient and enhance plant growth.

Biography
Rozita has joined FRIM since 1987. She is a Chemist and Head of Soil Management Branch. She is also the Head of Soil Chemistry Laboratory, involve in soil and plant technical services. Her research area includes soil chemistry, Free air carbon enrichment (FACE), heavy metals, organic waste utilisation, layered organic-inorganic nanohybrid and controlled release formulation. She has published more than 40 publications in journals and conference proceedings.

Jianfeng Wang
City University of Hong Kong

Exploring the Micromechanics of Granular Soils Using Machine Learning Methods

Abstract

There is a dearth of machine-learning investigations of the micro-mechanics of granular soils. The micro-mechanics deals with the mechanics of granular materials at the micro-scale (often particle scale) or meso-scale and is contrasted with the macro-mechanics which focuses on the macro-scale behavior measured at the laboratory sample scale or field scale. In this talk, a pioneering investigation of the contact force chains (CFC) in quasi-statically sheared granular materials using machine learning methods is conducted.An artificial neural network (ANN) based on discrete element method (DEM) simulation data is developed and applied to predict the anisotropy of CFC in an assembly of spherical grains undergoing a biaxial test. Five particle-scale features including particle size, coordination number, x- and y-velocity (i.e., x and y-components of the particle velocity), and spin which all contain predictive information of the CFC are used to establish the ANN. The results of model prediction show that the combined features of particle size and coordination number have a dominating influence on the CFC estimation. An excellent model performance manifested in a close match between the rose diagrams of CFC from the ANN predictions and DEM simulations is obtained. In addition, some preliminary results of the prediction of the constitutive response of granular materials using the machine learning method are also presented.

Biography

Dr. Wang received his BSc and MSc degrees from Tongji University, China and his PhD degree from Virginia Tech, USA. Dr. Wang is internationally well known for his works in the field of micromechanical characterization and modeling of granular soils. Dr. Wang's work has been awarded the prestigious international prizes of 2011 Geotechnical Research Medal (UK Institution of Civil Engineers) and 2010 Higher Education Institutions Outstanding Research Award - Natural Science Award (the Ministry of Education of China). His research has attracted over 7 million HKD of external grants including the Research Grant Council (RGC) of Hong Kong SAR and National Science Foundation of China (NSFC). Dr. Wang currently serves as a Scientific Editor of Journal of Rock Mechanics and Geotechnical Engineering (The Chinese Academy of Science), and an Editorial Board Member of Soils and Foundations (The Japanese Geotechnical Society). So far Dr. Wang has published 80 SCI journal papers with a Google Scholar H-index of 26.

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Advanced Form-Stable Phase Change Materials (Pcms) for Solar-to-Electric Energy Conversion

Abstract

The supporting material is utilized to fabricate form-stable phase change material (PCM) composites and sustain the intrinsic solid state during the phase transition process[1]. The PCM composites show high thermal energy storage (TES) which can absorb or release a large amount of heat in the range of temperature change[2]. Graphene aerogel is selected as a general supporting material due to the excellent chemical and thermal stabilities. The 3D porous structure can hold plenty of pure PCM in the internal space to fabricate the PCM composite[3]. However, volume shrinkage of graphene aerogel becomes a serious problem which causes some of weight loss to the PCM composite under the infiltration process. This volume shrinkage even decrease the efficiency of thermo-electric energy harvesting[4]. In order to overcome the volume shrinkage, increase the mechanical property and flexibility of graphene aerogel are indispensable to synthesize a modified supporting material. In this work, graphene aerogel with cross-linked structure is fabricated and utilized for solar-to-electric energy conversion. The cysteamine vapor method is utilized to generate the cross-linked graphene/cysteamine aerogel (GCA), and GCA can reduce the volume shrinkage effectively during the pure PCM infiltration process. Thus, the GCA supported PCM composite absorbs solar light adequately and thermo-electric power generator (TEG) generates an output electrical energy upon Light-On/Off process. This work indicates that the GCA supported PCM composite constructed TEG has a large potential for the solar-to-electric energy harvesting applications. The characteristics of PCM composites (PEG, and 1-TD) are listed in Table 1, and solar-to-electric energy harvesting results are shown in Fig. 1.

Table 1. The characteristics of PEG and 1-TD composites

Samples	Pure PCM (%)	T_{mp} (°C)	ΔH_m (J/g)	T_{cp} (°C)	ΔH_c (J/g)
PEG/GCA	**98.16**	**64.79**	**179.87**	**39.20**	**159.31**
1-TD/GCA	**97.95**	**42.88**	**213.78**	**30.25**	**212.50**

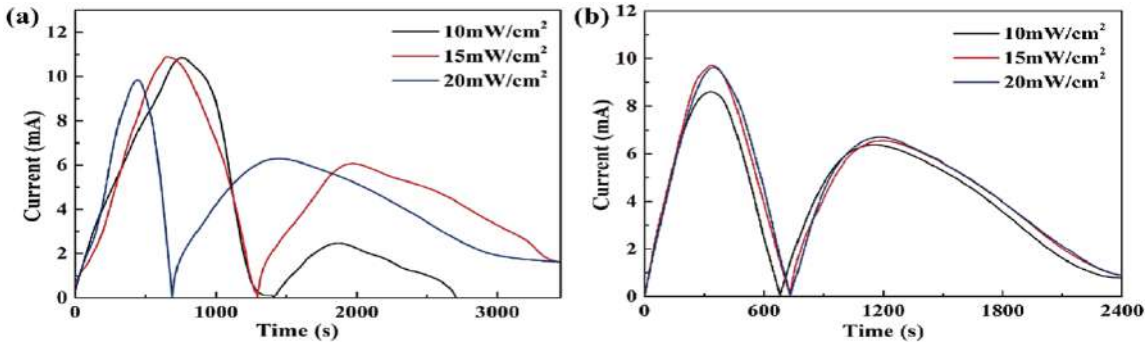

Fig. 1. Output electrical current at the various light intensities upon (a) Light-On process, and (b) Light-Off process

Keywords
form-stable phase change material; thermal energy storage; graphene/cysteamine aerogel; Light-On/Off

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Biography
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Degree of PhD: 2013.09 ~ 2019.02 Seoul National University (SNU). Material Science and Engineering
Have published 13 papers (9 first author, 4 co-author), and 4 papers (3 first author, 1 co-author) are under revision process. The published journals are Energy Conversion and Management, Macromolecular Research, Fibers and Polymers, Polymers for advanced technologies, Journal of Sound and Vibration, Materials & Design, Journal of Polymer Research, ACS Applied Energy Materials, Nanomaterials, and Chemical Engineering Journals. Applied energy, and ACS Applied Materials &Interfaces are under the reviewing.

- Mobile Number*: 080-7580-0489
- Category*: Oral presentation
- Research Interest*: Nanocomposite, Polymer Processing, Energy Storage and Harvesting

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Well-defined Block Copolymers for Next Generation Energy Conversion and Storage Devices

Abstract

Block copolymers containing poly(acrylonitrile) (PAN) were synthesized by RAFT or ATRP polymerization for high performance dye-sensitized solar cells (DSSCs) and supercapacitors (SCs). The PAN has been widely utilized to create polymeric gel-state electrolytes in the DSSC as well as nitrogen-enriched nanocarbons with three-dimensional hierarchical pore structures, after carbonization, for DSSC counter electrode as well as SC cathode. In order to improve the solubility of block copolymers, we introduced comonomers of ethylene oxide and amide-based monomer for the preparation of triblock copolymers and the amide-based segment increased not only their solubility but also their molecular weight. Triblock copolymer-based TiO2 composite quasi-solid state DSSCs with a ruthenium complex exhibited an overall photovoltaic conversion efficiency (PCE) of 10.49%, which is higher than a liquid electrolyte-based DSSC with a value of 10.02%. Also, nitrogen-enriched nanocarbons were obtained for DSSC counter electrode as well as SC cathode through a soft-templating method, utilizing the block copolymers of poly(butylacrylate) as a sacrificial component and PAN as a nitrogen-rich carbon source. The resultant nitrogen-enriched nanocarbons showed better electrochemical stability and higher electrocatalytic performance than platinum and are a promising metal-free alternative to costly platinum-based electrodes in organic-dye based DSSCs with Co-complex redox shuttles. In addition, the metalloid-doped nanocarbons, obtained from poly(butyl acrylate)-b-polyacrylonitrile (PBA-b-PAN) block copolymer with various metal precursors were investigated as a SC cathode as well as a DSSC counter electrode, leading to superior electrodes for DSSCs and SCs. In this presentation, PAN-based block copolymers for next generation energy conversion and storage devices will be discussed.

Keywords

Block copolymers, Polymer gel electrolytes, Nanocarbons, Counter electrodes, Dye-sensitized solar cells, Supercapacitors

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Biography

He received Ph. D in polymer chemistry from Carnegie Mellon University (1990). In 2007, he was invited as Distinguished Professor in the Department of Advanced Materials Chemistry at Korea University. He is currently served as the director of Centre for Next Generation Solar Cells and Convergence Technology. He received the Outstanding Research Award by the Korean Chemical Society, the Distinguished Research Award as well as HanWha Excellent Polymer Research Award by the Korean Polymer Society, and the Monthly Award of Scientist and Engineer by NRF & MOST, etc. He was served as the president of Korean Society of Photoscience and Korean Organic Photovoltaics Society as well as the vice-president of Korean Polymer Society. Recently, he was nominated as the fellow of Korean Polymer Society. His current researches have been focused on developing advanced organic and polymer semiconductors as well as carbon-based materials for next generation solar cells and solar batteries.

Jun-Won Kook
Ajou University Medical Center, AI-Superconvergence KIURI Biomed Translational Research Center, Republic of Korea

Preparation and Properties of Hybrid Nanostructured based on Polymeric Core-Shell Nanoparticles: Its Applications

Abstract

This thesis describes a polymeric core/shell nanoparticle process using three method to increase the applicability and compatibility of phase change materials (PCM) and curcumin used as core materials. Shell materials were synthesized by introducing various polymers (such as polystyrene (PSt), polyurea (PU), and polyrhodanine (PRd)).

First, the purpose of producing PCM-PSt nanoparticles using PCM as a core material to enhance the adhesion and mechanical properties of the nanoparticles and synthesized into a core/shell type PCM and PSt using poly(styrene-co-acrylic acid)(SAA) which is an alkali soluble resin as a surfactant by using resin-fortified mini emulsion polymerization method. The adhesion property of PCM/PSt nanoparticles prepared using SAA by dip-coating method were confirmed with a thermal imaging camera.

Then, core/shell nanoparticle was prepared by interfacial condensation polymerization system by introducing PU for heat capacity and high compatibility in PCM nanoparticle. In addition, PCM/PU nanoparticle was embedded in PEO nanofiber, and thermal storage nanofibers were fabricated in a mat type using electrospinning method, and thermal behavior by PCM/PU nanoparticle content was confirmed by thermal imaging camera.

Finally, due to the recent emergence of the COVID-19, related research (antimicrobial and antiviral) is being actively conducted. This research will approach this problem from a new perspective, and the method is to develop a new material through various chemical reactions (Fenton reaction and reactive oxygen species) and structural properties using natural materials, polymers, or magnetic particles. So, we'll mainly synthesize core-shell and porous type nanostructures using various manufacturing methods. As a result, we'll verify the correlation between materials manufactured by various analysis methods.

Biography

Jun-Won Kook has completed his Ph.D at the age of 35 years from Yonsei University and postdoctoral studies from Korea Institute of Industrial Technology. For a year, the medical device company developed products related to silicon polymers. He has published 10 papers in the journal on Polymers and related research at many international conferences.

Ali Reza Modarresi-Alam[a,b,c]

[a]Organic and Polymer Research Laboratory, Department of Chemistry, Faculty of Science and [b]Renewable Energies Research Institute, University of Sistan and Baluchestan, Zahedan, Iran.
[c]Laboratory of Printable Electronics,Department of Chemical Engineering and Waterloo Institute for Nanotechnology (WIN), University of Waterloo, Ontario, Canada.

New Generation Solar Cells from Magnetic Nanocomposites

Abstract

Polyaniline (PANI) is a very popular conducting polymer because of its easy synthesis, low-cost monomer, high stability, its adjustable characteristics comparing other conducting polymers and its countless usage in different industries is interesting. The electronic industry is one of the industries in which PANI has many applications in making solar cells. The magnetic field and/or mixing magnetic nanoparticles can be used in the solar cell structure for increasing the lifetime of the exciton.

In this lecture, I wish to report a summary of our recent works on the application of the novel superparamagnetic core-shell nanocomposites of PANI derivatives and Fe3O4 nanoparticles. The most important innovation in this type of nanocomposites is the in-situ production of superparamagnetic Fe3O4 nanoparticles simultaneously with the polymerization of PANIs in solid-state.

It can be confirmed by different mechanisms such as a spin-orbit coupling and singlet fission (SF) which can increase the triplet state of excitons and/or trimerons formation. The other factors influencing the source of this great success are discussed.These novel devices display major advancements in the field of polymer solar cells for energy conversion based on the high performance of simple, stable, and single-layer cells with low-cost fabrication materials, and facile and green preparation method for both nanocomposite and cell. It is concluded that such cells offer a promising new approach to commerce the new solid-state polymer solar cells as New Generation Solar Cells from Magnetic Nanocomposites.

Biography

Ali Reza Modarresi-Alam is a full professor at the Organic and Polymer Research Laboratory, Department of Chemistry and Renewable Energies Research Institute at University of Sistan and Baluchestan, Zahedan, Iran. He received his PhD degrees in Organic Chemistry from Isfahan University of Technology (IUT), Isfahan, Iran in 2000.His research interests are in Organic Chemistry and Nanomaterials: Synthesis and characterization, dynamic NMR, nanomachines, conformational analysis, computational chemistry, nanopolymers, and nanocomposites especially chiral and conducting polymers, and their application in fuel cells, solar cells, sensors, PLEDs, supercapacitors etc.He has published more than 80 papers in reputed journals and has been serving as an editorial board member of repute in various journals.

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Sabu Thomas

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Engineering at the Nanoscale: A Strategy for Developing High Performance Functional Materials from Biopolymers

Abstract

Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. Cellulose nanoparticles (fibers, crystals and whiskers) can be extracted from agrowaste resources. Chitin is the second most abundant biopolymer after cellulose, it is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (fibers, whiskers) can be extracted from shrimp and crab shells. Starch nano particles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalization through chemical modifications due to presence of large amount of hydroxyl group on the surface. The preparation of these nanoparticles includes both series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nano particles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials. These nanocomposites are being used as biomedical composites for drug/gene delivery, nano scaffolds in tissue engineering and cosmetic orthodontics. The reinforcing effect of these nanoparticles results from the formation of a percolating network based on hydrogen bonding forces. The incorporation of these nano particles in several bio-based polymers has been discussed. The role of nano particle dispersion, distribution, interfacial adhesion and orientation on the properties of the ecofriendly bio nanocomposites has been carefully evaluated.

Recent Publications

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Biography

Sabu Thomas is currently the Vice-Chancellor of Mahatma Gandhi University, Kottayam, Kerala, India. He is a Professor at the International and Inter University Centre for Nanoscience and Nanotechnology and Full Professor of Polymer Science and Engineering at the School of Chemical Sciences of Mahatma Gandhi University, Kottayam, Kerala, India. His ground-breaking research has covered the areas of polymer science and engineering, polymer nanocomposites, elastomers, polymer blends, interpenetrating polymer networks, polymer membranes, green composites and nanocomposites, nanomedicine and green nanotechnology. Prof. Thomas has received several national and international awards in recognition for his work, and recently received Honoris Causa (DSc) from the University of South Brittany, Lorient, France, in recognition for his contributions to polymer science and engineering. Prof. Thomas has published over 1400 peer- reviewed research papers, reviews and book chapters. He has co-edited more than 170 books. Currently he is having an H index of 124.

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Smart Hybrid Nanocomposites for Structural Health Monitoring Application

Abstract

Smart Hybrid Nano composite sensors are developed to diagnosing their own state of strain in which Nano-materials used as conducting filler. Nano-material like carbon fibre (CF), multiwall carbon nanotube (MWNCT), and graphene have a unique property that they can change applied strain into electric resistance. Hence, they can be used as conducting filler in the cement matrix. The present study mainly concerns with developing smart hybrid Nano composite cement based sensors and implementation of these sensors for structural health monitoring by embedding sensors into structural components. Two different combinations of sensors are developed by inserting Nano materials (0.25 and 0.5% weight of cement of MWCNT, CF, and Graphene) into cement mortar matrix. The insertion of carbon Nano filler into base material makes them into sensitivity to mechanical modification. This self-sensing property for material is achieved by adding piezoresistive materials into them. These piezo resistivity makes the materials self-sensing by indicating a detectable change in their electrical resistivity with applied stress or strain and make them useful for health monitoring of structures. Many studies shows that nano materials possess greater conductivity properties which can be used as smart materials. The size of specimen sensor was fixed to 80 mm 80 mm 50 mm with three 10 mm diameter tube was the filler is filled with copper electrode. From the electromechanical test it indicates that both combination sensors show good strain sensing with respect to applied load and also it is observed that is increased in flexural strength about 30.08% for 0.5% combination. A flexural and compression test was conducted by embedding Nano composite cement based sensors into structural components. The test results shows the variation in resistance for both compression and flexural loading which indicates into self-sensing property of structural element by embedding sensors into them, hence it will be helpful in monitoring the structure. Scanning electron microscope is carried to understand the morphology of sample. A Finite elemental modeling is done to validate this experimental result. A FEA modelling is carried out using ANSYS software, subjected to steady steady static loading and electric analysis were done. Form the experimental is observed that addition carbon fiber induces conductivity property and the resistance decrease for failure load. The resistivity from experimental study observed is 9.2 kilo ohms and 11.2 kilo ohms for embedded carbon fibre sensor into beam and column respectively. The percentage error in electrical analysis of experimental tests compared with analytical modelling, found to be 15 %. A molecular dynamic simulation is carried to understand the atomic level interaction particles to evaluate the mechanical and electrical properties. Based on these results it can be concluded that carbon fiber cement composites have great potential and they can be used for structural health monitoring applications.

Keywords

Nanocomposites, carbonfibers, MWCNTs, Sensing properties, mechanical properties, electromechanical tests, FEA modelling

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Synthesis and Characterization of Thin Film Composite Membranes Modified with Graphene Oxide and Copper Nanoparticles

Abstract

The desalination of seawater by reverse osmosis is a process that has stood out in recent years to use the seawater as fresh water source. Thin film composite (TFC) membranes are the most widely used for desalination, mainly due to their excellent permeation and selectivity properties [1]. However, this type of membranes present problems related to biofouling, limited thermal resistance, low mechanical resistance, and water fluxes [2].In this research, we propose the synthesis[3] and modification of the active surfaces layer of polyamide(PA) membranes by adding hydrophilic polymer polylysine (PL) and biocide agents such as copper oxide nanoparticles (Cu2O NPs) and graphene oxide dopped with copper oxide NPs(GO-Cu2O NPs) by dip coating procedures to improve the membrane hydrophilicity and thermomechanical properties. The nanoparticles were synthesized by wet chemical reduction [4] and characterized by Scanning Electron Microscopy (SEM) and Dynamic Light Scattering (DLS). These materials showed a cubic morphology and size between 29-200 nm and 40-200 nm for Cu2O NPs y GO-Cu2O, respectively. Main results were found:1) hydrophilicity by contact angle measurements of membrane surfaces, 2) thermal properties by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC), and 3) mechanical properties through mechanical tests such as uniaxial traction, bending tests and dynamic mechanical analysis. According to figure 1, the hydrophilicity of the membranes increased significantly. The one modified with Cu2O-PL became slightly less hydrophilic (43%), compared to those modified with PL-PA/PSf and PL-GO-Cu2O, which presented a higher hydrophilicity (58%).

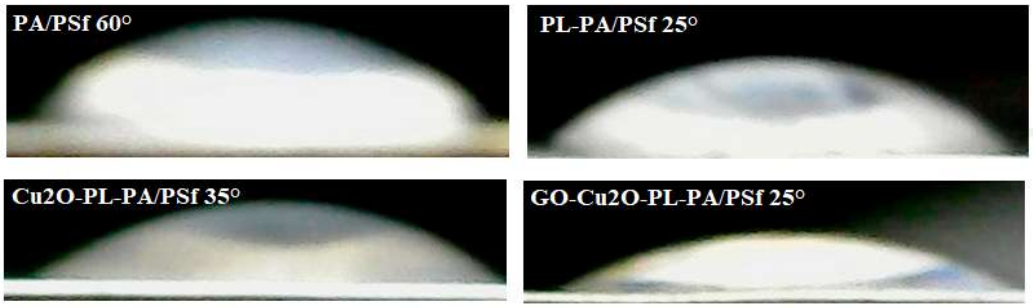

Figure 1: Images of water drop on pristine and modified membranes.

Keywords
copper oxide nanoparticles, graphene oxide-copper oxide nanocomposites, thin film composite (TFC) membrane, interfacial polymerization, dip coating, mechanical properties

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Biography
Constanza is Industrial Chemist at UTEM, and she is MSc student in Chemistry mention Materials Technology, in Chile.

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Functional Thermoplastic Elastomers to Meet Contemporary Needs

Abstract

Numerous designer polymers have been developed to address the growing number of needs in all technological areas. We pose the question, “Can one technology platform be made sufficiently versatile and robust so that it can significantly benefit many, but certainly not all, of society’s needs?” For this purpose, we elected to use thermoplastic elastomers, a class of self-networking macromolecules that are currently used in many commodity applications. In other words, these materials are abundantly available, and new ones are being synthesized from sustainable sources. Because of their innate ability to form networks and impart elasticity, we can exploit their mechanical properties while functionalizing them for specific applications. Here, several of these applications will be addressed, ranging from tunable compatibilizers and rubber-toughening agents in blends to stimuli-responsive standalone materials. Of particular interest in this vein are gas-separation membranes for removing basic (NH_3) and acid (CO2) gases from gas mixtures, solar cells that can be designed to mimic leaves or function as dye-sensitized devices [1], antimicrobial materials that can kill (to 99.9999+%) Gram-positive/negative bacteria, viruses (including SARS-CoV-2) and mold in ~5 min [2], and a new generation of quasi-solid Li-ion batteries that retain ~100% efficiency and >70% capacity after 1000 h (which equates to ~4 yrs).

Keywords

Tunable compatibilizers, antimicrobial surfaces, solar cells, electroactive media, carbon-capture membranes, Li-ion batteries

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Biography

Richard Spontak received his B.S. and Ph.D. degrees in Chemical Engineering from Penn State and UC Berkeley, respectively, and pursued post-doctoral studies at Cambridge University (UK) and the Institute for Energy Technology (Norway) before joining Procter & Gamble in 1990. In 1992, he transitioned to NC State University, where he is a Distinguished Professor. He has >300 peer-reviewed journal publications and >35 book chapters and invited works, and his research has been featured on 31 journal covers and cited about 15,000 times. He has received numerous honors including the ACS Chemistry of Thermoplastic Elastomers Award (Rubber), the ACS Roy W. Tess

Award for Coatings (PMSE), the SPSJ International Award, the IOM3 Colwyn Medal and the SPE International Award. He is a fellow of the American Physical Society, the Royal Society of Chemistry, IOM3, and the ACS PMSE Division, and he is a member of the Norwegian Academy of Technological Sciences.

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mRNA - based Systemically Delivered Directed Gene Therapy using Nanomaterials

Abstract

The presentation focuses on systemically administered targeted gene therapy using mRNA instead of DNA; why the former is superior for this purpose will be discussed. Lipid nanoparticles (LNPs) and, more recently, extracellular vesicles (EVs, aka exosomes) have proven effective vectors. An example of LNP-mediated directed mRNA delivery is that of Cas9 gene for editing of PTEN by the CRISPR/Cas system. Also, an mRNA-LNP drug, NTLA-2001, is in clinical trial for treating transthyretin amyloidosis. EVs are nature's own antigen delivery system, posing minimal immunogenicity/toxicity risk and their surface integrins confer intrinsic tissue tropism. They have been engineered to display targeting moieties, which are fused to EV anchor domains. Emphasis here will be on the lactadherin C1-C2 anchor domain (which binds to the EV surface) and its fusion to a high affinity anti-HER2 scFv, resulting in HER2 receptor targeting EVs. These were loaded with mRNA that encodes the enzyme HChrR6, which can activate several prodrugs, including CNOB and CB1954 (tretazicar). (The loaded and targeted EVs are called 'EXODEPTs'.) Systemic delivery of EXODEPTs along with either CNOB or tretazicar resulted in the killing of HER2+ breast cancer xenografts in mice without any off-target effects, indicating gene delivery exclusively to the cancer. Attaining specific tumor targeting and loading of the EVs with the HChrR6 mRNA were greatly facilitated by the fact that the activated drug of CNOB, MCHB, is highly fluorescent and can be visualized non-invasively in living mice. Tretazicar (whose activation could also be visualized vicariously by MCHB) was effective at its safe dose; the EVs needed to be delivered only twice; and there were no side effects. Thus, the results augment clinical transfer potential of this regimen. Examples of EV targeting using other anchor proteins, e.g., Lamp2b and CD47, will also be briefly discussed. As the EV anchor domains can be fused to other targeting moieties, the approach is generic for specific gene delivery also in other diseases.

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Turning Polymer Insulators into Heat Conductors

A continuous increase in power density and miniaturizing devices makes heat dissipation one of the most complex technological challenges.1 A major issue is that waste heat generated during device operation leads to overheating problems.2,3 A need for new materials to manage overheating arises. Polymers have been used for electronical and optical applications, thanks to their unparalleled properties.4However, common polymers are regarded as thermal insulators with low thermal conductivities, which are undesirable for efficient heat dissipation.5-7Turning polymer insulators into heat conductors are needed for better thermal management.5-9In this talk, I will present our recent work on developing highly thermally conductive polymers that can conduct heat better than metals and ceramics. I will discuss relationships between high thermal conductivities and polymer structures. I will highlight current challenges within the design and synthesizing of commercial polymers with high thermal conductivity. I will emphasize the potential possibilities and inspiring opportunities for future applications of thermally conductive polymers with metal-like thermal conductivities.

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Bio: Yanfei Xu joined the Mechanical & Industrial Engineering Department at University of Massachusetts Amherst as an assistant professor in 2019. She became an adjunct assistant professor in the Chemical Engineering Department in 2020 fall.

Before joining UMASS, from 2013-2018, she was a postdoctoral researcher in the Mechanical Engineering Department at Massachusetts Institute of Technology, where she was active in pursuit of turning polymer insulators into heat conductors. Before joining MIT, from 2011-2013, she passionately

pursued GENIUS research funded by European Commission — printable organic electronics, and secured Marie-Curie Fellowships with major European institutions and companies, including the Max Planck Institute for Polymer Research, Humboldt University, University of Cambridge, Italian National Research Council, Université de Strasbourg, and the headquarters of BASF SE. From 2013 to 2015, she has been appointed an assistant professor at Huazhong University of Science and Technology. She received Ph.D. in Chemistry from Nankai University, where she was awarded “Top 100 Most Influential Scientific Researchers in P. R. China (among all fields)”.

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