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Electro spun materials: From encapsulation to templates for non-traditional vesicle fabrication

Guadalupe Rivero
Institute of Materials Science and Technology Research, Argentina

Electrohydrodynamical techniques are versatile processing methods for producing sub micrometric structures. The application of tension to polymeric solution jets infused through a nozzle at a controlled speed, allows obtaining nanofibers or nanoparticles. There are many parameters involved: compositional (which define the conductivity, viscosity and surface tension of the fluid), processing (flow, tension, nozzle-collector distance) and environmental variables can be optimized for the fine tuning of complex architectures and controlled morphologies. The possibility to incorporate drugs, cells or other bioactive agents in fibers or submicron particles is extremely interesting for the manufacture of controlled release systems. Indeed, during the last two decades, electro spun materials have been applied in tissue engineering and drug delivery systems. Moreover, besides the encapsulation capability, electro spun structures can be also used as templates for the fabrication of vesicles by in-situ self-assembly when dissolved in water. This non-traditional fabrication method offer offers advantages for the storage, transfer and administration of vesicles, which derive in benefits in its functionality, stability, bio accessibility, etc. While conventional vesicles manufacture methods often require complex and expensive methodologies to trigger the self-assembly processes, this nanofabrication method pre-confines phospholipids and polymers inside solid micro-environments; so that they can generate liquid suspensions of vesicles when contacted with water, when required, without a mandatory sterilization step. In this presentation, different compositional and processing parameters were evaluated. Fibers composed of polyvinylpyrrolidone polymer and soybean lecithin as a source of phospholipids were electro spun in order to manipulate the molecular self-assembly for the synthesis of vesicles. The morphological and compositional features of the precursor fibers (solvent system, phospholipid type) and the involved processing parameters (voltage, flux) can be correlated with the vesicles sizes obtained when the Nano fibrous membranes are dissolved in water. These results are extremely encouraging to propose these structures as versatile and tunable carriers of active agents of different nature in controlled release systems.

Biography

Guadalupe Rivero is an Associate Researcher from the National Scientific and Technical Research Council (CONICET) – Argentina, in the Institute of Materials Science and Technology Research (INTEMA). As Bachelor in Chemistry and PhD in Materials Science, she is the Deputy-Head of the Biomedical Polymer Division. During the last 10 years, she has gained experience in the fields of encapsulation of active agents, electro hydro dynamical techniques, biomaterials, drug delivery systems and tissue engineering. With an h-index=11, she has published 19 journal articles, 3 book chapters, 1 patent and over 60 works in scientific events. Her recent research lines focus on the design of electro spun Nano fibrous membranes for bone, dermal and neuronal regeneration; and smart materials for the targeted delivery of therapeutic agents.

grivero@fi.mdp.edu.ar

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SUPERCAPATTERY: A Breakthrough in energy storage devices

Ramesh T Subramaniam

Centre for Ionics University of Malaya, Department of Physics, Faculty of Science, University Malaya, Malaysia

Society has experienced a global surge and reliance on mobile phones, laptops, portable medical treatment, electric vehicles to power our daily lives. The available electrochemical energy storage systems (batteries, supercapacitors and fuel cells) either provide high energy density or high-power density but not both together. We are introducing a novel solid state supercapattery, a smart hybrid device that can be used for smart and sustainable e-transportation (electric/hybrid vehicles). Supercapattery offer higher energy density than supercapacitors and higher power capability than batteries. Solid state supercapattery is expected to demonstrate outstanding advantages in tackling the safety shortcomings of traditional electrochemical devices while meeting high demands on performances. The advancement in manufacturing techniques like 3D printing has enabled the assembly of solid-state electrochemical devices in a more complex geometric configuration. We focus on synthesis and formulation of new types of electrolytes and electrodes to fabricate and optimize solid-state Supercapatterys for electric/hybrid vehicles. A novel complete solid state Supercapattery with economic feasibility is a new breakthrough in electric transportation industry

Biography

Ramesh T. Subramaniam is a material scientist experienced in development of polymer electrolytes as a source of energy for use in various electrochemical devices. He was selected as a “TWAS Young Affiliate Fellow” in 2009. In 2010, he received the “Pacific hem Young Scholar Award” from the American Chemical Society and in 2011, the “Young Scientist Award” from IUPAC. In 2017, he was conferred the “Established Scientist Award” by Royal Society and elected as a “Fellow of Royal Society of Chemistry. He is also a recipient of the “Fulbright Fellowship 2017” with tenure at the Princeton University, USA and a recipient of the “International Senior Research Fellowship 2018” at Durham University, UK. In 2020 he was recognized and placed as World's Top 2% Scientists for Career-Long Citation Impact by Stanford University. On the global front, he was the Invited Scientist for World Science Forum and World Economic Forum

ramesh@um.edu.my

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Fabrication of highly efficient ZnS-based piezoelectric Nano generator

Haranath Divi

Department of Physics, National Institute of Technology Warangal, India

In the current work, we have demonstrated the effect of growth temperatures on the morphology and piezoelectric characteristics of zinc sulfide Nano sheets (ZnS-NS) grown on aluminum (Al) substrates. More precisely, we have fabricated two Nano generator devices based on two different growth temperatures namely, 140□ and 160□. It has been observed that an increase in growth temperature has a greater influence on the aspect ratio of ZnS-NS due to the presence of extra thermal energy leading to significant structural deformation which in turn optimizes the exact growth temperature for the synthesis. Indium doped tin oxide (ITO) coated on polyethylene terephthalate (PET) substrate and ZnS-NS deposited thin Al foil were used as top and bottom electrodes respectively, for the fabrication of a piezoelectric Nano generator (PENG) device. The open-circuit voltage for the as-fabricated PENG devices made at 140□ and 160□ growth temperatures were ~400 mV and ~600 mV, respectively. For the first time, a systematic study was carried out on the ZnS-NS system for designing novel PENG devices that are highly efficient energy harvesters and can scavenge biomechanical energy for next-generation flexible self-powered electronics devices. This study also promises for a good replacement of conventional ZnO Nano sheets based 2D PENG devices due to its simplicity, flexibility, single-step production process, cost effectiveness, and high output gain.

Biography

Haranath Devi is currently working as Associate Professor in the Department of Physics, NIT Warangal, India. He was post-graduated (M. Sc.-Physics) from Kakatiya University, A. P. with University First Rank and Two Gold Medals in 1994. He did his Doctoral degree (PhD) from Shivaji University, Maharashtra, India, in 1999. He began his research career as Scientist in the Electronic Materials Division of CSIR-National Physical Laboratory in 2000. He has guided more than 10 Ph.D. and 25 MTech students. He has more than 250 research papers in SCI peer-reviewed journals and 9 patents to his credit. He research interests broadly lies in the development of various novel materials and devices for Energy Harvesting Applications. He is the inventor of OzoNIT- a multifunctional chemical-free virus disinfectant system. He was recently conferred as the Fellow of Luminescence Society of India.

haranath@nitw.ac.in

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Role of Bio-based monomers in coating applications

Pieter Samyn
Sirris Department Circular Economy and Renewable Material, Belgium

Statement of the Problem: In a transition towards circular economy, the use of renewable materials is encouraged to replace traditional petrol-based polymers. In particular, it is expected that the processing and performance properties of the bio-based alternatives are similar to the traditional polymers, but often discrepancies related to viscosity, quality procurement, availability and performance of the bio-based materials are encountered. Therefore, care on the exact processing conditions of bio-based alternatives should be taken in order to provide materials with even enhanced properties and functionalities. Methodology & Theoretical

Orientation: A comparative study on coating applications is done by making formulations of fossil-based polymers and their bio-based alternatives derived from vegetable feedstock. The processing conditions under UV-curing are evaluated in order to optimize the coating performances.

Findings: The incorporation of bio-based monomers in coating formulations provides enhanced properties in terms of mechanical resistance against abrasion, reduced brittleness, higher ductility and better water resistance. Under conditions providing fully cured coatings, the bio-based acrylate coatings systematically present lower wear. The internal material structure of coatings with bio-based monomers is characterized through a hierarchical organization within micro- to nanoscale entities that improves the mechanical properties. Moreover, the presence of a hydrophobic monolayer at the surface enhances lubricity of the bio based coatings. In parallel, the curing kinetics of bio-based and fossil-based materials is very similar resulting in comparable cross-linking densities. Conclusion & Significance: In this study, the benefits of introducing bio-based chemical building blocks in coating applications are illustrated. This case study serves as a motivation to support a transition into bio based materials with enhanced properties and functionality

Biography

Pieter Samyn received Ph.D. in Materials Science and Engineering in 2007 from Ghent University presenting his research on polymer tribology. He followed an academic career from 2000 to 2020 at Universities of Ghent, Freiburg, Toronto and Hasselt having different positions of assistant professor and visiting professor. In 2021, he joined the collective research Centre Sirris as a Senior Researcher in Circular Economy and Renewable Materials. His experiences focus on synthesis, processing and characterization of bio-based materials for composites and coatings.

pieter.samyn@outlook.be

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Bending of CR4 steel: Lattice strain measurement

Gupta Tilak Raj
Injectoplast Pvt. Ltd, India

Statement of the Problem: In this work, effect of deformation and different orientations on CR4 steel sheet at lattice constant, crystallite size and lattice strain has been analyzed.

Methodology & Theoretical Orientation: The samples were prepared by air bending using 1mm thick CR4 steel. Air bending was carried out on a universal testing machine, using various sheet orientations, constant size of the specimen, constant process parameter and same tooling. Further, for analyses of deformation and orientation on CR4 steel, X-ray diffraction spectroscopy was performed. The samples were cut by wire electric discharge machining (WEDM) and polished for X-ray analysis. Qualex 2.1 software was used for analyzing the peaks, lattice constant was analyzed using Bragg's law and lattice strain using Williamson-Hall's method. Crystallite size was analyzed by Scherer's method and Williamson-Hall's method.

Conclusion & Significance: The lattice constant is found to be the smallest on rolled face and after bending it increases along thickness. Further, the lattice strain was observed compressive in nature for all the three orientations. However, for 0◦orientation lattice strain (0.5%) was found to be more across the thickness as compared to 90◦orientation lattice strain (0.34%). Furthermore, the crystallite size was analyzed by Scherer's method and Williamson-Hall's method, respectively. It is found that the crystallite size by using Williamson-Hall's method is smaller than by using Scherer's method. Further, crystallite size is observed to be the smallest on the rolled face. Moreover, after application of bending force enhancement in the lattice strain is observed while the size of the crystallite is reduced noticeably.

Biography

Gupta Tilak Raj has obtained his PhD in Mechanical Engineering from Punjab Technical University and M.E. in Polymer Technology from University of Delhi. Presently, he is working as Vice President, Technical / Product Development, at Injectoplast, Kanpur-India and involved in the development of parts, assemblies and sub-systems for automotive industries. Since last 25 years (Jan.1997onward). Previously, he was engaged in teaching of P.G. Diploma (Tool Design and Manufacture) & Diploma Tool & Die Making, student at Tool Room & Training Centre, (Now DITE), an Indo- Danish Project, Delhi-India for 17 years (Jan.1980-Dec.1996). His research interests are in the field of processing of metals and, polymers, product engineering and tool engineering. He is a Fellow member of the Institution of Engineers (India), designated as C. Eng. (I) FIE and Life Member of Indian Society for Technical Education

trg2in@yahoo.com

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Removal of cyanobacteria from a water supply reservoir by sedimentation using flocculants and suspended solids as ballast: Case of Legedadi Reservoir (Ethiopia)

Hanna Habtemariam

Addis Ababa University Center for environmental science, Ethiopia

The massive growth of potentially toxic cyanobacteria in water supply reservoirs, such as Legedadi Reservoir (Ethiopia), poses a huge burden to water purification units and represents a serious threat to public health. In this study, we evaluated the efficiency of the flocculants/coagulants chitosan, Moringa oleifera seed (MOS), and poly-aluminum chloride (PAC) in settling cyanobacterial species present in the Legedadi Reservoir. We also tested whether coagulant-treated reservoir water promotes cyanobacteria growth. Our data showed that suspended solids in the turbid reservoir acted as ballast, thereby enhancing settling and hence the removal of cyanobacterial species coagulated with chitosan, Moringa oleifera seed, or their combination. Compared to other coagulants, MOS of 30 mg/L concentration, with the removal efficiency of 93.6%, was the most effective in removing cyanobacterial species without causing cell lysis. Contrary to our expectation, PAC was the least effective coagulant. Moreover, reservoir water treated with MOS alone or MOS combined with chitosan did not support any growth of cyanobacteria during the first two weeks of the experiment. Our data indicate that the efficacy of flocculants/coagulants in the removal of cyanobacteria is influenced by the uniqueness of individual lakes/reservoirs, implying that mitigation methods should consider the unique characteristic of the lake/reservoir.

Biography

Hanna Habtemariam has completed her PhD in 2021 in Environmental Science from Addis Ababa University, Ethiopia. She has been working at Addis Ababa University, Center for Environmental Science since 2014. She coordinated different international projects of Wageningen University for 3 years. In the field of limnology and lake restoration she published articles in reputable international journals. Currently she is involved in Initiative for Effective Adaptation and Resilience (LIFE-AR) project of The Global Green Growth Institute (GGGI) and she is also a member of steering committee of Green Climate Fund (GCF) for the National Adaptation Planning (NAP) Readiness project.

hanhabtemariam@gmail.com

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Sn/SnO and Ag hybrid carbon nanotubes and graphene for thermal interface material and interconnections with hybrid carbon nanotubes

Jagjiwan Mittal

AINT, Amity University Noida UP, India

Sn/SnO coated & filled multiwall carbon nanotubes (MWCNTs) and coated few layer graphene (FLG) were successfully prepared by reacting with SnCl2 and reducing under H2/N2 gas. The thermal diffusivity (TD) and thermal conductivity (TC) of hybrid nanotubes of 1 mm thickness pellet by laser method was increased to 4.41 mm2/sec, 5.39 W/m.K of as compared to 0.36mm2/sec and 0.28 W/m.K of the pristine nanotubes. Whereas, in case of hybrid FLG, TC was surged to 7.91 mm2/s, 14.41 W/m.K from 2.17 mm2/s and 3.27 W/m.K of the pristine FLG, respectively. The enhancement in thermal conductivity is attributed to the presence of Sn coating on surface and inside the carbon nanotubes and coating Sn on the surface of graphene the formation of compact structures by reducing the air gaps between nanotubes because of their joining during compression and sintering. Current-voltage measurements using tuna probe in atomic force microscopy demonstrated the higher number of negative charge carriers in the hybrid FLG compared to pristine FLG because of electron transfer from graphene to Sn. Study using transmission electron microscopy showed the development of interconnection using Sn/SnO hybrid graphene with Sn coated and filled MWCNTs.

In another method, a simple method to coated and filled with silver Bulk thermal diffusivity and thermal conductivity of Ag hybrid MWCNTs were increased by 242% and 255%, respectively. Furthermore, current-voltage measurements using tuna probe in atomic force microscopy showed higher number of charge carriers in the Ag hybrid nanotubes compared to pristine MWCNTs which resulted in up to 173% increase in their electrical conductivity.

Biography

Jagjiwan Mittal received his M Tech and PhD degrees in Chemistry from IIT Delhi, India. Besides India, he worked as JSPS fellow in Japan, CNRS Associate Researcher in France, and post doc. in Taiwan. His specialization is in materials chemistry particularly carbon and graphitic materials including graphene and carbon nanotubes. His current research work include development and application studies on different nanomaterials ranges from carbon nanotubes, graphene, solder metals and alloys, metal nanoparticles and nanofibers. At present, he is working as Associate professor in Amity University

jmittal@amity.edu

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Unequal train collision flexural performance of circular RC components with CFRP shear strengthening: experimental and model assessment

Khalil AL-Bukhaiti

PhD Candidate, School of Civil Engineering, Southwest Jiaotong University, China

The analysis of the dynamic response of the RC and CFRPRC under unequal span effect is provided. Unequal lateral impact tests were carried out on RC members that had been wrapped in one and six layers of CFRP. It is able to develop the deflection-time history curves of the two components under high-impact energy circumstances. In tests, CFRP increases the impact resistance of the component. It is possible to decrease maximum component deflection and change the force mode using carbon fiber reinforced polymer (CFRP). RC members shear predominantly as a result of considerable concrete damage, while CFRPRC components bend primarily as a result of slight concrete damage. When wrapped in many layers of CFRP, it is more prone to cracking. The model's calculations are consistent with the results of the tests. These studies were carried out in collaboration with numerical simulation work, which investigated the impact force exerted on members once components were subjected to unequal-lateral impacts. Regardless of the impact velocity, the lateral impact on an unequal span promotes severe shear failure of reinforced concrete members in the short span zone. CFRPRC components, on the other hand, exhibit bending deformation that is proportional to the impact velocity. Increasing the reinforcement ratio of RC members has little effect; however, increasing the impact resistance of CFRPRC components has a significant impact. Greater reinforcing ratios are utilized in order to avoid steel rupture.

In another method, a simple method to coated and filled with silver Bulk thermal diffusivity and thermal conductivity of Ag hybrid MWCNTs were increased by 242% and 255%, respectively. Furthermore, current-voltage measurements using tuna probe in atomic force microscopy showed higher number of charge carriers in the Ag hybrid nanotubes compared to pristine MWCNTs which resulted in up to 173% increase in their electrical conductivity.

Biography

Khalil AL-Bukhaiti has his expertise in evaluation and passion for improving structural engineering constructions. His evaluation model based on responsive constructivists creates new materials for improving structural members' resistances. After years of experience in research, evaluation, teaching, and analysis, he has built this model both in laboratories and educational institutions. The focus points on his direction belong to effects of impact force coming from train derailed collisions on the reinforced concrete members (i.e., columns, bridges piers), which is a methodology that utilizes the previous generations of evaluation: analysis, design, and evaluations. It allows for theories' assumptions. This approach is responsive to all field practice and has a different way of focusing.

eng.khalil670@hotmail.com

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Synthesis of iron oxide (Fe3o4) nanoparticles to reduce LDL cholesterol

Nisar Ali Othi

Metallurgy and Materials Engineering Mehran University of Engineering and Technology Pakistan

Cholesterol is a lipid (fat) delivered by the liver and is crucial for the typical working of the body. It is an important lipid found in human blood, each cell within the human body has cholesterol in its outer membrane. Cholesterol is carried within the blood by atoms called lipoproteins. A lipoprotein could be a compound containing both lipid (fat) and protein. The two primary sorts of cholesterol are: LDL (low density lipoprotein) – is often referred to as bad cholesterol and HDL (high density lipoprotein) - is often referred to as good or happy cholesterol. Iron oxide (Fe3O4) nanoparticles were synthesized directly from Chloride anhydrous (FeCl3), polyethylene glycol (PEG) and hydrazine (N2H2) by hydrothermal method, the size of the Fe3O4 nanoparticles can be easily controlled by varying the amount of PEG and hydrazine (N2H2). Iron oxide (Fe3O4) NPs have suitable surface chemistry and much attentional in the field of biomedical due to their unique properties. We reported iron oxide (Fe3O4) coated with lysine amino acid (C6H14N2O2) unprecedented removal of cholesterol under UV light. Cholesterol removal was done at different time scale, in 0 min 0% decrease in cholesterol level, in 10 min 8.58% decrease in cholesterol level, and in 20 min 13.3% decrease in cholesterol level to related actual level of cholesterol in the sample.

Biography

Nisar Ali has his expertise in Synthesis and characterization of Iron oxide nanoparticles and its function in reduction of LDL cholesterol. He has experience in Teaching and Research. He is Research fellow and student of Master of Engineering at Mehran University OD Engineering and Technology Jamshoro Pakistan.

nisaraliothi@gmail.com

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Study the effects of exposure to different doses of X–ray on some blood rheological properties

Nourhan I.Ghoneim

International Maritime College Oman, Sultanate of Oman, Maritime Department, Oman

Radiotherapy is widely used in a variety of medical applications because of its potential drawbacks. The purpose of this paper was to investigate the biological effects from a clinical therapeutic 6 MV linear accelerator facility at faculty of Medicine, Alexandria University-Egypt. Blood was selected as the biomarker for assessing the risk associated with exposures to X-rays at different doses because it is a vital system for human life. Five main groups of male albino rats were studied "namely group A, B, C, D, and E" and blood samples were collected from each animal at 3days and 9 days post exposure. Biomechanical osmotic fragility and rheological and power low model studies were carried out for different blood samples. Results of 3 days post exposed blood samples indicated significant changes in blood osmofragility and remarkable increase in viscosity coefficient at different shear rates with lower rheological flow index. Results of 9 days post exposed blood samples indicated changes in blood fragility and remarkable decease in viscosity coefficient at different shear rates with higher rheological flow index.

Biography

Nourhan I.Ghoneim Acting Head of Maritime Department - International Maritime College Oman (IMCO), Working as an Assistant Professor at International Maritime College Oman (IMCO), Maritime Department. PhD Degree, Master Degree and University Degree (B.Sc) in marine engineering and naval architecture department.

norhan@imco.edu.om

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Electrochemical pH control and Calibration of protons concentration using carboxyfluorescein marker

Janwa EL Maiss

Luxembourg Institute of Science and Technology, Luxembourg

Controlling locally produced acidity in miniaturized spaces is of high importance yielding to monitor simultaneous chemical reactions. It is one of the most important strategies in solid phase synthesis of biopolymers like peptides1 and nucleotides2. The use of these peptides in diagnostic and therapeutic applications pushes the challenge of the combinatorial chemistry to its highest. It requires fast and economic methods for the screening of these building blocks and their fabrication with high purity and efficient yields using acid/base labile protecting groups2. To meet these requirements, it is crucial to control the composition and the acidity in the fabrication medium. In our work, we aim for a new miniaturized device containing multiplexed micro reactors (of few hundred microns), each one enabling an electrochemical control of the acidity in ~ nL volumes. The control of the acidity occurs using electro-polymerizable 4-aminothiphenol molecules (4-ATP) 3, generators of free protons in the system during several minutes. The control of these electro generated protons is traceable via a fluorescent probe (Carboxyfluorescein) in aqueous and organic solvents respectively, using a Nafion layer to protect the electrodes from cross contamination. The calibration of the acidity using the fluorescence signal permits the titration and the calculations of the pka values of products in organic solvents. In the generation and control of acidity in organic solvents allow also the deportation reaction of acid-labile protecting groups4. This step is a key step in the synthesis of peptides that could be used to fabricate personalized cancer vaccines.

Biography

Janwa EL MAISS received her PhD in chemistry. She has her expertise in surface functionalization, creation of super hydrophobic and antibacterial coatings. Her First postdoctoral training allowed her to work on the functionalization and labeling of enzymes, the generation of glucose biosensors via electrochemistry and the corporation of AuNPs to the biosensor core. Lately, she joined a new team working on the functionalization of carbamates. Her key role in this project was to synthesize large scale surfactants via green chemistry, their characterization, as well as their application to cosmetic formulations. Lately, she joined her current group, where she works on the development of a prototype demonstrating a multiplexed electrochemical peptide synthesis for personalized medicine applications as well as the Development of COVID-19 plasmonic biosensor.

janwa.elmaiss@list.lu