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ABSTRACT BOOK

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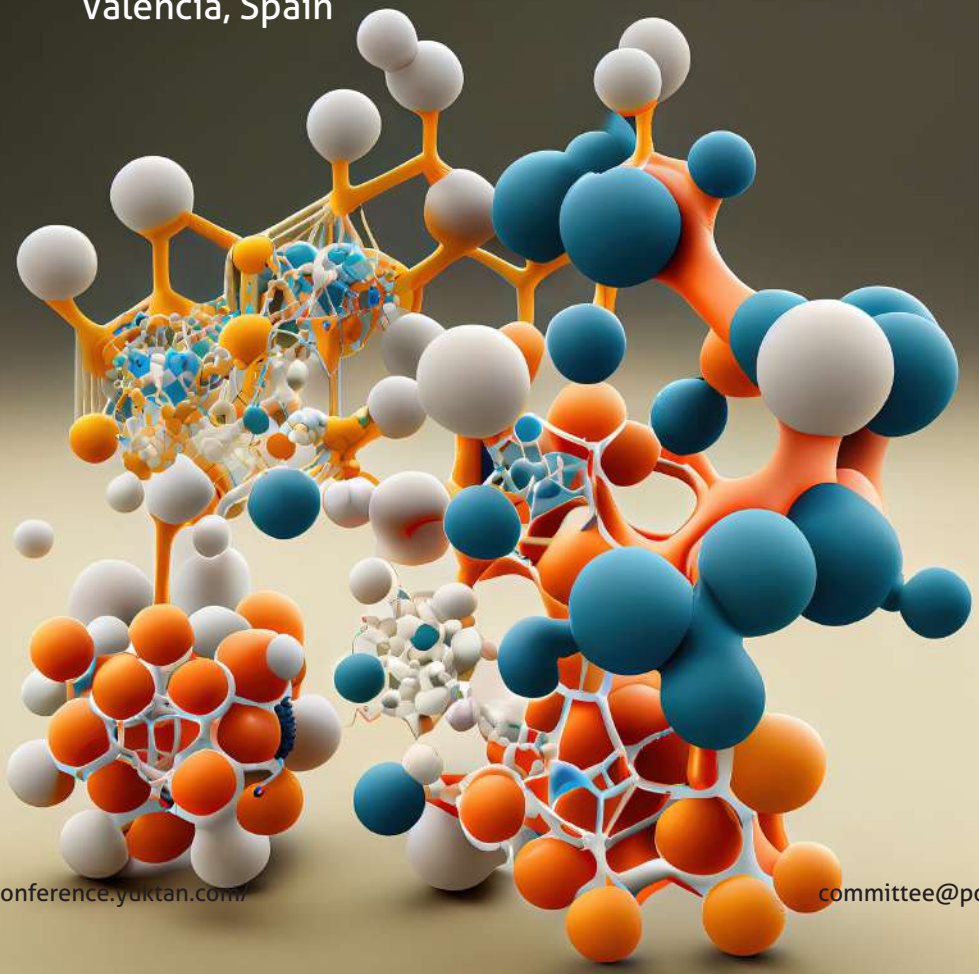

Keynote Presentations

Water-Activated Carbon-Capture: From Nanostructured to Hybrid-Integrated Membranes

Richard J. Spontak
North Carolina State University, Raleigh, NC, USA

Abstract:

While a wide range of carbon-capture efforts are being developed around the world to help mitigate the adverse effects of global climate change, advances in membrane technologies that combine greatly improved CO_2 separation efficacy with low cost, facile fabrication, upscaling and implementation, and mechanical robustness are still needed. In this study, we introduce an integrated membrane strategy wherein a high-permeability thin film is functionalized with a highly CO_2-philic open, brush-like surface layer. This nanofabrication scheme is based on a low-diffusivity, high-solubility mechanism that relies on enrichment of CO_2 in the surface layer naturally hydrated by the water vapor present in all targeted gas streams, followed by fast CO_2 transport through a supported thin film of a highly permeable polymer. Spectroscopic methods confirm the existence of the amine surface layer, which also enhance surfaces roughness and, thus, separation area. Integrated multilayer membranes prepared in this fashion are not diffusion-limited and, in some cases, are able to retain much of their inherently high CO_2 permeability while their CO_2 selectivity is increased in some cases by over ~150x, far exceeding the upper bound that traditionally reflects the trade-off between gas permeability & selectivity.

Short Biography:

Richard J. Spontak, a Distinguished Professor at NC State University, received his Ph.D. from UC Berkeley and pursued post-doctoral research at Cambridge University before joining P&G in 1990 and NC State in 1992. He has published over 300 peer-reviewed journal papers. He has received numerous research awards including the NC State Holladay Medal for Excellence, the ACS (PMSE) Tess Award, the SPSJ International Award, the IChemE Underwood Medal, the ACS (Rubber) Chemistry of Thermoplastic Elastomers Award, and the IOM3 Colwyn Medal. An elected APS, IOM3, ACS-PMSE, and RSC fellow, he is a member of the Norwegian Academy of Technological Sciences.

Application of Organic Catalysis and Sustainable Chemistry Towards AI-assisted Materials Discovery

James L. Hedrick
IBM Research Almaden Research Lab, San Jose CA 95120, United States

Abstract:

The discovery, development and deployment of new materials provides business opportunities as well as drives advances in high value applications ranging from microelectronics to medicine. As progress in computational chemistry and AI systems continue, there influence on materials discovery including the creation of new polymer-forming reactions and catalysts discovery will become more pervasive. We have developed a broad class of highly active organic catalysts that span many orders of magnitude over a large palette of monomers. Fundamental mechanistic and theoretical investigations together with AI-assisted insights have created new pathways to well-defined macromolecular architectures. To overcome the time to market challenge, the merging of automated synthesis, high-throughput characterization, and predictive AI into a single pipeline offers the opportunity to dramatically accelerate materials development at a fraction of the traditional cost.

Short Biography:

James L. Hedrick is a Distinguished Research Staff Member at IBM's Almaden Research Center, but spends a significant amount of time at Stanford University as well as the Institute of Bioengineering and Nanotechnology (IBN), Singapore. Jim has pioneered new polymer-forming reactions as high temperature interlayer dielectrics and block copolymers for low dielectric materials. Jim has also worked in organic catalysis as an environmentally benign means to living polymerization that provided entry into the fields of nanomedicine and circular economy. Jim now works in a diverse team effort to accelerate materials discovery with AI.

Effect of Polymer Interlayers in Perovskite Solar Cells and Memory Devices

Antonio Guerrero*
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Abstract:

Halide perovskite materials are mixed electronic and ionic conductors that find use in several applications such as solar cells or memory devices.[1] Ionic conductivity is something to avoid in solar cells configuration which is responsible for their degradation.[2] Similarly, the ion movement and their interaction with the contacts leads to hysteresis in the current-voltage curves in the solar cells which has proved challenging for their proper characterization. On the other hand, the hysteresis is maximized in the memory configuration (memristor) by using the adequate polymer interlayers and metallic contacts. Here we explain how this ion migration can be used to our advantage to promote formation of conductive and insulating states making them useful as resistive memories (memristors). We show that the working mechanism and performance of the memory devices can be tuned and improved by a careful selection of each structural layer. Several configurations are evaluated in which structural layers are modified systematically with special emphasis in the polymer buffer layer[3,4] and the nature of the metal contact[5]. Overall, we provide solid understanding on the operational mechanism of halide perovskite memristors that unveils the connection between electronic and ionic conduction.

References:

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Liposome Serum Development Utilizing Hydrolyzed Collagen from Seafood Industry By-product for Facial Nourishment

Thanaporn Amnuaikit[a]*, Rajeev Shankar Rajagopal[a], Krisana Nilsuwan[b], and Soottawat Benjakul[b]

[a]*Drug Delivery System Excellence Center, Department of Pharmaceutical Technology, Faculty of Pharmaceutical Sciences, Prince of Songkla University, Songkhla, Thailand*

[b]*International Center of Excellence in Seafood Science and Innovation, Faculty of Agro-Industry, Prince of Songkla University, Hat Yai, Songkhla, Thailand*

Abstract:

Collagen is a skin constituent responsible for strengthening, enhancing resilience, and moisturizing the epidermis, thus aiding in wrinkle reduction. However, the body's collagen production diminishes as we age, but it can be substituted in many ways. In our study, we aimed to enhance facial collagen content using cosmetics that incorporate hydrolyzed collagen extracted from fish skin, which is a by-product of the seafood industry. This is sustainable as these cosmeceutical products are formulated using by-products. However, the relatively large hydrolyzed collagen molecules extracted from fish skin can hinder their permeability through the skin. Furthermore, collagen emits fishy odors, and its gray color can impact product aesthetics. This study aims to address these concerns by encapsulating hydrolyzed fish collagen and nicotinamide within liposomes. This strategy seeks to enhance skin penetration efficiency while effectively concealing unpleasant odors and colors. Phosphatidylcholine from soybean, cholesterol, and Tween 80 in an 8:2:1 weight ratio exhibited favorable physicochemical attributes, showing an entrapment efficiency of 95.72±2.00%, a particle size of 170.6±0.70 nm, and a zeta potential of -19.32±0.72 mV, resulting in a more visually appealing formulation. Skin permeability studies employing a modified Franz's Diffusion cell highlighted the superior permeation and accumulation of active agents within liposomes compared to the solution containing active agents, and subject satisfaction assessments proved that liposome could eliminate the fishy smell. Based on comprehensive experimental results, it can be inferred that well-composed liposomes enhance skin penetration while effectively masking undesirable odors and colors, underscoring their potential for advancing skincare technology.

Short Biography:

Associate Professor Thanaporn Amnuaikit, Ph.D., specializes in topical and transdermal drug delivery systems, as well as the formulation development of cosmetic and pharmaceutical products using natural substances. She holds a position as a lecturer in Faculty of Pharmaceutical Sciences, Prince of Songkla University, Thailand, conducting research across interdisciplinary collaborations with fellow researchers in diverse fields. This approach supports and enriches knowledge pertaining to product development and prototypes. With nearly 80 publications and 10 patents to her credit, she has acquired extensive expertise, particularly in employing polymers as integral components within formulations.

Oral Presentations

Changes in Ion Concentrations Upon the Binding of Short Polyelectrolytes on Phospholipid Bilayers: Computer Simulation Study

Karel Procházka[1*], Tomáš Blovský[1], Zuzana Limpouchová[1] and Karel ŠIndelka[2]

[1]*Charles University, Faculty of Science, Albertov 6, 128 40 Prague 2, Czech Republic*
[2]*Institute of Chemical Process Fundamentals, Rozvojová 135/1, 165 02 Prague 6, Czech Republic*

Abstract:

The drug-resistant bacteria cause severe medical problems and the so far inefficient treatment of resistant diseases calls for systematic biomedically oriented research. The computer study was inspired by the experimental observation [Y. Qian et al.: ACS Applied Materials and Interfaces, 2018, 10, 15395] that the short positively charged β-peptide chains and their oligomeric analogues efficiently suppress the problems caused by antimicrobial drug-resistant bacteria in spite that they do not penetrate the bacterial membrane. The dissipative particle simulations (DPD) aim to elucidate the mechanism of this slightly unexpected effect. The study actually tests the tentative explanation by Qian et al. that the potent antimicrobial activity is a result of the non-specific (general) entropically driven release of divalent ions (mainly magnesium ions essential for the proper biological function of bacteria) into bulk solution upon the electrostatic binding of β-peptides to the bacterial membrane. The study shows that the entropy of small ions (which, e.g., controls the behavior of synthetic polyelectrolyte solutions) plays important role in this and also in analogous biologically important systems. In solutions containing univalent (Me^+) and divalent (Me^{2+}) ions, Me^{2+} preferentially concentrate close to the membrane and neutralize the negative charge. The added oligomer chains (positively charged models of β-peptides and their analogues) bind electrostatically to the membrane and replace Me^{2+} ions which escape into bulk solvent and move there freely increasing their translational entropy.

Short Biography:

Prof. Karel Procházka, DrSc. is a Professor at the Department of Physical and Macromolecular Chemistry of the Charles University in Prague, Czech Republic. In the past, he spent several years abroad (Canada, USA, Sweden and France). In 1998 – 2013, he was 6 years the Deputy Head and 9 years the Head of the Department. He and his team have been studying the conformational and self-assembling behavior of polymers experimentally and by computer simulations. He is the author of 187 publications with more than 3400 citations and his h-index is 37.

Development of PVA Electrospun Nanofibers for Fabrication of Bacteriological Swab

Rebecca Pellegrino[a] , Nico Carrino[a] , Stefania Villani[a] , Daniela Spagnolo[b] , Matteo Calcagnile[c] , Pietro Alifano[c] , Cristian Demitri[a] and Paola Nitti[a],*

[a]*Department of Engineering for Innovation, Campus Ecotekne, University of Salento, Via per Monteroni, 73100 Lecce, Italy*
[b]*Microbiotech Srl, Via a. Tamborino snc, zona PIP 73024 Maglie (Le), Italy*
[c]*Department of Biological and Environmental Sciences and Technologies, University of Salento, Lecce, Italy.*

Abstract:

The emergence of the Covid-19 pandemic has brought the use of swabs for collecting biological samples to the forefront of the healthcare industry. Swabs consist of a stick that facilitates easy handling and maneuverability of the swab even in more complex districts and an adsorbent tip designed to uptake and release the biological material. In this study, we report the fabrication of an innovative PVA (poly-vinyl-alcohol) nanofiber swab tip using the electrospinning technique. The PVA nanofibers swab obtained showed comparable uptake and release capacity of protein and bacterial species (S. aureus and P. aeruginosa) with those of the commercial Foam-type swab. Using the electrospinning process makes the fabricated swab very attractive due to its low cost process, easy scalability, good absorption and release performance. Short Biography: Paola Nitti is a Researcher in Industrial Bioengineering at the University of Salento. She earned her degree in Industrial and Environmental Biotechnology from the University of Bari and her PhD in Materials and Structure Engineering and Nanotechnology from the University of Salento. She worked in R&D area of Italian companies focusing on the synthesis and characterization of smart materials for Tissue Engineering and biomedical devices (swab). She is currently working at the University of Salento focusing mainly in the synthesis of biomaterials scaffolds for Tissue Engineering produced by electrospinning or freeze-drying, as well as their chemical-physical, mechanical and biological characterization.

Preparation and Characterization of a Biodegradable Hydrogel for Female Hygiene Products

Vimla Paul[a]*, I Mongaa[b], O Zinyemba[b] , S Muniyasamy[c]

[a]**Department of Chemistry, Durban University of Technology, Durban, South Africa;*
[b]*Department of Chemical Sciences, University of Johannesburg, Johannesburg, South Africa;*
[c]*Council for Scientific and Industrial Research (CSIR), Pretoria, 0001, South Africa.*

Abstract:

This study was carried out to develop a green approach to synthesising sodium cyanide (NaCN) using hydrogen cyanide (HCN) extracted from cassava (Manihot esculenta Crantz) leaves after 120 min of maceration at 30 ◦C and 45 min of recovery under vacuum at 35–40 ◦C. The CN- ion released via autolysis was reacted with the Na+ ion following vacuum extraction of the former to produce NaCN by saturating the absorbing sodium hydroxide (NaOH) solution. This specific extraction method avoided direct contact between the cassava leaves homogenate and the absorbing solution. NaCN was crystallised by drying the NaCN slurry at 100 ◦C in an air oven. 15.70 kg of fresh cassava leaves was needed to produce 32.356 g of NaCN (green-NaCN) (% NaCN yield = 0.21%). The results of X-ray diffraction, attenuated total reflectance–Fourier transform infrared spectroscopy and scanning electron microscopy with energy-dispersive X-ray spectroscopy, show that NaCN was successfully prepared using the proposed method. These spectral techniques showed that the control and green-NaCN contained sodium carbonate impurities. The latter was quantified by the titration experiments and was found to be 0.61% and 2.29% in the control and green-NaCN, respectively. Furthermore, the titration experiments revealed that the residual NaOH content was 1.63% in control NaCN and 4.68% in green-NaCN. The aim of modifying the green synthesis route for producing NaCN from cassava, developed by the Attahdaniel research group in 2013 and 2020, was achieved.

Short Biography:

I am a senior lecturer in Analytical Chemistry in Department of Chemistry at the Durban University of Technology. My research interest is in the field of biomaterials and nanomaterials from agricultural waste products. I supervise masters and doctoral students.

Bio-Inspired Polyamines: Synthesis, Self-Organization and Delivery Systems

Vadim V. Annenkov*, Stanislav N. Zelinskiy, Viktor A. Pal'shin and Elena N. Danilovtseva

Limnological Institute Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia

Abstract:

Short and oligomeric polyamines (up to 30 nitrogen atoms) were found in silicifying organisms, such as the siliceous frustules of diatom algae. These polyamines and polyamine-containing proteins are an important part of the silicification system. We have developed versatile synthetic procedures for biogenic polyamines and their derivatives that contain three or four methylene groups between nitrogen atoms. Thus, dozens of polyamine structures became available for scientific and potential industrial purposes.

Polyamines are capable of association in an aqueous medium, depending on structure, pH, temperature and the presence of inorganic salts. Hydrophobic interactions involving alkyl side groups are the main driving force of this association. Hydrophobic compounds (Nile red dye, some drugs) can be stabilized by polyamines in the form of nanoparticles.

Polyamines are active in multipoint interactions with weak polyacids, which is observed in the bio-silicification processes. The grafting of polyamines onto hydrophilic polymer chains makes it possible to create complex structures that can work as delivery systems for hydrophobic compounds and oligonucleotides. Introduction of photo-sensitive groups (hexaaryl biimidazole, o-nitrobenzene derivatives and etc.) into polyamine chain allows to switch associative and complexing activity of the polyamines and their polymeric forms.

We acknowledge financial support from the Russian Science Foundation (grant # 22-15-00268).

Short Biography:

Vadim Annenkov was graduated from Irkutsk State University, Russia, in 1984. He received Ph.D. in Macromolecular Science from Irkutsk Institute of Chemistry in 1989 and D.Sc. degree from Irkutsk State University in 2001, Professor from 2009. He is a Deputy Director of the Limnological Institute SB RAS, Irkutsk, Russia. He has near 160 scientific papers and 18 patents. Research interests include synthesis and properties of hydrophilic polymers; physical chemistry of polymer solutions; mathematical simulation of macromolecular systems; study of the molecular mechanisms of biomineralization; biomimetic methods for nanoparticles synthesis; design systems for immune and genetic diagnosis.

An Advanced Approach for Preparation of Spherical Nucleic Acids with Polymer or Hybrid Polymer/ Phospholipid Cores

Emi Haladjova,[a]* Iva Ugrinova,[b] Stanislav Rangelov[a]

[a] *Institute of Polymers, Bulgarian Academy of Sciences, Sofia, Bulgaria*
[b]*Institute of Molecular Biology, Bulgarian Academy of Sciences, Sofia, Bulgaria*

Abstract:

The spherical nucleic acids (SNAs) are a new class of carrier systems showing great potential in gene delivery. They represent nanostructures of spherical morphology with densely arranged and highly oriented oligonucleotides on the surface of an inorganic core. SNAs are a rapidly emerging class therapeutics that have catalyzed worldwide interest with their unique properties, potential and commercially viable applications. The spherical architecture of the oligonucleotide shell imparts unique advantages over traditional nucleic acid delivery methods, including cellular uptake with no need of transfection agents, resistance to nuclease degradation and ability to overcome different biological barriers.

Here we report on a feasible synthetic approach for preparation of SNA structures with polymer coated thermoresponsive or phospholipide cores. These nanoconstructs are synthesized in a chemically straightforward process involving formation of a core-template, coating the template with a thin crosslinked polymeric layer, and grafting the latter with short oligonucleotide strands. The SNAs are found to carry thousands of strands per particle exhibiting high binding affinity to complementary oligonucleotides. The constructs are fully biocompatible and unlike any other nucleic acid structural motif, they cross the cell membrane and enter cells without the need of transfection agents. The core template based on thermoresponsive polymer or phospholipid liposomes impart additional properties of SNA structures as they could be thermoresponsive undergoing reversible collapse upon heating and swelling upon cooling or hollow able to deliver various cargo molecules.

Short Biography:

Dr Emi Haladjova has received a PhD degree in Macromolecular Chemistry from University of Chemical Technology and Metallurgy in Sofia, Bulgaria. Her thesis has been prepared in collaboration with Institute of Polymers, Bulgarian Academy of Sciences, where currently she has an Associate Professor position. She has been awarded various national prizes for young scientist during the period 2012-2017. Her research interests include preparation and characterization of polymeric and hybrid nanocarriers for delivery of therapeutic agents such as drugs, nucleic acids, proteins etc.

Original Synthesis of Novel Amphiphilic Polymeric Systems by Initiator-free Thiol–ene "Click" Coupling Reactions

Natalia Toncheva-Moncheva[1]*, Erik Dimitrov[1], Pavel Bakardzhiev[1], Christo Novakov[1], Aleksander Forys[2], Jordan Doumanov[3], Kirilka Mladenova[3], Svetla Petrova[3], Barbara Trzebicka[2], Stanislav Rangelov[1]

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[3]Department of Biochemistry, Faculty of Biology, Sofia University "St. Kliment Ohridski" 8, Dragan Tsankov Blvd., 1164 Sofia, Bulgaria

Abstract:

Initiator-free thiol-ene "click" coupling reactions were employed to obtain diversity of amphiphilic polymeric systems and hybrid biomacromolecules. The reactions were performed by a custom-made device supplied by LEDs emitting UV light at a fixed wavelength of 365 nm. Series of polymer amphiphiles were obtained by reacting poly(allyl glycidyl ether) (PAGE) with various mono- and di-polyoxyethylene thiols (PEG thiols). On the other hand, the same methodology was used to produce nucleolipids – hybrid biomacromolecules consisting of a covalently linked lipid-mimetic residue and a single stranded DNA oligonucleotide. The novel amphiphiles were found to self-assemble and co-assemble into variety of structures. They were fully characterized by means of light scattering (dynamic, static, and electrophoretic) and cryogenic transmission electron microscopy (cryo-TEM). The loading capability of the structures with respect to hydrophilic and hydrophobic substances was examined as well.

Key words: Liposomes; Nucleolipids; Oligonucleotides; Thiol-ene click reaction; Light scattering; Cryo-TEM, Poly(allyl glycidyl ether), PEG-thiol

Acknowledgement: Financial support from the European Regional Development Fund within the Operational Programme "Science and Education for Smart Growth 2014–2020", grant number BG05M2OP001-1.001-0008-C01 is gratefully acknowledged.

Short Biography:

Natalia Toncheva-Moncheva is and Assoc. Prof., at the institute of Polymers, Bulgarian Academy of Sciences. She received a PhD degree at UCTM-Sofia, Faculty of Organic chemistry, department of Plastics. She has been awarded various national prizes. Her current areas of research are preparation of spherical nucleic acid, niosomes and liposomes, "click" chemistry reactions , monomer and (co)polymer synthesis.

Covalent Adaptable Networks as Biobased Binders in Composites

Julio Vidal[a]* and Carlos Hornero[a], Pere Castell[a]

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Abstract:

Composites are formed by a matrix and reinforcement. The interphase between both elements is key to achieve the outstanding properties of the thermoset composites. Nevertheless, as eco-design and recyclability it is also taking importance as an element that will enable the separation of both components. In this research, AITIIP has worked on the development of different strategies that using Diels-Alder (DA) reaction mechanisms allow to generate a reversible bond between both phases enabling the separation of both materials for their proper recycling process.

Different treatments and structures of diene and dienophile are used to observe the mechanism and the impact that this has on the final properties of the composite. Besides, thermal treatments are used to observe the effect that the external stimulus has in the binder and therefore in the separation between both fiber and matrix. The modification of the fibers has been monitored by contact angle and raman while the final composite has been characterized by SEM, DMA and delamination tests. Thanks to the variety of techniques used it has been possible to determine the proper treatment order to incorporate the DA structure into the fiber and afterwards enhance their effect in the crosslinking of the matrix, having a covalent bond between both matrix and resin.

The work done by AITIIP in the framework of the VIBES project (GA: 101023190) is one of the different strategies used by the VIBES consortium to provide technological solutions that will enable the implementation of eco-design concepts in the composite industry.

Short Biography:

Julio has a chemistry degree by the University of Zaragoza with a master in nanomaterials. He is currently working on his PhD in sustainable materials for industrial applications in AITIIP. He has worked bringing together investors and innovators as well as boosting and financing of circular economy projects so far he has been involved in more than 10 competitive EU projects related with sustainable products.

His main research boosts the transition of the plastics towards circular economy, covering waste valorization for improving the added value products and end-of-life strategies to minimize environmental impacts.

Thermoplastic Composites with Plasma Treated Polyethylene Matrix

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Abstract:

Adhesion between a matrix and a filler is the key parameter to obtain composite with suitable mechanical properties. Special sizings have been developed and frequently used for fiber treatment used for composites with thermoset resin matrix (epoxy, polystyren.etc) which enables production of composites with superior properties. Such composites are nowadays applied in various branches of industry including automotive and/or aircraft production. On the contrary improvement of interfacial adhesion in thermoplastic matrix-based composites is still an open question. Mechanical anchoring, the predominant adhesion type at composites produced by the injection moulding fails for so called non-pressure technologies like 3D printing and/or rotation moulding. Good adhesion is also demanded for some functional composites. Experimental results of thermoplastic composites made from thermoplastic polyethylene matrix and several types of reinforcement with natural fibers, glass fibers and/or carbon fibers will be presented. To enhance the interfacial adhesion the raw polyethylene powder was plasma treated to incorporate functional groups on its surface. Example of the glass-fiber reinforced composite for industrial rotomolding production of insulating containers and a sports kayak will be demonstrated.

Short Biography:

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Panikkassery Sasidharan Sari, Sabu Thomas, Petr Spatenka, Zoya Ghanem, Zdenka Jenikova: Effect of plasma modification of polyethylene on natural fibre composites prepared via rotational moulding. Composites Part B 177 (2019) 107344

Zoya Ghanem, Hana Jelinek Šourkova, Jan Sezemský, Petr Špatenka: The effect of plasma treatment of polyethylene powder and glass fibers on the properties of glass fibers/PE composites prepared via rotational molding. Polymers 2022, 14, 2592

Effects of UV and Atmospheric Plasma Treatments on Fracture Toughness of Glass Fibre Reinforced Thermoplastic Composites

Alojz Ivankovic[a]*, G Scarselli[b], D Quan[c] , V Prasad[a, b], PS Rao[d], M Hardiman[e] , I Reid[a] , NP O'Dowd[d] and N Murphy[a]

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[b]*Department of Engineering for Innovation, University of Salento, Lecce, Italy*
[c]*Shandong University, China*
[d]*Bernal Institute, School of Engineering, University of Limerick, Limerick, Ireland*
[e]*Department of Mechanical, Biomedical, and Manufacturing Engineering, Munster Technological University, Bishopstown, Cork, Ireland*

Abstract:

Recent research highlights the growing interest in using thermoplastic composites for structural applications over traditional thermoset composites [1,2]. The superior properties of thermoplastic composites, such as their high fracture toughness and damage tolerance, as well as their recyclability make them attractive to various industries including aerospace [3,4]. The present work presents the effects of UV and atmospheric plasma surface treatment of glass fibre reinforced thermoplastic Elium Composites. The effect of fibre surface modification is analysed by conducting nanoindentation or push-out test to quantify the fibre-matrix interfacial shear strength (IFSS) properties. The Mode I fracture properties of the Elium resin is studied separately. The Double Cantilever Beam (DCB) test is performed to evaluate the Mode I fracture properties of the composites; the flexural properties are measured using the 3-point bending test. The effects of surface treatments are also characterized by performing the Scanning Electron Microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) analysis. The fractured surfaces are observed using Optical and SEM images for better interpretation of the fracture mechanisms. The UV and atmospheric plasma treatment improved the interfacial shear strength by 51% (27.6 ± 4.5 MPa) and 47% (26.9 ± 4.5 MPa), respectively. An overall increase in the interfacial strength leads to an overall decrease in the composite mode I fracture toughness evaluated by DCB tests. The plasma treatment improved the flexural strength of the composite, while UV treatment decreased it. Figure 1. shows the force and crack length versus the displacement from DCB tests on the untreated, plasma-treated, and UV surface-treated glass fibre composites, while the R-curve (resistance curve) of the composites is presented in Figure 2. Figure 1. DCB load- and crack length-displacement curve for untreated, UV treated and plasma treated samples Figure 2. DCB R-curves for untreated, UV treated, and plasma treated samples Reference [1] H. Chen, S. Li, J. Wang, A. Ding, A focused review on the thermo-stamping process and simulation progresses of continuous fibre reinforced thermoplastic composites, Composites Part B: Engineering. 224 (2021) 109196. https://doi.org/10.1016/j.compositesb.2021.109196. [2] E. Schuhler, A. Coppalle, B. Vieille, J. Yon, Y. Carpier, Behaviour of aeronautical polymer composite to flame: A comparative study of thermoset- and thermoplastic-based laminate, Polymer Degradation and Stability. 152 (2018) 105–115. https://doi.org/10.1016/j.polymdegradstab.2018.04.004. [3] S. Utekar, S. V k, N. More, A. Rao, Comprehensive study of recycling of thermosetting polymer composites – Driving force, challenges and methods, Composites Part B: Engineering. 207 (2021) 108596. https://doi.org/10.1016/j.compositesb.2020.108596. [4] N. Aliyeva, H.S. Sas, B. Saner Okan, Recent developments on the overmolding process for the fabrication of thermoset and thermoplastic composites by the integration of nano/micron-scale reinforcements, Composites Part A: Applied Science and Manufacturing. 149 (2021) 106525. https://doi.org/10.1016/j.compositesa.2021.106525.

Short Biography:

A. Ivankovic is Full Professor of Mechanics of Materials at University College Dublin. A.I. research group focus is on the process-structure-property relationship towards materials by design, which involves multi-scale characterisation and modelling of thermo-mechanical, damage and fracture behaviour and nano-modification and tailor design of polymers, composites, adhesives, super-hard and additively manufactured materials. A.I. track record includes: i) 393 publications (132 journal, 7 book chapters, 254 conference), ii) 31 graduated PhDs (4 of which are full Professors), 40 + MSc students, 24 past PostDocs including 2 Marie Curie Research Fellows. Areas of research interest are Fracture, Modelling, Polymers, Composites, Adhesives

Evolution of Fused-Filament-PLA Properties Due to Physical Aging

Jaime Orellana-Barrasa and José Ygnacio Pastor

Departamento de Ciencia de Materiales-Centro de Investigación en Materiales Estructurales Universidad Politécnicas de Madrid, Madrid, España

Abstract:

There is a direct relationship between the thermal and mechanical properties of the polymer and its stability. It is well known that when a polymer is cooled down from liquid to solid, polymers reach a glassy state with excess entropy, enthalpy, and free volume. This out-of-equilibrium situation evolves towards a more stable one, a phenomenon referred to as relaxation or ageing due to the thermal vibrations of the polymeric chains. In this work, we characterised the evolution of PLA's thermal and mechanical properties after it was printed via Fused Filament Fabrication (FFF) in the shape of 1D filaments. We aim to understand the effect of the natural ageing on these material properties after the FFF, decoupled from the variables related to the structure (infill, printing direction, layer height…).

Short Biography:

Jaime is PhD in Materials Science and Engineering specialised in the thermal and mechanical properties of polymeric and composite materials. He has graphene and polymers (PLA and PMMA) expertise for orthopaedics applications. He obtained his Dr. title with funds from the prestigious FPU national scholarship. Last year, he received the 1st National Award for the best engineering student career from the Government of Spain. He has done internships at the Massachusetts Institute of Technology (Boston, USA) and the Institute of Biomaterials (Erlangen, Germany) and worked at Granta (Cambridge, UK).

Effect of Fiber Loading on Thermal, Morphological Properties of Biodegradable Polybutylene Succinate/Waste Natural Fiber Composites

Mohau Justice Phiri[a*], Puseletso Julia Mofokeng[b], Mapoloko Mpho Phiri[c], Mfiso Mngomezulu[b], Zikhona Tywabi-Ngeva[c]

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[b]Department of Chemistry, University of the Free State (Qwaqwa Campus), Private Bag X13, Phuthaditjhaba, 9866, South Africa
[c]Department of Chemistry, Nelson Mandela University, P.O. Box 7700, Gqeberha, 6031, South Africa

Abstract:

The use of natural fibers in polymer composite applications has been widely researched due to their biodegradability and lightweight properties. However, the extended application of natural fiber/polymer composites has been limited by the poor adhesion properties among the components of the polymer composites. One of the challenges for the agricultural industry is the issue of petroleum-based mulching plastic, which takes years to degrade into soil. The current study aims to use sodium hydroxide-treated waste pineapple leaf fibers (PALF) in the formulation of polybutylene succinate (PBS) composites. PBS/PALF composites with fiber content ranging from 0-20 wt.% will be prepared using an internal mixer. The chemical, thermal, and morphological properties of the samples were studied using FTIR, XRD, DSC, TGA, and SEM.

The FTIR results showed no noticeable differences among the various composites while the water absorption uptake of the composites was found to increase with fiber content due to the hydrophilic nature of the PALF fibers. The incorporation of the fibers into the PBS matrix decreased the crystallinity of the composites as shown by the XRD results. SEM analysis of the composites exhibited morphologies where the fibers pulled out from the polymer matrix as the fiber content was increased in the composites and this behavior was ascribed to the poor compatibility among the components. Overall, polymer composites fabricated with chemically modified fibers have promising applications due to their improved adhesion properties, sustainability, and environmentally friendly characteristics.

Short Biography:

Dr Mohau Justice Phiri is a Senior Lecturer in Chemistry at the Department of Agriculture, Biotechnology, and Chemistry, Vaal University of Technology and he is registered as Natural Scientist with the South African Council of Natural Scientific Professions. He is an active researcher in the field of polymer composites and solid waste management, and he has published about 12 peer-reviewed articles and book chapters in the field of polymer chemistry and biodegradable polymer Composites. Currently, he serves as the reviewer of three Scopus-index journals, Waste Management, International Journal of Polymer Processing, and European Journal of Wood and Wood Products.

Electrospun Polymer Materials with Targeted Design for Pollutant Removal

Olya Stoilova*, and Petya Tsekova

Laboratory of Bioactive Polymers, Institute of Polymers, Bulgarian Academy of Sciences, Sofia, Bulgaria

Abstract:

Nowadays, great efforts are devoted to electrospinning – the cutting-edge technique that allows simple, inexpensive and efficient fabrication of new generation of polymeric materials (the so-called "mats") with unique properties like extreme high surface area, lightness and porosity. Furthermore, electrospinning allows production of mats from various materials e.g. organics and inorganics in different configurations and assemblies. Nevertheless, more studies are required to fabricate targeted electrospun materials with desired design, morphology and controllable properties relevant to prospective applications.

The lecture will give an overview on the most recent approaches and innovative methods for fabrication of versatile electrospun hybrid materials with targeted design, as well as on characterization of its morphology and properties. In addition, some aspects on equipment solutions for lab-scale fabrication of mats with desired alignment of the fibers and with tunable mechanical properties, will also be discussed. Special attention will be paid to variety of possible applications of the fabricated mats designed for water purification from organic pollutants.

Acknowledgments:

Financial support from the European Regional Development Fund within the Operational Programme "Science and Education for Smart Growth 2014–2020", grant number BG05M2OP001-1.001-0008-C01 is gratefully acknowledged.

Short Biography:

Prof. Olya Stoilova is heading the Polymeric Biomaterials Department at the Institute of Polymers, which is focusing on the development of novel biocompatible and biodegradable polymeric materials, polymer-inorganic hybrid nanoparticles and nanocomposites, and design of biomaterials for tailored applications. She has published more than 40 research papers, one chapter in book and one interactive vocational training tools in the field of Food Industry, with over 950 citations (h-index: 19). She is a project leader and participant of more than 25 national and international research projects and is the inventor of 1 utility model and 1 patent.

Alcoholysis of Poly(bisphenol A carbonate) Computational Investigation of Environmental-friendly, Economic, and Effective Way to Degrade Plastics

Shiru Lin[a]*, Raven Gallenstein, and Gustavo Salazar

[a]Division of Chemistry and Biochemistry, Texas Woman's University, Denton, Texas, United States, 76208

Abstract:

Poly (bisphenol A carbonate) (PC), a plastic, has grown in use and in turn waste over the past couple years. PC does not degrade easily and often forms microplastics, and when it does degrade releases the toxic compound bisphenol A into the environment. Consequently, we need a method to recycle this material and form a circular economy. One promising method is alcoholysis, which has been used to recycle PC into its monomers, dimethyl carbonate, and bisphenol A. To make this reaction more feasible, green catalysts need to be explored in combination with the proper alcohols. To determine the best pair, we investigate depolymerization reactions with computer modeling of the reaction using Density Function Theory to determine the interaction energies and reaction energy barriers. With this information we can test various alcohols and catalysts to determine the best candidates for recycling PC into its monomers.

Short Biography:

Dr. Shiru Lin earned her Ph.D. from the University of Puerto Rico in 2020. Then she went on to conduct postdoctoral research at Boston College. She started to join Texas Woman's University as an assistant professor in 2022. Her research interest is Machine Learning applications for material screening and design; metallic catalysts and nanomaterials as catalysts for energy-related reactions; screening porous materials for water purification; Two-dimensional (2D) materials design, stabilities, and properties computations of novel materials; Nanomaterials for Lithium/Sodium-ion, Lithium-sulfur batteries; Interactions and reaction pathways of small molecules and polymers.

Rheological Properties of Aqueous Graphene Oxide/TEMPO-oxidized Cellulose Nanofibrils Suspensions

Iris Malnarič[a]*, Urška Šebenik[a]

[a]*Faculty of Chemistry and Chemical Technology, University of Ljubljana, Večna pot 113, SI-1000 Ljubljana*

Abstract:

Both graphene oxide (GO) and nanocellulose can find several applications in various fields due to their peculiar features and rheological properties displayed in aqueous phases. Structural states of graphene oxide and TEMPO-oxidized cellulose nanofibrils (TOCNF) suspensions strongly depend on concentration and particle geometry. Concentrated GO suspensions show viscoelastic behavior typical for a suspension in an arrested state and marked shear thinning, thixotropic behavior with a significant yield stress due to particle rotational restrictions, electrostatic attraction/repulsion, and nematic phase formation. TOCNF suspensions exhibit shear-thinning behavior, while their mechanical spectra tend to resemble those of weak gel systems, being more evident at higher concentration and longer ageing time. The present work is concerned with aqueous GO-TOCNF hybrid systems and is aimed at examining how much the ratio of components affects the viscoelastic and flow properties of the hybrid system. In addition, the concentration of calcium ions is varied to study the effect of a crosslinker on the hybrid network structure, which allows further tailoring of desired hydrogel properties. The observed differences in rheological behavior of suspensions with different ratios are explained by the arrangement of cellulose nanofibrils and GO liquid crystals in aqueous suspension. Positive synergistic effects are attributed to ionic crosslinking with calcium ions between negatively charged groups on TOCNF and GO.

Short Biography:

Iris Malnarič, young researcher at the University of Ljubljana, Faculty of Chemistry and Chemical Technology, Master's Degree in Chemical Engineering. Research field deals with hybrid aqueous suspensions of polysaccharides and layered nanomaterials, more specifically fibrillated nanocellulose and graphene oxide nanoparticles, with specific structural and rheological properties, exploiting the advantages of both components for potential hydrogel applications.

Rheology and Reactivity of Different Acid Systems with Carbonate Rocks

Bader Alharbi[a]*, Norah Aljeaban[a], Tamim Alshehri[a]

[a]*EXPEC ARC, Saudi Aramco, Dhahran, Kingdom of Saudi Arabia*

Abstract:

Well stimulation is crucial to improve the well productivity and injectivity and hence hydrochloric acid (HCl), and organic acids have been widely used for carbonate stimulation including matrix acidizing and acid fracturing. Despite the high success rate of these acids, there are drawbacks to be addressed. Therefore, alternatives solutions are required to overcome these limitations. In this study, different types of particles including nanosilica and graphene have been used to stabilize emulsified acid.

Viscosity measurements were carried out using Chandler viscometer. Static dissolution tests and corrosion experiments have been conducted over a wide range of parameters including temperature, acid, and nanoparticle to investigate the performance of the acid.

The viscosity measurements revealed that the graphene and some tested commercial nanosilica had insignificant impact on the viscosity and stability of the emulsified acid. Two nanosilica particles, on the other hand, resulted in significant decrease in the viscosity i.e., 30 % and 50 % reduction in viscosity. In terms of reactivity, the static carbonate dissolution experiments showed that the emulsified acid has retarded reaction rate compared to the plain acid and moreover the nanoparticles stabilized the emulsion during the reaction which lead to slight retardation of reaction rate. As expected, the protective layer i.e., hydrocarbon, reduced the corrosion rate in the emulsified acid compared to the other tested system.

Therefore, the results presented in this work would help properly design the well stimulation treatment and improve the effectiveness of carbonate stimulation by creating conductive fractures and long wormholes.

Biography:

Bader Alharbi joined Saudi Aramco in 2006 as a petroleum engineer. He graduated with BSc degree in chemical engineering and MSc in petroleum engineering, both from king Fahd University of Petroleum and Minerals. He holds PhD degree in petroleum engineering from Heriot Watt University. His research interest includes well stimulation and corrosion and scale mitigation. Bader authored and coauthored more than 35 journal and conference papers and more than 25 patents.

Comparison of the Friction Behaviour of Textured Surfaces Between Different Polymer Materials

Isabela Evangelista[a,b], Dorota Wencel[b], Steve Beguin [b], Nan Zhang[a], and Michael D. Gilchrist[a*]

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[b]*I BD (Becton, Dickinson & Company), Blackrock Business Park, Carysfort Avenue, Blackrock, Co., A94H2X4 Dublin, Ireland;*

Abstract:

Medical devices frequently include moving components that are exposed to friction forces, and controlling the tribological properties of such components is essential for effective product-patient interactions. Recent literature [1] has confirmed that reducing contact area at the interface between moving surfaces reduces friction forces. This present research uses prototyped thermoplastic samples, typical of polymer medical devices, so as to better understand friction behaviour during dry sliding contact.
Polymer surface modifications are investigated in this study as a way of optimizing surface interaction that minimise the contact area between opposing surfaces. Microscale features in the form of cylindrical pillars (diameter 100 µm, height 50 µm, Fig.1) with a pitch spacing of 140 µm were compared against plane surfaces devoid of any textured features.

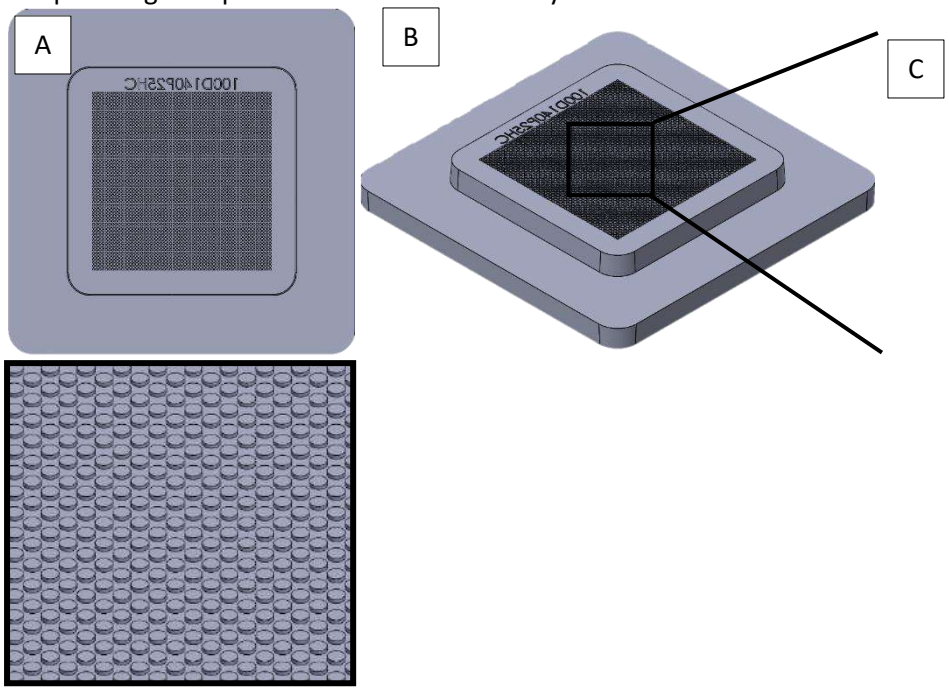

Figure 1 Three- dimensional representation of textured sample where a) top surface, b) isometric view and c) amplification view of surface sample where cylindrical pillars structures are represented.

Microinjection moulding was used to produce samples of different thermoplastic materials including polyacetal and polybutylene terephthalate. For microstructure filling, key injection moulding process parameters such as mould temperature, packing pressure, and injection speed were optimized. Surface characterization of the moulded components was performed using scanning electron microscopy, while the coefficients of friction and wear rates between flat and textured samples in dry

conditions were measured using a tribometer. This presentation will discuss the changes found for the various materials.

References:

[1] Evangelista, I., Wencel, D., Beguin, S., Zhang, N. & Gilchrist, M.D., Influence of surface texturing on the dry tribological properties of polymers in medical devices. Polymers, 2023, 15, 2858.

Short Biography:

Isabela da Conceicao Evangelista is a currently PhD student in her final year under University College of Dublin with a partnership with Becton in Dickinson based in Dublin, Ireland. Her early education was completed at the University of Minho in Portugal, where she studied Polymer engineering for her undergraduate and master's degrees. In terms of academic collaborations, in addition to a summer internship in material characterization, a master thesis on additive manufacturing was developed with DONE Lab. Recently, the primary research focus has been on texturing surfaces to reduce friction in sliding contacts in the medical device applications.

Diffusion Phenomena in Biodegradable Composites: From Barrier Packaging to Electrospun Fibrils for Drug Delivery

Alexey Iordanskii[a]*, Anatoliy Olkhov[a] , Pavel Borovikov[b], and Valentina Siracusa[c].

[a] *N.N. Semenov Federal Research Center for Chemical Physics, Moscow, Russian Federation.*
[b] *Kulakov National Medical Research Center for Obstetrics, Gynecology, and Perinatology, Moscow, Russia.* [c] *University of Catania, Catania, Italy.*

Abstract:

In the framework of the European Circular Economy with the focus on the transition from custom petrol-based plastics to sustainable, renewable, and eco-friendly plastics, a series of biodegradable composites has been elaborated and characterized on the structural and dynamic levels. The composites were fabricated on the base of the biopolymer market leaders such as polylactide [PLA], poly(3-hydroxybutirate) [PHB], and chitosan [CHTS]. The topic of the presentation is to highlight the inherent role of diffusion phenomena in packaging barrier materials, for drug delivery from electrospun fibers, oil spill remediation, efficacy prosthetic reparation, etc. In response to phase separation, the morphology, crystallinity, and segmental dynamics in the composite films and ultrathin fibers affect the water and drug diffusivity as well as their functional behavior including thermal behavior, the active barrier features, and the temporary-spatial pattern for drug release. Besides, the role of loaded drugs has been essentially elucidated for the homopolymers PHB, PLA, CHTS, and their composites with diverse macromolecular content. Specifically, it has been shown that electrospun ultrathin fibers produced at the different PHB/PLA ratios and the controlled drug-loaded content are characterized by the variation of diameter, geometry (string-on-bed), and crystallinity. A powerful modern method, electron spin resonance (ESR), has been successfully applied for the exploration of heterogeneous molecular dynamics in biocomposites. For transport phenomena in biocomposites, the accordance between computer modeling and experimental data has been clearly observed. The multifaceted analysis of composite ultrathin fibers will enable the experts to enhance the operation perspectives in drug delivery platform design and innovative packaging.

Short Biography:

Alexey Iordanskii, Prof., DSc (Polymer chemistry), is a Principal Investigator at Semenov Federal Research Center for Chemical Physics, RAS Moscow RF. His researches have focused on diffusion, drug release and biodegradation in biopolymers with the emphasis on composites and nanofibers. He is internationally respected expert in the above areas with 340 publications. Fellowship at the Institute of Macromolecular Chemistry, Prague, Czech Republic and the Institute of Medical Polymer Chemistry. Wroclaw, Polish Republic. Science lecturing in the "Rhone Poulenc Co" Lion-Paris France (1987) Nowadays, Alexey Iordanskii is the Board Member of MDPI Publishing, Switzerland, and Reviewer Board Member of “Polymers”.

Polyacrylonitrile Membranes Doped with Carbonaceous Materials in Low Salinity Water Desalination Process

Merchan-Arenas, Diego R.[a]*, Romero-Jaímes, Cindy J.[b], Patrouilleau-Quintana, Daniel A.[a]

[a]*Instituto Colombiano del Petróleo, Ecopetrol, Piedecuesta Santander, Colombia*
[b]*PSL Proanálisis S.A, Floridablanca, Santander*

Abstract:

Water scarcity is a major concern in the sustainable development goal (SDG), thus industrial water pollution has been converted in the main industrial and academic challenge. Some industries as agroindustry consumes more than 70 % of fresh water and the trouble became worst in thirsty places. Other industrial sector as Oil and Gas requires around 1.71-8.25 WB/OB in all production chain; however, some wells can produce 13 WBPD/OBPD and this water could be used in other applications towards an environmental protection. This water source is treated by conventional methods to remove oil and grease, TSS, among other pollutants. Nevertheless, dissolved solids as cations are recalcitrant pollutants and polishing steps are necessary to reach irrigation water quality. Therefore, from AQUA program in ECOPETROL, we are developing new materials based on polymers to remove TDS.

Then in our research we performed polyacrylonitrile (PAN) membranes optimizing the electrospinning protocol to produce it varying different times, PAN/DMSO concentration, injection flows, among others. On the other hand, we obtain a sulfonated char that can be used as solid support to exchange H^+ with M^+. Afterwards, we doped our polymer solution with 15 % wt of sulfonated char, where this carbonaceous material could act as ion exchange (IX) resin. The membrane was characterized using XPS and SEM-EDS techniques and finally was tested in dead-end filtration process having a 2.1 mg de Na^+ / cm^2. Other parameters as permeability and energy surface were measured.

Short Biography:

Merchan-Arenas, Diego R. finished his PhD in 2015 at the Universidad Industrial de Santander under Vladimir Kouznetsov supervision. In 2019 he moved to Chile to realize his postdoctoral fellowship in organic chemistry at Universidad Católica de Chile. He has worked in projects with different universities in Colombia, Venezuela, Chile, and Switzerland. He has written more than 30 international publications in organic chemistry, biological chemistry, materials chemistry, environmental science, and petrochemical science. He had six years of experience in Oil and Gas industry, and he is working in materials synthesis for residual industrial water treatment, microbiology induced corrosion, among other issues at the Instituto Colombiano de Petróleo, ECOPETROL.

The Plastics Paradox

Sibele Piedade Cestari[a]* and Chris DeArmitt[b]

[a] *Innovation in Polymer Engineering (PIEP), University of Minho, 4800 Guimarães, Portugal*
[b] *President of Phantom Plastics*

Abstract:

This presentation is intended to briefly show facts and figures regarding plastics and their paradoxical relationship to sustainability, based on "The Plastics Paradox" book by Chris DeArmitt. Despite the widespread knowledge of ecological footprint, sustainability, and life cycle analysis, the media bombardment against plastics has led even well-informed individuals astray. There is a lot of misinformation in the media about plastics. The misinformation in the media is exemplified by the uproar over ocean-bound plastic, which actually originates from the mainland due to improper handling of urban solid waste. Replacing plastics with conventional materials can significantly increase the environmental harm caused by human activities. Moreover, the use of bioplastics in replacement of effective regular plastics in single-use packaging applications diverts valuable resources directly to waste production, perpetuating the culture of production-consumption-disposal so desired for products with a linear life cycle. It is crucial to recognize that polymers, as materials, are among the most sustainable ever created by humankind. All of them are theoretically recyclable or redirectable, and the hindrance to recycling some plastics lies in the sheer lack of economic interest in doing so. "The Plastics Paradox" contains valuable information that is often overlooked by the media but is essential for a comprehensive understanding of plastics and their impact on the environment. Being well-informed about this subject is critical in making decisions that will impact future generations. By embracing science-based, peer-reviewed facts, we can work towards building a genuinely sustainable future.

Short Biography:

Sibele Cestari is a polymers scientist working as a Researcher at the Innovation in Polymer Engineering (PIEP), at the interface between academic knowledge and industrial developments. Her expertise in plastics recycling includes experiences in Brazil, Germany, The Netherlands, United Kingdom and Portugal. She has published over twenty papers in reputed journals, one Brazilian patent, six book chapters, media articles and delivered talks about polymers and sustainability.

Re-valorizing Industrial Biogenic Waste – Sustainable Substitutes for Fossil-based Polymers

Marius Wolf[a]*, Stefan Hanstein[a]

[a]*Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS, Alzenau, Bavaria, Germany*

Abstract:

Replacement of fossil-based polymers is a current challenge, which needs a broad feedstock of bio-based substitutes produced with a reasonable CO2-footprint. As indigestible biopolymers ß-1,4-hemicelluloses were extracted with an extraction process without usage of chemicals from plant-based industrial residues as a heterogeneous mixture. Requirements for industrial applications as binder in coatings or printing inks the hemicelluloses need to be tailored in size and distribution. Solving these issues hydrothermal (HTD) and acid catalyzed depolymerization (ACD) are used to improve suitability of our hemicelluloses for various applications. Desired degree of polymerization (DP) below 15 could be achieved at 190 °C in 50 min with HTD and at 90 °C in 120 min with 1.5 wt% H2SO4 with ACD, which have been characterized by SEC-MALS-dRI, ATR-IR and elemental analysis. For further improvement of monodispersity and purification ultrafiltration was introduced as fractionation media with 1 and 4 kDa multi-channel ceramic membranes. With this process, hemicelluloses from food processing industry residues will be harnessed as a substitute for fossil-based polymers after tailoring molar mass distribution and chemical modification.

Short Biography:

Marius Wolf completed his M.Sc. degree in chemistry with focus on polymer characterization at Technical University of Darmstadt. He is currently finishing his PhD in materials science/chemistry in an industry-sponsored PhD project at Fraunhofer IWKS (cooperation with Technical University of Darmstadt). His research interests are based in the field of biopolymers with focus on extraction, depolymerization, chemical modification and characterization. As feedstock industrial waste streams are utilized to make biogenic substitutes for fossil-based polymers available.

Paving the Way to Sustainability: Exploring the Synthesis of Ligninderived Diisocyanates for Bio-based Polyurethanes Elaboration

Aliénor Delavarde[a] *, Jean Koobus[a] , Julien Pinaud[a] and Sylvain Caillol[a]

[a]*Institute Charles Gerhardt Montpellier, Departement 2, University of Montpellier, CNRS, ENSCM, 1919 route de Mende, 34095 Montpellier, France*

Abstract:

Poly(lactic acid) or PLA is a biodegradable thermoplastic polymer derived from bio-based resources like cornstarch or sugarcane. It finds a wide range of applications in industries, including packaging materials, food containers, medical implants, 3D printing filaments, and more. Due to its biodegradable nature, PLA is particularly attractive for the development of other biodegradable materials, such as polyurethanes. In order to valorize PLA waste, we employed a catalyst-free process called alcoholysis to depolymerize the crude PLA. This involved reacting the PLA with a bio-based polyol, resulting in the production of diols with low molar mass (115- 269 g.mol-1) and low viscosity (250-650 mPa.s) derived from PLA. The PLA-derived diols obtained were fully characterized using FTIR, NMR, and GC-MS analysis. Additionally, the hydroxyl value was determined through acid-base titration, following ISO 14900 guidelines. Subsequently, PLAderived diols were utilized to develop fully biobased polyurethane resins using bio-sourced isocyanates that demonstrate excellent physicochemical properties (Tg = 5-20 °C, Tmax(degradation) = 480 °C). To prevent any adverse effects on enzymatic response during tests on the biological degradation of polymer materials, the polyurethane materials were developed without the inclusion of catalysts. In the final step, the degradation of the samples will be evaluated using the OECD 301B method and a method simulating industrial compost. Short Biography Aliénor Delavarde obtained a master's degree from the Graduate School of Chemistry, Biology, and Physics of Bordeaux (ENSCBP, France) in 2020, specializing in biopolymers and renewable resources for chemical purposes. She is currently pursuing a PhD degree with the company Synia and the Institute of Charles Gerhard in Montpellier, France. Her research focuses on the development of polymers with low environmental impact, such as bio-sourced polymers or biodegradable polymers.

Development of Specific & High Affinity Polymer-binding Peptides for Microplastic Identification and for Enhanced Enzymatic Degradation

Sonja Harter*[a], Franziska Lederer[a]

[a] *Helmholtz Institute Freiberg for Resource Technology, Biotechnology Department, Freiberg, Saxony, Germany*

Abstract:

Microplastic pollution is one of the most pressing problems of our time. There are innumerable sources of microplastic including the production of fine particulates as a by-product of various industrial processes. These particles mainly end up in landfills where they are released into the environment. Efficient recycling of these materials reduces microplastic pollution and saves primary resources for polymer production. However, economically and ecologically relevant recycling technologies for fine polymer particles are not yet established.

The aim of the presented work is to provide methods for rapid and simple analysis of complex environmental samples and the optimization of particle degradation. These methods will be based on low-cost and environmentally friendly peptides that bind specifically and with high affinity to polyethylene terephthalate (PET), polyamide and polyurethane, respectively.

To identify the peptides, phage surface display (PSD) is performed on micrometer-sized polymer particles. Eight putative PET binding phages were already identified by PSD using PET particles as target material. In future, isothermal titration calorimetry will be used to determine the thermodynamic parameters of the peptide-polymer interaction. To identify the chemical groups involved in binding, fourier-transformed infrared spectroscopy along with alanine scanning mutagenesis will be utilized. Upon optimization, the developed polymer-binding peptides will be heterologously expressed with different fluorescent labels. Flow cytometry will be used for the analysis and sorting of fluorescently marked particles. Cooperation partners at the Helmholtz Center Berlin will produce hybrids of the developed polymer-binding peptides and polymer-degrading enzymes to enhance enzyme-particle affinities resulting in improved polymer degradation.

Short Biography:

- 10/2016-12/2019: Bachelors Degree in Nano-Science at the Eberhard Karls University of Tübingen, Germany
- 12/2019-10/2022: Masters Degree in Nano-Science at the Eberhard Karls University of Tübingen, Germany
- Since 02/2023: PhD Student at the Helmholtz-Center Dresden-Rossendorf, Germany

Teaching Sustainability Using 3D Printing in Engineering Education: An Observational Study

Thanh Tuan To[a]*, Abdullah Al Mahmud [b] and Charlie Ranscombe [c]

[a]*Thanh Tuan To: Swinburne University of Technology/School of Design and Architecture, Melbourne, VIC 3122, Australia*
[b] *Abdullah Al Mahmud: Swinburne University of Technology/School of Design and Architecture, Melbourne, VIC 3122, Australia*

[c] *Charlie Ranscombe: Swinburne University of Technology/School of Design and Architecture, Melbourne, VIC 3122, Australia*

Abstract:

One of the many features of three-dimensional printing (3DP) that contribute to its status, as a cutting-edge technology is its positive impact on sustainability. Students in higher education can also use 3DP technologies to understand environmental, social, and economic issues. However, there is a lack of knowledge on how sustainability is integrated through 3DP in higher education, especially in developing countries. Thus, this study explored the teaching of sustainability through 3DP in five public engineering universities in Vietnam using field observations (75 students and five educators), followed by semi-structured interviews with ten students and five educators. The findings revealed that sustainability through 3DP was not taught as a separate unit in the participating institutions as they were not equipped with the necessary tools and software to educate students about sustainability through 3DP, the time spent teaching students about 3DP was limited, and most of the educators were not trained in implementing sustainability through 3DP in higher education. Despite these barriers, students were instructed on how to use 3DP materials economically and were taught which materials were beneficial for the environment. In cases of limited resources and funding, assisting students in assembling low-cost do-it-yourself 3D printers by utilizing open-source materials will maximize their learning outcomes. These findings may help higher education institutions teach sustainability through 3DP and motivate students to explore multidisciplinary knowledge in developing countries. The research also guides both higher education sectors and policymakers on taking the steps necessary for utilizing the benefits of 3DP in engineering education.

Short Biography:

Tuan has an MSc in Advanced Multimedia and 3D Technologies from Brunel University, United Kingdom.

Tuan and his colleagues at Icostudio deployed more than 300 projects of different industries and sectors to clients in Europe. With over 10 years of experience, Tuan and his team had many breakthrough solutions and solved many difficult problems, helping customers achieve their goals and high profits.

Since working in both industry and academia, Tuan has observed a need to enhance sustainability in the education sector for developing countries through 3D Printing technology. Tuan is now a Ph.D student at Swinburne University of Technology.

Development of Bio-based Derived Thermosets Derived from Acrylated Epoxidized Soybean Oil (AESO) and Environmentally Friendly Cinnamates

Jaume Gomez-Caturla[a]*, Juan Ivorra-Martinez[a], Sandra Rojas-Lema[a], Virginia Moreno[a] and Daniel Garcia-Garcia[a]

[a]*Instituto de Tecnología de Materiales (ITM), Universitat Politècnica de València (UPV), Plaza Ferrándiz y Carbonell 1, 03801, Alcoy, Alicante, Spain*

Abstract:

This work reports on the development of environmentally friendly thermoset materials based on the combination of acrylated epoxidized soybean oil (AESO) with ethyl cinnamate (EC) and allyl cinnamate (AC), which are all bio-based components. Several formulations were prepared varying the proportion of cinnamate used with relation to AESO. 2:1, 3:1, 4:1 and 5:1 AESO-cinnamate proportions were used for each one of the cinnamates (AESO:EC and AESO:AC) in order to observe how the quantity of comonomer affects the general properties of the thermosets. Butylperoxybenzoate at 2 wt.% was used as a catalyst. A first curing process at 90 °C for 2 hours was carried out, followed by a second curing cycle of 2 h at 120 °C. The resulting formulations were characterized by mechanical, thermal, thermomechanical, morphological and chemical characterization. A clear increase in stiffness and resistant mechanical properties (young modulus and tensile strength) was observed for the formulations with the highest content in AESO, due to a decrease in the content of comonomer used. Additionally, the glass transition temperature of the samples was shifted towards higher temperatures as the proportion of AESO increased, which was ascribed to lower mobility of the polymeric chains as a result of an enhanced crosslinking effect.

Short Biography:

Jaume Gomez-Caturla is a PhD student who finished his chemical engineering degree in Universitat Politècnica of València (UPV) in 2019. Afterwards, he started a master in engineering, processing and characterization of materials in the same university, finishing his studies in 2021. He was awarded several prizes for his academic record during his degree studies and for the final project of his master. In March of 2021 he initiated his PhD in engineering and industrial production in UPV and he is currently working with the mechanical engineering and materials department in several research lines involving the development of environmentally friendly polymers.

Compatibilization of PLA/Posidonia Composites with Cinnamon Derived Plasticizer by Means of Reactive Extrusion

Juan Ivorra-Martinez[a]*, Jaume Gomez-Caturla[a], Diego Lascano[a], Ramon Tejada-Oliveros[a] and Nestor Montanes[a]

[a]*Instituto de Tecnología de Materiales (ITM), Universitat Politècnica de València (UPV), Plaza Ferrándiz y Carbonell 1, 03801, Alcoy, Alicante, Spain*

Abstract:

The incorporation of posidonia fibers in PLA composites results in a reduction of the mechanical properties of PLA due to the fact that the incorporation of the fibers promotes stress concentrators in the polymer matrix. To improve the performance of composites it is possible to consider different strategies to increase the polymer/fiber interaction in order to improve the final performance of the composite materials obtained. One of the possibilities is the incorporation of plasticizers to improve the ductile properties of PLA. In this case, a plasticizer derived from cinnamon is incorporated to increase the ductility. With the cinnamon derived plasticizer, the elongation at break of the composites is improved up to 31.1 %. In addition, a reactive extrusion process is considered in the composites in order to improve the interaction of all the materials considered. For the reactive extrusion process, the incorporation of dicumyl peroxide acted as a free radical initiator to create links between the different parts. With the reactive extrusion, an improvement of the mechanical properties is observed by the increased interaction confirmed in the microscopy images taken from the fracture surface of the composite with a clear reduction in the gap formed between PLA and the Posidonia fibers.

Short Biography:

Dr. Ivorra-Martinez is a postdoctoral researcher at the Universitat Politècnica de València (UPV) in the Department of Mechanical and Materials Engineering. He is also a member of the Institute of Materials Technology (ITM). He holds a degree in Mechanical Engineering from the Universitat Politècnica de València and a Master's in Materials Engineering, Processing and Characterization of Materials. His research is focused on the development of new polymeric materials with a low environmental impact, focusing especially on their processing by means of different manufacturing techniques such injection molding and additive manufacturing.

Compatibilization Solution for Enhancing Plastic Waste Content in Bitumen

In collaboration with Gdansk University of Technology, SABIC B.V. and Saudi Aramco

Mateusz Malus,[a*] Joanna Bojda,[a,b] Maciej Sienkiewicz,[c] Wojciech Szot,[a] Miloud Bouyahyi,[d] Maha AlSayegh,[e] Rasha Daadoush,[e] Maria Soliman[d], Rob Duchateau,[d,f] Lidia Jasinska-Walc[a,d]

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[b] *Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences, Lodz, Poland*
[c] *Department of Polymer Technology, Faculty of Chemistry, Gdansk University of Technology, Gdansk, Poland*
[d] *SABIC Technology and Innovation, STC Geleen, Geleen, the Netherlands*
[e] *Saudi Aramco, Research & Development Center, Dhahran, the Kingdom of Saudi Arabia*
[f] *Department of Chemical Engineering, University of Groningen, Groningen, the Netherlands*

Abstract:

SABIC has developed a new class of functionalized polyolefins (IRF-PO), which are being produced by a patented catalytic in-reactor technology. In the presented research, we have utilized low crystalline hydroxyl-functionalized propylene-based terpolymers as compatibilizers of crumb rubber modified bitumen.

SABIC's IRF-PO technology is a "game-changer" in bitumen application as it introduces polarity into inherently apolar polymers, thereby ensuring good interaction between apolar and polar bitumen ingredients, as well as with polar minerals, used for asphalt preparation. These polar groups' interactions create a thermo-reversible cross-linked interpenetrating network that provides mechanical integrity and contribute to the adhesive strength to different components of the modified bitumen at service temperatures, while affording excellent processability at high application temperature ranges. This special feature results in the IRF-PO's superior compatibilizing ability, which allows doubling the ground tire rubber (GTR) incorporation as compared to state- of-the-art compatibilizers.

IRF-PO do not greatly increase the overall viscosity of the GTR-modified binder and thus reduce processing costs. It also provides excellent rheological properties and stability during binder annealing. The bitumen surface morphology is significantly improved, as proven by AFM studies. This results from the uniform polar constituents' distribution and interfacial energy reduction of the compatible binder components. Furthermore, IRF-PO's enhance the rutting deformation resistance and improve the cohesive strength of bitumen blends resulting in a superior in-service performance of the final products. The significantly improved rutting resistance of modified bitumen confirms high compatibility of the ingredients that results from the formation of a dynamic, lightly crosslinked network between the compatibilizer, recycled polymer and SARA components of the bitumen.

Short Biography:

As a third-year PhD candidate in Chemical Sciences at the Gdansk University of Technology in Poland, my research focuses on the development of an innovative and eco-friendly approach toward asphalt modification. The primary focus is on utilizing challenging-to-recycle polymer-waste streams, employing specialty compatibilizers like functionalized polyolefins to achieve this objective. The research is implemented in close collaboration between Gdansk University of Technology, SABIC B.V., where the IRF-PO technology has been developed and Saudi Aramco searching for novel bitumen modification strategies. Together, we aim to contribute to the advancement of sustainable and cost-efficient technologies in the field of asphalt modification.

Functionalisation of Lignocellulosic Fibres for the Fabrication of Porous SiC(O) Ceramics from Preceramic Precursors

Romain Lucas[a]*, Juliette Hirsch[a], Manon Gireau[a], Sabrine Sayadi[a,b], Sylvie Foucaud[a], Rachida Zerrouki[b,c], François Brouillette[b]

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Abstract:

Porous silicon carbide (SiC) materials were designed using preceramic precursors with kraft pulp papers (KPP) as starting materials. In this way, different functionalised KPP were impregnated by selected organometallic precursors. The pyrolysed materials were characterised at different stages, by using thermogravimetric analysis coupled with mass spectrometry (TGA-MS), scanning electron microscopy (SEM), and X-ray diffraction (XRD). Various architectured SiC(O) ceramics were successfully obtained with adjustable porosities, depending on the nature of the initial template. The key role of the previous functionalisation of papers was highlighted in terms of interactions at the interface between the polymer and the fibrous lignocellulosic sheets. Moreover, the incorporation of copper in the preceramic papers was also investigated. Depending on the functionalisation of the materials, different phases and coating/dispersion were obtained, with potential applications in the field of catalysis. Short Biography: Dr. Romain Lucas obtained his PhD in Organic Chemistry from the University of Limoges (France) in 2009. He was appointed as a Lecturer in 2010 at the Institute of Research on Ceramics (IRCER) and at the IUT of Limoges. His current research interests focus on the syntheses and rheology of original preceramic polymers, including a core-shell approach, the role of the interfaces between ceramic and organic materials, and the 'green' fabrication of new composites and catalysts using cellulose-based bioresources. He is the author and co-author of 52 publications, 61 oral presentations, with 15 invited talks.

Semiconductor Wide Band Gap Cd1-xBexTe Crystals-based Dye-sensitized Solar Cells

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[b]*Center for Solar Cells & Renewable Energy (CSRE), Department of Physics, Sharda University, Gr. Noida, India*

Abstract:

Solar energy is treated as one of the best alternatives for the global energy crisis. The paper deals with the synthesis and various properties like thermal stability and photovoltaic performance of mixed ternary crystals $Cd_{1-x}Be_xTe$ (cadmium beryllium telluride, CBT) for dye-sensitized solar cells. CBT crystals were grown using the Bridgman technique for different beryllium content *x* (up to 0.1) at high temperatures and pressures. In dye-sensitized solar cells (DSSC), we have tried to propose and test this material as an alternative to standard dye (Ruthenium). We fabricated dye-sensitized solar cells (DSSC) using CBT as a working electrode with the modified doctor blade method. We prepared a polymer electrolyte solution while the counter electrode is common. Comparative studies (without dye) with standard DSSC (with dye) photovoltaic performance are also presented in detail regarding better stability and charge mechanism. We check the sample structure and morphology for further characterization with atomic force microscopy, X-ray diffraction, transmission electron microscopy, scanning electron microscopy, and photoluminescence. As prepared, DSSCs using ternary $Cd_{1-x}Be_xTe$ show good efficiency performance as high as 3.11% with a high fill factor. The life spam measurement indicates very promising results, and DSSCs are stable up to 720 hrs with a reasonable decrease in photovoltaic parameters.

Short Biography:

Diksha Singh from Poland is pursuing Ph.D. at Nicolaus Copernicus University, Torun, Poland. My research is related to semiconductor wide-band gap crystals.

Extremely Stretchable Sustainable Elastomeric Conductor for Printed Soft Electronics

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[a]*Advanced Materials Research Center, Technology Innovation Institute, Masdar City 9639, Abu Dhabi, United Arab Emirates*
[b]*School of Materials Science and Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore*

Abstract:

Electroadhesion is a promising method for enhancing robotic functions with continuous, astrictive, and reversible adhesion force. However, a lack of suitable dielectric materials and processing capabilities has hampered the incorporation of electroadhesive modules into soft robots that require mechanical compliance as well as robustness. We describe an iontronic adhesive based on a dynamically crosslinked gel-elastomer system with adhesive electrodes made of an ionic organohydrogel and dielectric layers made of a robust polyurethane with high electrostatic energy density. The dual-material system demonstrates cohesive heterolayer bonding and autonomous self-healing from damages thanks to supramolecular design and synthesis. Additive manufacturing is used to create iontronic soft grippers that perfectly integrate actuation, adhesive prehension, and exteroceptive sensation. In contrast to electroadhesives, the grippers can catch soft and malleable materials, carry a high payload under little voltage input, and immediately release foreign objects. Our materials and iontronic methods pave the path for future advancements in multifunctional adhesive-enhanced soft devices.

Short Biography:

Gurunathan Thangavel is a senior researcher in the Advanced Materials Research Center, Technology Innovation Institute (TII), Masdar City 9639, Abu Dhabi, UAE. He received his M.Sc. in 2007 at the Chemistry Department of Bharathidasan University and an M.Tech. degree in polymer science and engineering at Anna University (AU) in 2011. In 2015, he received his Ph.D. in polymer technology at the AU. His research interests include self-healing polymers, functional materials, energy materials, and polymers for electronic applications.

Magnetoactive Elastomer Lamellar Surfaces: Frustration, Optical Properties and Object Transport

Gašper Kokot[a]*, Izidor Straus[b], Gaia Kravanja[c], Luka Hribar[c], Raphael Kriegl[d], Mikhail Shamonin[d], Matija Jezeršek[c] and Irena Drevenšek-Olenik[ab]

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[c]*University of Ljubljana, Faculty of Engineering, Ljubljana, Slovenia*
[d]*Ostbayerische Technische Hochschule Regensburg, Regensburg, Germany*

Abstract:

Magnetoactive elastomers (MAEs) are composed of magnetic microparticles dispersed in an elastomer and are known to respond to external magnetic fields by modifying bulk properties, for example elastic modulus. This feature makes them a good candidate for smart adaptive materials and soft robotics. Recently, MAE research focus has shifted to surfaces which were shown to display intriguing new properties especially when we introduce patterns. Here we will present experimental and theoretical investigations of a lamellar surface MAE made with soft iron particles and subjected to time varying magnetic field. Lamellae can be coaxed into changing the surface reflectivity in a reversible and instrument limited manner. We will offer an explanation for the frustration of the lamellar surface in uniform magnetic fields. Finally, we will discuss the origin of object transport, when the MAE lamellar surface is subjected to magnetic fields with cyclic changes in polarity.

Short Biography:

Dr. Gašper Kokot obtained his PhD from University of Ljubljana, Faculty of Mathematics and Physics, Slovenia while at Jožef Stefan Institute, Slovenia. He concluded postdoctoral appointments at University of Zurich, Switzerland; Argonne National Laboratory, USA and Northwestern University, USA. He then worked at the Biophysics Institute, University of Ljubljana, Faculty of medicine, Slovenia and is currently holding a position at J. Stefan Institute, Slovenia. He is interested in particle ensemble behavior in different carrier media. In particular, how does it translate into combined macroscopic response of the particle ensemble together with the carrier medium.

Polymers Tribology in Food Packaging Equipment

Silvia Rossi*

[a] *Tetra Pak Packaging solutions Spa, Modena, Italy*

Abstract:

In food packaging equipment plastic bushings and rollers can be exposed to demanding conditions in terms of loads, running speed, surrounding temperature and chemical environment. The choice of material coupling with lowest wear rate is critical to maintain the lifetime of the Filling Machine components. A distinctive requirement for material selection in food industries is the compliance to the regulation requested for food contact applications, thus excluding many polymeric grades that are containing fillers not approved. Reference material tribological coupling, PEEK bushing against AISI 316L shaft, suffers of premature wear with generation of black particles. The wear mechanism has been studied both with pin on disk tests and in a test rig, which replicates the coupling of the real components, in terms of geometries and operative conditions. The impact of friction coefficient on interfacial temperature was investigated through measurements and virtual simulations. Due to the high CoF and environmental conditions, an interface temperature exceeding polymer Tg is developed generating black particles. FT-IR characterization of wear debris showed the presence of thermally oxidated PEEK, confirming the root cause. The same methodology and experimental setup have been successfully applied to select alternative plastic grades.

Short Biography:

Silvia has a master's degree in Materials Engineering, and she has been working at Tetra Pak Packaging Solutions, R&D department, since 2017. Specialist in Polymers, from materials advanced selection to components failure analysis and characterization. Involved in several validation activities of new materials and polymers-based coatings, she managed plans with suppliers to quickly find solutions that guarantee quality and certifications compliance. Driver of root cause analysis of polymers degradation and wearing issues.

Research interests in polymers tribology, polymers wettability and polymers accelerated lifetime tests. Continuous scouting of new compounds and high-performance plastics to mitigate current global raw materials shortage.

Hybrid Bioactive Materials for Bone Tissue Engineering

Khalil El Mabrouk*, Meriame Bricha

Euromed Polytechnic School, Euromed University of Fes, Eco-campus, Meknes Road, 30 030 Fes, Morocco

Abstract:

Maxillofacial injuries, periodontal diseases, and deformities can significantly impact patients' quality of life. While these diseases can be treated with various methods, including bone transplants, dental implants, and bone/tissue regenerative techniques, the results are frequently unsatisfactory due to restricted bone growth and infections. In particular, the success of bone/tissue regenerative procedures, among other factors, is highly affected by the nature, design, and performance of the used materials. Moreover, the use of non-resorbable barrier membranes in bone regeneration is associated with inflammation and necessitates additional surgery for their removal, leading to increased pain, financial burden, and a higher risk of bacterial invasion at the defect site. Multifunctional bioresorbable barrier membranes are thought to have potential breakthrough to the mentioned problems.

The composite materials contain a blend of polymers, BG doped with essential elements for enhanced strength and flexibility, and therapeutic molecules for more potent pharmacological benefits.

At medium and high bioglass content (10% and 15 wt%), the composite membrane presented an outstanding biomineralization capability. The degradation rate was enhanced at a rate comparable to hydroxyapatite deposition. These results are mainly attributed to the homogeneously dispersed BGn throughout the fibrous matrix and the resulting changes induced by these particles on the membranes' wettability and nanostructure.

Short Biography:

Ph.D. in Chemical Engineering in 2005 at Laval University-Canada; Postdoctoral: Queen's University-Canada and Dow Chemical New Jersey-USA; Research Director in Moroccan Foundation for Advanced Science Innovation and Research (2008-2013). Since 2013, Full Professor at Euromed Polytechnic School, Euromed University of Fes-Morocco.

Chemical Recycling of Polyolefins: An Approach to Reduce Power Consumption

Alberto García-Peñas[a], Marcelo Calagua*, Antonio F. Calles-Valero[b], María L. Cerrada and José M. Gómez-Elvira[c]

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[b]*Instituto de Ciencia y Tecnología de Polímeros (ICTP-CSIC), Juan de la Cierva 3, 28006 Madrid, Spain*

Abstract;

The demand of polyolefins, specifically polyethylene and polypropylene, continues growing independently of the new regulations that limit the use of plastics because of their versatility, extensive range of applications and low cost. Nevertheless, the use of some polyolefins could also contribute to the green deal in terms of energy efficiency for the production of new type of capacitors, whose residues could be treated as raw materials after chemical recycling. In this sense, the incorporation of cyclic olefins, such as norbornene, onto polymeric chains based on ethylene and propylene can contribute to these applications in terms of better properties.
For that purpose, this work is focused in the preparation of poly(ethylene-*co*-norbornene) copolymers for a promising generation of devices for energy applications that could be treated by chemical recycling after use. The studies associated with the thermal stability exhibits an activation energy lower for these copolymers than for PE, pointing out that chemical recycling would require a lower energy consumption.

Short Biography:

Dr. Alberto García-Peñas is Assistant Professor in the department of Materials Science and Engineering at University Carlos III of Madrid. Furthermore, he is Coordinator of the master's degree in Circular Engineering, Secretary for Academic Affairs of "Álvaro Alonso Barba" Institute of Chemistry and Materials Technology, Founder of the CIRMAT Symposium, Computer Council Member, and Laboratory Safety Officer at University Carlos III of Madrid.

The outcome of his research work includes more than 50 SCI-publications in reputed journals such as Chemical Engineering Journal, Carbohydrate Polymers or Chemosphere. He contributed to 4 book chapters and edited 1 book.

Measuring Structural Composite Panel Temperature Exposed to a Flame

Fabien Dupont[a]*, Tanja Pelzmann[b], Benjamin Saute[a] and Étienne Robert[b]

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[b]*Université Polytechnique Montréal, 2500 Chem. de Polytechnique, Montréal, QC H3T 1J4, Canada*

Abstract:

Two-color (2C) pyrometry has long been used for flame temperature and soot concentration studies and is now becoming more widely used to measure surface temperatures of burning materials. With the obvious advantage of being a contact-free method that requires only minimal optical access, 2C pyrometry combined with high-speed acquisition is a promising diagnostic tool to obtain exceptional temporal and spatial resolution of thermally degrading samples. Telops is developing a 2C pyrometry algorithm that extends point-based two-color pyrometry principles to calculate the absolute temperature and emissivity of a multispectral thermal infrared image on a per-pixel basis.
In this work, a multispectral infrared camera was used to collect radiance data on flame-heated materials for preliminary investigations of algorithm performance. We used an experimental configuration representative for fire resistance testing for aerospace and naval applications. Satisfactory temperature and emissivity separation is achieved for static scenes including the back face of a flame-heated steel plate. Investigations of a dynamic scene such as the front face of the flame-heated structural composite panel reveal the importance of adequate sampling speed to accurate retrieval of sample temperature and emissivity.

Short Biography:

M. Fabien Dupont received his B.Sc in Université d'Orsay (France) in opto-electronics engineering, and his M.Sc. in Electrical Engineering at Université Laval (Québec, Canada). He has some experience in infrared detectors, flight qualification of optical modules, and hyperspectral infrared imagers. He is working now as an opto-electrical scientist at Telops, Quebec Canada. His work mainly focuses on the radiometric performance of infrared cameras for academic research.

Breaching the Outer Limits of Cationic Polymerization in the Quest for Sustainability

Dr. Stewart P. Lewis*

Pyramid Polymers LLC, United States

Abstract:

The cationic technique is the oldest known method for the production of polymers from both synthetic and natural monomers. It is key to the manufacture of materials vital to modern life albeit, despite its long history it still poses serious environmental hazards and is costly to practice. The following talk discusses some of the research conducted by this author in an attempt to concoct a commercially viable yet sustainable methodology for inducing such reactions. The bulk of the strategies discussed in this presentation are unique and in many cases verge on the edge of scientific impossibility. From this talk the listener will come to the conclusion that: (1) out of the box thinking is required in order to truly improve sustainability of this chemistry (2) most companies practicing this form of polymerization have not invested adequate time, money, and fresh brain power into solving its shortcomings (3) major advances required to tackle this issue might only come from smaller companies and those located in developing countries.

Innovative Catalysts Based on Nitrogen-doped Graphene Materials

Adriana Marinoiu*

National Research and Development Institute for Cryogenic and Isotopic Technologies, Rm Valcea, Romania

Abstract:

Fuel cells, the most promising power sources for stationary and portable electronic devices, represent an alternative for decentralized energy production and long-distance transport, with applications already successfully employed in automotive, aerospace, and maritime transportation. Proton exchange membrane fuel cells (PEMFCs) demonstrated relevant advantages such as renewable source with very low emissions, low operating temperature, high energy efficiency and modularity. The core of PEMFC architecture consists of three major components that form the membrane electrode assembly (MEA): the anode (fuel oxidation site), polymeric proton-exchange membrane (typically Nafion, a sulfonated tetrafluoroethylene-based fluoropolymer-copolymer), and cathode (oxygen reduction site). From the applied research level, we expect the development of an innovative generation of electrocatalysts with improved stability and decreased Pt content optimized to be used in PEM FC, together with improved technologies for their preparation, their deposition on membrane for MEAs obtaining.

The graphene-based materials demonstrated superior properties up to date, such as large surface area and porosity, excellent electrical conductivity, and interconnected pore structures. Through these properties, graphene-based materials not only provide more anchor sites to immobilize metal nanoparticles but also could improve the mass transport of reactants. Since the cost is a key factor that influences the manufacturing of ORR electrodes for real PEMFC, Metal-free, PGM-free, or low-PGM graphene-based electrocatalysts are regarded as a great opportunity to replace the high-cost Pt/C-based catalysts.

Acknowledgments: Nucleus Program of the Ministry of Education and Research, Romania, projects PN 23 15 01 02 and PN 23 15 01 03; project PN-III-P2-2.1-PED2021-0840 PED 695/2022

Short Biography:

Dr. Adriana Marinoiu is the Group Coordinator for “Materials for Hydrogen Energy - Mat4H”, ICSI ENERGY, ICSI Ramnicu-Valcea, Romania. Her research area is related to proton exchange membrane fuel cells and related catalysts for energy systems. Her research contributions include: development of new synthesis methods for graphene-based materials decorated with noble and non-noble metal nanoparticles; electrodes manufacturing; catalysts deposition methods; methods of manufacturing membrane-electrode assemblies; polymeric membrane characterization via protonic conductivity; ORR electrocatalysts characterization.

New Biodegradable Bio-based Plastic Film Developed from Cotton Gin Trash (A Byproduct of Cotton Industry)

Renuka Dhandapani[a,*] and Zengxiao Cai[b], Abu Naser Md Ahsanul Haque[b], Maryam Naebe[b]

[a]*Cotton Incorporated, Cary, North Carolina, USA*
[b]*Institute for Frontier Materials, Deakin University, Geelong, VIC 3216, Australia*

Abstract:

Cotton gin trash (CGT), the waste generated by the cotton industry after processing cotton fiber, has been repurposed into a biodegradable bio-plastic film. The CGT films were developed by compounding and pelletizing powdered CGT with polycaprolactone (PCL). The pellets were next molded into bio-plastic composite films. The biodegradation rate of the bio-based films was controlled by addition of a plasticizer during the compounding process. The process followed in converting CGT into a bio-based film was sustainable with the CGT being completely consumed without any waste residue being produced. The morphology of the CGT bio-plastic composite films developed showed even distribution of the CGT powder within the PCL matrix. The mechanical properties of the newly developed films were compared with commercial bio-based film to study the efficacy of the new films. The CGT added to the PCL film helped improve the UV resistance, thermal stability and Young's modulus of the film. Biodegradation of the developed bio-based films were compared against PCL only film to monitor the degradation rate for the films.

Short Biography:

Renuka Dhandapani is a *Manager* in Textile Chemistry Research at Cotton Incorporated with a number of years of experience in the textile industry. Her focus has been on formulating new functional finishes to improve the performance of cotton substrate. She is also focused on helping develop new markets for cotton. 3D printing, injection molding and e-textiles are some of the areas where cotton has successfully been used. Renuka holds a *Ph.D.* in Textile Sciences from the University of Georgia and an MS in Design and Merchandising from Colorado State University. She is an active member of AATCC (American Association of Textile Chemists and Colorists).

Results of the Castor Oil-based Polyurethane Development in the Absorption of Impacts

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[a]*University of São Paulo, Institute of Chemistry of São Carlos (USP / IQSC), São Carlos, SP, Brazil*

[b]*Paulista State University (UNESP), Laboratory of Hydrology and Hydrometric - LH2, Ilha Solteira, SP, Brazil*

Abstract:

Polyurethane's (PU's) as a well-known class of versatile polymeric materials characterized by -NH-CO-O- groups. These materials have found wide applications in various domains of engineering and consumer products. The properties of polyurethane foams such as low density, high specific strength, thermal and electrical insulation, mechanical energy absorption, resilience and noise reduction capacity have made them unique over conventional solid materials. Another most important advantage of polyurethane foam is that its properties can be tuned for a given application through variation of its constituent reacting compounds and density. In this study closed cells polyurethane foam, derived from castor oil, was developed for impact absorption purpose. the mechanical properties were evaluation by diametral tensile strengths (DTS) with four different velocities of compression (960; 120; 39 and 3 cm/min.). The castor oil-based PU employed was developed it is reaction product of two components, polyol and pre-polymer. The polyol was synthesized from castor oil and the pre-polymer from diphenylmethane diisocyanate (MDI), associated with a small fraction of polyol. The pre-polymer was named A 249 and the polyol as DF, the stoichiometric was 1:1.5, respectively. As a result, PU foam's performance was evaluated by reaction force versus deflection and energy versus deflection curves from DTS test. The parameters obtained such as crushing force, displacement, absorbed energy, restored energy, dissipated energy, restitution time and restitution coefficient showed that PU castor oil- based works as an excellent impact absorber, especially in situations that require a second impact after the first. The PU developed has high energy absorption capacity (>90%) and temporal restitution in order of 60 seconds, therefore it is ideal for impact absorption applications.

Short Biography:

I am a doctor in analytical chemistry. My specialties are analytical analysis, production and characterization of polyurethane, chemical modifications, natural products, antifouling coating, mechanical testing of materials and also teacher of chemistry.

Specialized by University of São Paulo, Institute of Chemistry of São Carlos, Brazil.

An Insight Into Ziegler–Natta Catalyst Active Site Distribution for Polyolefins: Application of Jitter Differential Evolution

Harshad R Patil*

Reliance Research and Development Centre, Reliance Corporate Park,
Reliance Industries Limited (RIL), Navi Mumbai, India

Abstract:

Most commercial polyolefins are made with heterogeneous Ziegler–Natta and metallocene catalysts with narrow to broad molecular weight distribution due to the presence of several active sites in the catalyst. We have carried out deconvolution of the molecular weight distribution (MWD) curves from gel permeation chromatography into distributions for individual active sites considering Flory distribution. Polyolefin from three different types of catalysts— (1) propylene and propylene/1-octene copolymer using MgCl2- supported Ti catalyst, (2) linear low-density polyethylene (LLDPE) by silica-supported Ti catalyst and (3) LLDPE by silica-supported metallocene catalyst—is considered for deconvolution studies. A robust jitter differential evolution (JDE) method-based computer algorithm is developed to deconvolute the MWD curves into various Flory distributions. The investigation gave insights on the active sites distribution, peak molecular weight, and ratio of termination to propagation rate of each active site. Our analysis has shown that five individual Flory distributions provide PP and LLDPE with better than a 99.9% degree of fit. We have also rolled out this deconvolution method with a simple Excel sheet-based input on a cloud-based interface. The results show that JDE approach is a powerful tool to decipher the role of catalyst active sites and correlate with polymer characteristics. The talk will also include few other examples of JDE application for Polyolefins.

Short Biography:

Dr Harshad R. Patil is Group Lead for the Polyolefin Process Development group at Polymer R&D Centre with Reliance Industries Limited, Navi Mumbai, India. He received his BTech in Chemical Engineering from MS University, Baroda, and Masters/PhD from SVNIT India. His work involves process development and scale-up of polyolefin catalysis and its systems at Reliance. He has been author/co-author on 21 research papers, inventor/coinventor on 15 patent inventions, and author of 1 book chapter. His research interests are in propylene/ ethylene polymerization and its improvement, process optimisation for ZN catalysts, process-product correlation studies for polyolefin and catalysis and polyolefins recycling.

Precision Injection Moulding of Polymer Micro-components: Determining Heat Transfer Coefficient and Process Simulation

Quanliang Su*, Nan Zhang and Michael D. Gilchrist

School of Mechanical & Materials Engineering, University College Dublin, Belfield, Dublin 4, Ireland

ABSTRACT:

In polymer melt processing, the heat transfer coefficient (HTC) determines heat flux across the polymer mould interface for both conventional and micro injection moulding (uIM), and is a key parameter in mould design and predictive computational simulations. However, values typically used in commercial software for injection moulding are usually obtained from large-scale experiments, which may not be appropriate for uIM. The present work will describe current work to calculate HTC in uIM and the influence of injection velocity, packing pressure and mould temperature on HTC. Experimentally calculated HTC values for the packing and cooling stages were approximately 8500 and 6300 W/m2K, respectively. Based on process monitoring from short shot experiments, subsequent simulation of a 600 um thick part was predicted successfully using multi-scale finite element modelling. Wall slip and venting parameters were optimised using a one-factor-at-a-time method, and a friction coefficient of 0 and no venting were found to be the optimal parameters for modelling wall slip and venting. Both are critical in simulations, although wall slip has a greater influence than venting on the simulation accuracy. The default and calculated HTC values were used in the simulations for comparison, while the simulations using the calculated HTC values were validated as being effective and accurate.

Separation of Liquid Mixtures Using Polymeric Membranes of Crosslinked PIM-1

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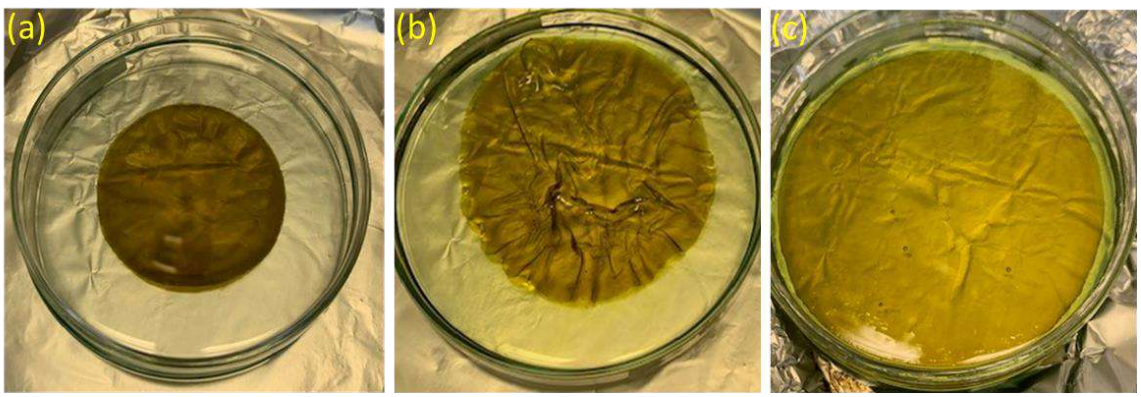
[b] *Department of Chemistry, College of Science and Arts, Qassim University, Ar Rass 52571, Saudi Arabia.*

Abstract:

Branched forms of the archetypal polymer of intrinsic microporosity PIM-1 may be crosslinked under ambient conditions by palladium (II) acetate. Branched PIM-1 can arise in polymerizations of 5,5′,6,6′-tetrahydroxy-3,3,3′,3′-tetramethyl-1,1′-spirobisindane with tetrafluoroterephthalonitrile conducted at a high set temperature (160 °C) under conditions, such as higher dilution, that lead to a lower temperature profile over the course of the reaction. Membranes of PIM-1 crosslinked with palladium acetate are sufficiently stable in organic solvents to be suitable for separation of miscible liquid organic mixtures. The crosslinked membranes are currently being investigated in pervaporation and perstraction studies, but can potentially be extended into other areas of liquid separation. The membranes give high separation factors in pervaporation of toluene/DMSO mixtures (around 10 with a 77 vol% toluene feed). However, detailed analysis shows that the membranes themselves are slightly selective for DMSO and that the separation is driven by the high driving force for toluene evaporation. In perstraction, the membranes proved to be practical for preferentially allowing phenol to be extracted from its aqueous solution by a stripping solvent.



Damage Analysis of Glass/Epoxy Composite on Varying the Matrix Weight Fraction under Low Velocity Impact & Flexural Loading

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[2]Defence Metallurgical Research Laboratory, DRDO, Hyderabad, Telangana, India

Abstract:

The glass/epoxy composite in two different matrix weight fractions were analyzed for damage that occurred during low velocity impact (LVI) testing and flexural testing. The drop weight impact test as per ASTM D7136 was conducted using 12.7 mm hemispherical steel projectile with a terminal velocity of 3.63 m/s at 35 J of impact energy for analyzing LVI behavior. The three point bending test was conducted as per ASTM 790 using 100 KN UTM and the results showed a positive effect on normalized load carrying capability and normalized flexural strength on increase in matrix content. The LVI results showed that load carrying capability decreases with increase in matrix weight percent and adequate fiber quantity in laminate is a must to maintain its structural integrity. The damage study also supported the post-LVI behavior reflected in force and energy time histories and force displacement curves. The posttest images were captured not only to investigate the failure modes and quantify damage surface morphology but also to compare the effect of varying the matrix weight percent. The damage in the form of matrix deformation & delamination was found during flexural loading but restricted around loading point in both cases. The lower matrix content laminate showed severe matrix deformation, fiber crushing and plus shape delamination as major energy absorbing mechanism during LVI at both impacted & non-impacted faces. Whereas, higher matrix content laminate did not absorb enough energy during LVI to avoid perforation possibly due to lack of minimum fiber content and absence of delamination. Keywords: low velocity impact, fiber-matrix ratio, delamination, damage morphology Short Biography: {Max words limit 100} Mr. Amit Kumar is Indian Scientist serving in Defence Research and Development Organization under Ministry of Defence, Government of India. He did B-Tech in Mechanical Engineering from Indian Institute of Technology (BHU) Varanasi and M-Tech from Indian Institute of Technology Kanpur. His broad area of interest are advanced composites for ballistic and blast applications, Impact problems and Joining Technologies etc. He is recipient of Laboratory Scientist of the year Award, Silicon Medal for oration at National Science Day & prestigious DRDO Agni Award. He has six granted patents, and 30+ technical reports & publications to his credits.

Poster Presentations

PHBV production by *Haloferax mediterranei* cell factory through agricultural wastes valorization

María Nicolás[a]*, Salvador García [a], María Salud Baeza[a], Rosa María Martínez-Espinosa [b,] Sergio Benitez [c]

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[b]*University of Alicante, San Vicente del Raspeig, Alicante, Spain*

Abstract:

Polyhydroxyalkanoates (PHA) are biobased and biodegradable biopolymers that can be accumulated intracellularly as energy sources by several bacteria and archaea under unfavourable conditions. However, its high production cost limits its commercial applications. On the other hand, organic waste valorization is a potential solution to reduce production costs, using these wastes as low-cost substrates. In this work, haloarchaeas were used as cell factories for PHA production, using agroindustrial by-products as carbon sources, following the circular economy strategy. Within the PHA polymers, the two most promising are Poly(3-hydroxybutyrate) (PHB) and Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV). Although PHB is synthesized by a considerable number of archaea and bacteria, PHBV is produced by a few microorganisms without employing precursors, one of which is *Haloferax mediterranei.* PHBV shows higher flexibility and is less crystalline than PHB. These properties enable the use of PHBV in applications such as biomedical or packaging.

In the Agro2circular (A2C) project framework, agroindustrial wastes, such as apple and lemon by-products, were tested as carbon sources to feed *Haloferax mediterranei*. As a result, this halophilic archaeon can produce PHBV under nutritional restrictions, accumulating up to 70% of PHBV in the biomass. Furthermore, the PHBV was extracted and purified; then, the PHBV presence was confirmed with FTIR. After the extraction process, the PHBV properties were characterized; thermal properties with Differential Scanning Calorimetry (DSC) and chemical composition with Nuclear magnetic resonance (NMR).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101036838.

Short Biography:

María Nicolás holds a degree in Biotechnology from the University of Valencia and a MSc in Industrial and Environmental Biotechnology. She is specialized in organic waste valorization and fermentative processes, and she is experienced in the research, development and optimization of circular economy and microbial bioprocesses from laboratory to pilot scale to obtain high-added value products.

Effects of Graphene on Bone Cement (PMMA-based) Curing Times

Jaime Orellana-Barrasa[a]*, Miguel Sánchez-Lozano[a,b], Fernando Calle[c], and José Ygnacio Pastor[a]

[a]*Departamento de Ciencia de Materiales-Centro de Investigación en Materiales Estructurales, Universidad Politécnicas de Madrid (UPM), Madrid, España*
[b]*Mechanical Engineering Department, University of California Santa Barbara, USA*
[c]*Departamento de Ingeniería Electrónica-ISOM, Universidad Politécnicas de Madrid (UPM), Madrid, España*

Abstract:

PMMA-based bone cement has limited durability due to the mechanical failure of the bone cement and its associated effects. However, it concerns the potential interaction between the initiator of the MMA polymerisation and the graphene. Graphene was a suitable material for improving the fracture toughness of the bone cement, h. In this work, we present the influence of several graphene additions on the curing time of PMMA-based bone cement.

Short Biography:

Jaime is PhD in Materials Science and Engineering specialised in the thermal and mechanical properties of polymeric and composite materials. He has graphene and polymers (PLA and PMMA) expertise for orthopaedics applications. He obtained his Dr. title with funds from the prestigious FPU national scholarship. Last year, he received the 1st National Award for the best engineering student career from the Government of Spain. He has done internships at the Massachusetts Institute of Technology (Boston, USA) and the Institute of Biomaterials (Erlangen, Germany) and worked at Granta (Cambridge, UK).

Polymer coated Silicone Urinary Catheters with Anti Fouling Properties

Jan Tejbrant* and Graeme Brookes, Per Wirsen, Serhiy Surkov

CytaCoat AB, Stockholm, Sweden

Abstract:

The risk of healthcare-associated infections (HAIs) when using catheters is a significant threat for patients and a huge cost to healthcare systems. Biofilm forms when clusters of bacteria attach to a surface and create a self-produced matrix, which shields them from antibiotics and the immune system. Biofilm is linked to 65% of all microbial infections and 80% of chronic infections (HAIs) and there is no effective coating to prevent biofilm on medical devices on the market. We have developed the CytaCoat® LIP Foley catheter which has a grafted and modified polymer surface that in laboratory experiments prevents biofilm formation. Bacteriological experimental data from several gram-positive and gram-negative bacteria will be presented.

The polymer surface is also much more slippery than the original catheter, this characteristic can offer improved ease of insertion and removal and greater patient comfort.
Clinical trials will start in Q-3 2023.

Short Biography:
Ph.D. from Stockholm University 1992, Solid Phase Synthesis of Glycopeptide, Post Doc. U of Minnesota under Prof. G. Barany 1993-94, Peptide Chemistry and protecting group chemistry.
Pharmacia 1995-2011 Medicinal Chemistry
Medivir AB 2012-2017 Medicinal Chemistry
Cytacoat AB 2018-Present, Chemist

Smart Hydrophilic Polymers with Multiple Sensitivity

Elena N. Danilovtseva*, Viktor A. Pal'shin, Stanislav N. Zelinskiy and Vadim V. Annenkov

Limnological Institute Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia

Abstract;

Smart hydrophilic polymers sensitive to temperature, pH, inorganic ions and light are promising substances for modeling biogenic systems and for biomedical and other applications. There are two main ways to obtain such polymers: i) design and polymerization of sophisticated monomers; ii) modification of relatively simple polymers. The first method assumes the use of complex monomers containing various active groups, such as double bonds, basic and acidic moieties, and a light-sensitive fragment. These groups can interfere with each other and be unpredictable during polymerization. The latter approach allows many complex systems to be obtained from a single polymer matrix.

We obtained a set of smart water-soluble polymers and gels, starting with poly(acryloyl chloride), vinyl amine homopolymer and its copolymers. The main modifiers were di- and triamines, unsaturated acrylates. Alkyl substituents, amine and carboxyl groups provided temperature and pH sensitivity. Photosensitive groups (hexaaryl biimidazole, o-nitrobenzene derivatives, etc.) were responsible for removing side substituents from the polymer chain or destroying cross-links in hydrogels. Possible applications of new polymers in the bio-medical area are discussed.

We acknowledge financial support from the Russian Science Foundation (grant # 22-15-00268).

Short Biography:

Elena Danilovtseva was graduated from the Department of Chemistry, Irkutsk State University, Russia in 1984. She received her Ph.D. in Macromolecular Science from the Institute of Chemical Sciences, Almaty, Kazakstan in 1991. She is a Senior researcher in Limnological Institute SB RAS, Irkutsk, Russia. She is author of near 110 scientific papers and 12 patents. Her scientific interests include synthesis and properties of water-soluble polymers; complexes of polymers with metal ions; molecular mechanisms of biosilicification; biomimetic methods for the preparation of nanoparticles and hybrid materials; design of functionalized coatings; application of fluorescent compounds in study of living organisms.

Oxepine-Based π-Conjugated Ladder Polymer

Nathan Man-Wai Wu*, Molly Warndorf, and Timothy M. Swager

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Abstract:

π-Conjugated ladder polymer, in which the repeating unit consists of continuously π-conjugated ring-fused backbone in the polymer chain, has been regarded as a promising candidate of functional materials for potential applications, including organic light emitting diodes (OLEDs) and organic field effect transistors (OFETs). Despite its intriguing properties, the limited synthetic strategy, synthetic challenge and poor solubility have hindered the development of π-conjugated ladder polymer. Among various synthetic methods, Swager's group has pioneered the highly efficient acid-induced electrophilic cyclization reaction associated with the formation of six-membered ring as a post-polymerization modification to realize the synthesis of π-conjugated ladder polymer. Oxepine is a non-planar π-conjugated seven-membered heterocycle. The exploration of oxepine as functional materials is extremely rare, not to mention the incorporation of oxepine ring into the polymer. With the enduring interest in exploring π-conjugated ladder polymer with interesting properties, we have successfully synthesized the oxepine-based π-conjugated ladder polymer (**P1-c**) *via* the acid-induced electrophilic cyclization reaction of the poly(arylene ether) (**P1**), which was prepared by the step-growth nucleophilic aromatic substitution (S_NAr) polymerization.

Short Biography:

Nathan received the PhD degree in Inorganic, Organometallic and Materials Chemistry in 2019 at the University of Hong Kong under the supervision of Prof. Vivian W.-W. Yam. His research interest during the PhD study has focused on the development of novel photochromic organic and organometallic materials with photo-controllable functions.

After his PhD study, Nathan continued his research in photo-responsive materials as a Postdoctoral Research Fellow in the same research group from 2019-2021.

More recently, Nathan has joined the research group of Prof. Timothy M. Swager at MIT in March 2022 as a Postdoctoral Fellow, supported by the Croucher Foundation Fellowships.

Birch Outer Bark Extraction Residue as a Feedstock to Replace Synthetic Polymer Constituents

Janis Rizikovs*[a], Aigars Paze[a], Daniela Godina[a], Raimonds Makars[b], Guntis Sosins[b], Arnis Abolins[a]

[a] *Latvian State Institute of Wood Chemistry, Riga, Latvia*
[b] *PolyLabs SIA, Riga, Latvia*

Abstract:

Due to a high content of valuable extractives and natural polymer suberin, the birch outer bark after extraction has a high potential in circular bio-economy. Suberin is a complex polyester, consisting of linear polyfunctional long-chain fatty acids and glycerine, which is linked by covalent bonds to lignin-like monomer polyphenols. Extracted birch outer bark contains up to 60% of suberin and after depolymerizing in an alkaline environment, a mixture of suberinic acids (SA) is obtained. To set the parameters for the SA isolation process, different depolymerization solvents, acidification pH levels and SA drying temperatures were tested. In order to determine the chemical properties of obtained SA samples, total phenolic content, total amount of hexoses, acid number, saponification number, epoxy groups and hydroxyl number were determined. Four instrumental methods were developed using DSC, FTIR, GC-MS and SEC-RID to characterize both monomeric fraction as well as polymeric fraction present in SA samples. Depolymerized SA can be considered as an alternative resource to develop bio-polyols that can be further used in polymeric material production. Also solution of SA can be used for bulk wood impregnation to improve water resistance. While the side-stream product (residue) from obtaining SA for polyol synthesis together with lignocarbohydrate complex has moisture resistant wood adhesive properties.

Short Biography:

Head of Biorefinery laboratory, leading researcher and chair of the scientific council of Latvian State Institute of Wood Chemistry. More than 20 years in biorefinery science. Research related to several chemical, thermal and physical processing technologies to obtain high value-added products form lignocellulosic biomass by-products through interdisciplinary approaches – activated carbon, wood-based composites, extractives (emulsifiers, antioxidants and preservatives), ecological adhesive systems, polymeric building blocks for polyols, coatings and impregnation. Development of laboratory technologies and finding the scale-up solutions.

Polymeric Binders for Metal Injection Molding: Simulation Studies

Isabel Lado-Touriño*, Alicia Páez-Pavón, Rosario G. Merodio-Perea and Raquel Páez-Pavón

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Abstract:

Metal Injection Molding is a manufacturing process that allows the production of small and complex metal parts in large quantities. The metallic powder used in this process must be blended with a polymeric binder to make it more fluid inside the injector barrel and hold its particles together until sintering. There are several types of polymeric binders, among which are wax/polymer compounds. Waxes provide fluidity, while part dimensional stability is given by polymers. In the present work, molecular dynamics simulations were carried out to study the compatibility of a binder made of polyethylene (PE) and octadecane. Figure 1 shows some of the models used to analyze the miscibility of these two compounds. Figure 1. Models of small oligomers of PE (left) and PE/octadecane blends (right). The compatibility of both components, which is crucial to formulate an efficient binder, was studied as a function of PE structure and binder composition at two different temperatures, below and above the melting points of PE and octadecane. Flory−Huggins theory was applied to analyze the results, which show a strong dependence on temperature and polymer structure. Short Biography: Isabel Lado-Touriño holds a PhD in Chemistry and currently works as an Associate Professor at the Industrial Engineering Department of Universidad Europea de Madrid (Spain). Her research interests include molecular simulations of organic and inorganic nanomaterials and polymers using molecular mechanics, molecular dynamics and density functional theory methods.

A Study on the Bonding Performance of Steel-polymer Hybrid Materials Under Vehicle Driving Temperature Conditions

Jinho Park[1]*, Dong Woo Kang[1] and Beom-Gon Cho[1]

[1]*Chemical Materials R&D Department, Chassis & Materials Research Laboratory, Korea Automotive Technology Institute (KATECH), 303 Pungse-myeon, Dongnam-gu, Cheonan-si, Chungcheongnam-do, 31214, Republic of Korea*

Abstract:

In this study, predicted the life of steel-polymer hybrid automotive parts through a study on the durability performance of joints under vehicle driving temperature conditions due to the difference in thermal expansion coefficient between steel and polymers. Rheometer, differential scanning calorimetry (DSC), thermomechanical analysis (TMA), dynamic mechanical analysis (DMA) and tensile properties of various polymers with different thermal expansion coefficient (High density polyethylene (HDPE), Polyamide66 (PA66), PA66+Glass fiber (GF), Polyphenylene sulfide (PPS)) were analyzed. Afterwards, thermal stress analysis through finite element analysis of the steel-polymer hybrid material specimens predicted the steel-polymer interface behavior according to temperature changes. And the bonding strength of steel-polymer hybrid specimens produced by insert injection molding, bonding strength after high-temperature aging tests, and bonding strength after thermal shock tests was evaluated to confirm the difference with the analysis results. All steel-polymer hybrid materials were decreased in bonding strength after high-temperature aging and thermal shock tests. Also depending on the difference in thermal expansion coefficient, there was a difference in the rate of decrease in bonding strength after the thermal shock test. It was confirmed that the lower the difference in thermal expansion coefficient between the materials, the lower the decrease rate of the bonding strength according to the thermal shock test. Through this results, it is possible to predict the life of automobile parts made of steelpolymer hybrid materials according to the thermal expansion coefficient of the polymers. Short Biography: Jinho Park is currently working at the Korea automotive institute. Also he worked for the Toray advanced materials korea from 2017 to 2019, and the Hanwha solutions from 2019 to 2021. The research topic is the light weight composite for automobile parts and the hydrogen storage tank.

A Study on Miscibility Properties of Polyacrylonitrile Blending Films with Biodegradable Polymer, Shellac

Beom-Gon Cho*[,a] , Seo-Hwa Hong[a] and Han Gi Chae[b]

[a]*Chemical Materials R&D Department/Korea Automotive Technology Institute (KATECH), Cheonan-si, Republic of Korea*
[b]*School of Materials and Science and Engineering/Ulsan National Institute of Science and Technology (UNIST), Ulsan, Republic of Korea*

Abstract:

Polyacrylonitrile (PAN) films blended with shellac, biodegradable polymer, were prepared via simple solution casting method. The miscibility of PAN with shellac polymer was investigated and the optimal concentration of shellac in terms of hydrogen bonding between shellac and PAN chain was determined to be used as a novel biomass carbon precursor. Shellac and PAN chain could exert interaction and the interaction facilitates to loose the crystalline structure of the PAN chain, suggesting that the decrease of the oxidation temperature of the PAN chain in the PAN/shellac blends film by the introduction of shellac segments. The optimal PAN/shellac blends film exhibited outstanding mechanical performances (73.8 % higher tensile strength, 60 % higher storage modulus compared with control PAN film) showing homogeneous blending state.

Short Biography:

Beom-Gon Cho, a senior researcher currently works at the Chemical Materials R&D Department, Korea Automotive Technology Institute in Korea. He got a doctor degree in mechanical engineering department in UNIST and studied interphase strengthening of thermoplastic based carbon fiber composites with various surface modification. Meanwhile, nowadays, it being covered that development of lightweight biomaterials-based composites for automotive at KATECH.

Preparation of Polyimide/Silica Sol Nanocomposite Coatings with High Transparency and Self-cleaning Properties

Yun-Je Choi and Chan-Moon Chung*

Department of Chemistry, Yonsei University, Wonju, Gangwon-do 26493, Republic of Korea

Abstract:

When water droplets contact a dirt-contaminated superhydrophobic surface, the dirt particles are carried away from the surface by rolling water droplets. It means that the superhydrophobic surface has self-cleaning property. Such superhydrophobic coating surfaces find applications not only in self-cleaning, but also in anti-fouling, anti-corrosion, anti-icing, and anti-freezing. If the superhydrophobic coatings are even transparent, the range of possible application could be expanded to window and door glasses, skyscrapers, goggles, windshields, and solar cell panels. In this study, colorless polyimide/silica sol nanocomposite (CPIS) with high transparency and self-cleaning property were prepared. CPIS showed a high transmittance value (82-88%) at 550 nm. It was observed using SEM and AFM that their hydrophobic and self-cleaning properties are due to uniform silica particle distribution and relatively high surface roughness. Also, self-cleaning property was confirmed experimentally.

Short Biography:

As a dedicated Ph.D. candidate in Yonsei University, Yun-Je Choi is on an extraordinary journey, navigating the challenges and triumphs that accompany the pursuit of an advanced academic degree. His major is polymer chemistry, specific research focuses on study of polyimide, aiming to uncover new insights, address critical questions, or propose innovative solutions within their chosen domain. While on PhD journey, Yun-Je Choi has already achieved noteworthy milestones. Representatively, he published a paper on self-cleaning polyimide and eco-friendly polyimide research (Polymers 2021, 13(23), 4100/ACS Sustainable Chem. Eng. 2022, 10, 5, 1910–1919/Composites Part A, 166 ,2023, 107396).

The Effects of Different Physical Fields on Swelling Kinetics of PMAA-LTA Zeolite Composite Hydrogel Under Controlled Isothermal Conditions

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[a]*Institute for General and Physical Chemistry, Belgrade, Serbia*
[b]*Univertsity of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy, Belgrade, Serbia*
[c]*University of Kragujevac, Faculty of Technical Sciences, Cacak, Serbia*
[d]*University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia*
[e]*University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia*

Abstract:

Composite hydrogels are the subject of intensive research due to there specific 3D cross-linked structure with extraordinary physical and chemical properties which enables variety of applications In spite of increasing interest for using different external fields in physical-chemical processes, three are no available literature data about the effects of external fields on swelling and swelling kinetics of hydrogels. Therefore, the effects of (conventional) thermal (TH), ultrasonic (US) and microwave (MW) fields, on the swelling degree and swelling kinetics. A sample of poly(methacrylic acid) (PMAA) xerogel with 10%wt of LTA-zeolite (PMMA-LTA) was synthesized and thoroughly characterized. The isothermal kinetic swelling curves were determined within a temperature range T= 293-323K in the TH, US and MW fields. The results were well fitted with the Peppas' kinetic model. At all applied fields, with an increase in temperature, there is an increase in the equilibrium swelling degree (SDeq) and the swelling rate constant (k), while the parameter of Pepass's model (n) decreases. The maximum value of SDeq and parameter n is achieved at TH, while the US assisted process leads to the maximum value of k. The minimum value of the activation energy (Ea) and at the same time the maximum value of the pre-exponential factor (lnA) lnA were achieved by applying the MW field. The influence of US and MW fields on the diffusion of water molecules through the polymer network, activation of the polymer network for swelling and relaxation of the polymer network was analysed.

Short Biography:

Dr Jelena Jovanovic is a research professor at Institute of General and Physical Chemistry in Belgrade, Serbia. Dr J. Jovanovic has extensive career which covers several areas: advanced and smart materials, polymers, composites, hydrogels, poly(siloxanes), synthesis and polymerizations, and physicochemical processes (adsorption, extraction, swelling, dehydration, drug-release) both under conventional and non-conventional conditions (microwaves, ultrasonic, cavitation). Hydrogels are within the topic of her interest along with the effects of external fields on the reaction kinetics. She worked on novel methods of kinetics analyzes. Dr J. Jovanovic gained extensive international experience working on international projects and stayed abroad several times.

Direct in-situ polymerization to produce Polycaprolactone/Montmorillonite nanocomposite

Amine Harrane*, Mahmoud Belalia

Departement of Chemistry, Faculty of Exact Sciences and Computer,University of Abdelhamid Ibnbadis Mostaganem, Algeria

Abstract:

During the last decade, polymer layered silicate nanocomposites have received increasing attention from scientists and industrial researchers, because they generally exhibit greatly improved mechanical, thermal, barrier and flame-retardant properties at low clay content in comparison with unfilled polymers or more conventional microcomposites.

Poly(ε-caprolactone) (PCL)-layered silicate nanocomposites have the advantage of adding biocompatibility and biodegradability to the traditional properties of nanocomposites. They can be prepared by in situ ring-opening polymerization of ε-caprolactone using conventional initiator to induce polymerization in the presence of an organophilic clay, such as organomodified montmorillonite.

Messersmith and Giannelis used montmorillonite exchanged with protonated 12-aminododecanoic acid and Cr3+ exchanged fluorohectorite, a synthetic mica type of silicate. Sn-based catalysts such as tin (II) octoate and dibutyltin (IV) dimethoxide have been reported to efficiently promote the polymerization of ε-caprolactone in the presence of organomodified clays.

Previously we reported the synthesis of PCL using proton-exchanged montmorillonite clay, called Maghnite-H+, to induce the reaction of polymerization.

In this work, we have used an alternative method to prepare PCL/montmorillonite nanocomposites. The cationic polymerization of ε-caprolactone was initiated directly by Maghnite-TOA, organomodified montmorillonite clay, to produce nanocomposites (Scheme 1). Resulted nanocomposites were characterized by X-ray diffraction (XRD) (figure 1), transmission electron microscopy (TEM) (figure 2), force atomic microscopy (AFM) and thermogravimetry.

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- A. Harrane, R. Meghabar and M. Belbachir, Designed Monomers Polymers 8, 11 (2005)

Short Biography:

I am Professor of polymer chemistry in the university of Mostaganem- Algeria. Beside of my teaching activities in chemistry and supervisory of master and doctoral theses, I am currently a leader of a research team and the co-director of international research projects. My research field is focused on the development of new green materials such as nanocomposites obtained from natural and biodegradable polymers combined with modified clay. Modification of biodegradables polymers with natural substances like extracted resins from pine trees to obtain new material with antibacterial properties, for biomedical and food packaging application

Production of Low-density Nanocellular Foam Based on PMMA/PEBAX Blends

Nigus Maregu Demewoz* and Shu-Kai Yeh

Department of Materials Science and Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, Republic of China

Abstract:

Low-density nanocellular foam is a fascinating new-generation advanced material due to its mechanical strength and thermal insulation properties. In nanocellular foam, reducing the density increases the insulation ability. However, producing a nanocellular foam of densities less than 0.3 with a cell size of less than 100 nm is very challenging. In this study, poly (methyl methacrylate) (PMMA) was blended with Polyether block amide (PEBAX) to study the effects of PEBAX on the nanocellular foam structure of the PMMA matrix. We added 2 wt% of PEBAX in the PMMA matrix, and the PEBAX nanostructured domain size of 45 nm was well dispersed in the PMMA matrix. The foaming result produced a new generation special bouquet-like nanocellular foam of cell size less than 50 nm with a relative density of 0.24. Also, we were able to produce a nanocellular foam of a relative density of about 0.17. In addition to thermal insulation applications, bouquet-like nanocellular foam may be expected for filtration applications. Keywords: nanocellular foam, low-density, cell size, relative density, PMMA/PEBAX

Natural and Recyclable Alginate Hydrogels as Extracting Media for Recovering Valuable Metals of Spent Lithium-ion Batteries from a Deep Eutectic Solvent

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Abstract:

Portable devices and electrical vehicles have introduced rocket-like increase of lithium-ion batteries (LIBs) into global market, stimulating the awareness of recycling LIB from both industries and academia. Deep eutectic solvent (DES), composed of choline chloride and ethylene glycol, is proved to be an ideal leaching reagent for spent LIB cathodes with the benefit of biodegradability, recyclability, low viscosity, and especially selectivity toward Ni, Co and Mn[1]. However, the comparatively high price of the DES makes reuse mandatory for its further application. To make the loaded DES functional again, the metals cations in the leachate must be first extracted. Electrodeposition[2] and solvent separation[1] have been investigated, however, they are energy consuming and complicated, respectively. The present work managed to utilize alginate hydrogels, a natural recyclable biopolymer, as adsorbents to extract cobalt from the DES, which is low-cost, safe, and easy to scale up. DES can be reused after the eutectic state recreation with a performance over 80 % with respect to the pristine DES. Calcium cross-linked sodium alginate hydrogels, which were immersed in ethylene glycol and dehydrated afterwards, were able to extract cobalt from the leachate with an efficiency of 92 %. The aforementioned hydrogels can be reused after desorption and reach 91 % of the performance of the pristine ones. The DES together with alginate hydrogel brings therefore a highly efficient and reusable close-loop recycling method.

Short Biography:

Yifeng Wang: Pre-doc in BCmaterials (Spain), co-supervised by Prof. Qi Zhang and Dr. Eider Goikolea. Master of science in Advanced Material from Cranfield University (UK), Bachelor degree in Mechanical Design and Manufacturing from Hunan University (China)

Reference:

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Insight and Comparison of Property Improvement in LTA and MFI Zeolite Reinforced Poly(methacrylic acid) Highly Concentrated Composite Hydrogels

Vesna V. Panic[a]*, Jelena D. Jovanovic[b], Sanja I. Savic[c], Maja D. Markovic[a], Aleksandra M. Radulovic[b], Olga Pantic[c], Borivoj K. Adnadjevic[d]

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Abstract:

The preparation of zeolite rich polymeric materials presents a challenge due to the zeolite settling during synthesis, poor miscibility, the phase separation and generally insufficient interactions between polymers and zeolites. Combination of LTA, i.e. MFI, zeolite and poly(methacrylic acid) in the form of soft hydrogel network provided the stabilization of the zeolite particles and enabled synthesis of composite hydrogels with very high zeolite concentrations (26-52 mass%).

The investigated morphological, mechanical and primary structural properties, water swelling ability and thermal stability revealed high dependence on zeolite concentration and type. Zeolite particles were uniformly dispersed in PMAA matrix as confirmed by SEM and there was no agglomeration or zeolite leaching despite very high concentrations. FTIR spectra disclosed the existence of functional groups of PMAA network and both zeolite types that interacted mutually and led to increased crosslinking density. The established interactions changed the PMAA chain dynamics around the particles, especially of the LTA type, as showed by XRD. Having much more surface groups capable to generate interaction with PMAA, LTA zeolite stronger affected all of the investigated properties.
Composites' mechanics was improved both in dry and swollen state compared to the PMAA hydrogel (up to 21.8 times for the sample with the highest LTA concentration). Thermal stability of the composites increased with increasing zeolite concentration.

The composition-property correlations were determined making this work the base for further development of tailor-made zeolite-PMAA composite hydrogels aimed for specific application. Composites were tested as low-cost, regenerative, environmentally friendly sorbents and showed better removal of cationic dye compared to both components (PMAA and zeolite) alone.

Short Biography:

Vesna V. Panic, PhD in Chemical Engineering, was born in 1982 in Belgrade, Serbia. She graduated and earned her PhD in Chemistry and Chemical Technology- Polymer Engineering, at the Faculty of Technology and Metallurgy, University of Belgrade.

Currently, she is employed as an Associate Research Professor at the Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade, where she is working on the diverse academic and industrial projects related to the development of the polymeric materials modified with inorganic and organic (nano)fillers (zeolite, hydroxyapatite, proteins, etc.) in order to achieve better properties or some new features. She is married and a mother of three amazing kids.

New Perspectives for ORR Electrocatalysts: Challenges and Opportunities of Graphene-based Materials

Adriana Marinoiu*

National Research and Development Institute for Cryogenic and Isotopic Technologies, Rm Valcea, Romania

Abstract:

Fuel cells, the most promising power sources for stationary and portable electronic devices, represent an alternative for decentralized energy production and long-distance transport, with applications already successfully employed in automotive, aerospace, and maritime transportation. Proton exchange membrane fuel cells (PEMFCs) demonstrated relevant advantages such as renewable source with very low emissions, low operating temperature, high energy efficiency and modularity. The core of PEMFC architecture consists of three major components that form the membrane electrode assembly (MEA): the anode (fuel oxidation site), polymeric proton-exchange membrane (typically Nafion, a sulfonated tetrafluoroethylene-based fluoropolymer-copolymer), and cathode (oxygen reduction site). From the applied research level, we expect the development of an innovative generation of electrocatalysts with improved stability and decreased Pt content optimized to be used in PEM FC, together with improved technologies for their preparation, their deposition on membrane for MEAs obtaining.

The graphene-based materials demonstrated superior properties up to date, such as large surface area and porosity, excellent electrical conductivity, and interconnected pore structures. Through these properties, graphene-based materials not only provide more anchor sites to immobilize metal nanoparticles but also could improve the mass transport of reactants. Since the cost is a key factor that influences the manufacturing of ORR electrodes for real PEMFC, Metal-free, PGM-free, or low-PGM graphene-based electrocatalysts are regarded as a great opportunity to replace the high-cost Pt/C-based catalysts.

Acknowledgments:

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Short Biography:

Dr. Adriana Marinoiu is the Group Coordinator for “Materials for Hydrogen Energy - Mat4H”, ICSI ENERGY, ICSI Ramnicu-Valcea, Romania. Her research area is related to proton exchange membrane fuel cells and related catalysts for energy systems. Her research contributions include: development of new synthesis methods for graphene-based materials decorated with noble and non-noble metal nanoparticles; electrodes manufacturing; catalysts deposition methods; methods of manufacturing membrane-electrode assemblies; polymeric membrane characterization via protonic conductivity; ORR electrocatalysts characterization.

Amine Grafted Poly(acrylic-maleic) for Stainless Steel Corrosion Inhibition

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1 Department of Chemistry, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia.
2 Saudi Aramco, EXPEC Advanced Research Center, Dhahran 31311

Abstract:

The oil and gas value chain is mostly constructed of steel, with carbon steel being the most often used type due to its durability, reasonable cost and easily available. However, carbon steel is prone to corrosion. Corrosion cannot be completely stopped since it tends to turn metal into minerals or oxides, returning it to its original mixed state. Silica-based nanoparticles are produced from well-known physical and chemical characteristics and moreover modification to their structure can be obtained to have various properties from hydrophilicity to hydrophobicity and hence improve their performance. Nanosilica-based material improved the corrosion effectiveness that address the efficient material requirement. Additionally, their surface area can be easily modified with numerous functionalities resulting in a high affinity for the metal surface. As an example, silanization which produces (Si–O–Si) linkage produces material that can tolerate the high temperatures and thus can be a suitable candidate as inhibitors for harsh conditions. In this work, we synthesized modified silica-based inhibitor using thermal treatment procedure. The inhibitor consists of silica nanoparticles grafted with hydrophobic branches and amines; using triethoxysilane (TS), tetraethoxy orthosilicate (TEOS), and 3-(aminopropyl)trimethoxysilane (APTMS). The synthesized material showed good corrosion inhibition performance as indicated by the weight loss measurements.

Biography

Bader Alharbi joined Saudi Aramco in 2006 as a petroleum engineer. He graduated with BSc degree in chemical engineering and MSc in petroleum engineering, both from king Fahd University of Petroleum and Minerals. He holds PhD degree in petroleum engineering from Heriot Watt University. His research interest includes well stimulation and corrosion and scale mitigation. Bader authored and coauthored more than 35 journal and conference papers and more than 25 patents.

Valorization of Plastic and Cork Wastes in the Production of New Composite Materials

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University of Corsica Pasqual Paoli– CNRS UMR 6134 SPE, Campus Grimaldi, BP 52, 20250 Corte, France

Abstract:

Plastics are a revolutionary material widespread in everyday life [1]. However, the pollution caused by plastics damages the environment, human health and the economy of different countries. The large volume of plastics requires strategies to improve the valorization of the waste generated after consumption in order to minimize impacts [2]. In this study, a new composite material based on PP and HDPE waste from bottle caps and cork powder from unused cork (virgin cork) was developed, which has a high capacity for thermal insulation. The composites were prepared with virgin and modified cork.

The composite materials were obtained through twin-screw extrusion and injection molding. These materials were produced with proportions of 0 %, 5 %, 10 %, 15 %, and 20 % of cork powder in a polymer matrix (PP or HDPE). These composites were investigated in terms of mechanical, structural and thermal properties. The results showed that the addition of cork powder in the polymer matrix reduced the density of the composites. However, the incorporation of natural additive doesn't have a significant effect on the water adsorption. Regarding the mechanical properties, the value of tensile strength decreases with the addition of cork powder ranging from 30 MPa to 19 MPa for PP composites and from 19 MPa to 17 MPa for HDPE composites. Evaluation of the flammability of the composites was performed using a cone calorimeter. The results of thermal analysis and fire tests show that it is important to add flame retardants to improve fire resistance. The feasibility of the composites based on cork and PP and HDPE wastes opens new ways of valorization of plastic waste and virgin cork.

Short Biography:

Svetlana PETLITCKAIA is a Postdoctoral in material science at the University of Corsica Pascal Paoli. She holds a PhD in condensed matter physics from University of Montpellier in 2018. Her research interests include the composite materials.

Recycling and Refund of PET and Aluminum packaging – The REAP project

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[c]*Aveiro Institute of Materials (CICECO), University of Aveiro, Portugal*
[d] *TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Aveiro, Portugal*

Abstract:

The University of Aveiro (UA), located in Portugal, applied to the Environment, Climate Change and Low Carbon Economy Program promoted by the General Secretariat for the Environment and Climate Action to implement the REAP project. REAP stands for Recycling and Refund of PET and Aluminium Packaging. One of the major goals was to reimburse the UA community for each polyethylene terephthalate (PET) bottle or aluminium can that they deposit, to ensure social awareness for recycling and sustainability. Several collecting and refunding equipment were installed at the UA campus and polytechnical schools. Dedicated collecting systems were necessary to recycle the post-consumer PET bottles and cans. Another main goal was to provide a “second life” to the collected bottles and cans. Additive manufacturing (AM) and blow moulding were the 2 technologies selected for the reuse of recycled PET (rPET) bottles. Fused filament fabrication, an AM technique, was explored through the preparation of filaments with a recycled content of up to 100 %. Mechanical, thermal, morphological, rheological and chemical analyses were conducted on the developed filaments and printed specimens. In the case of blow moulding, it was initially injected preforms and then blown into water bottles (20 cl). A recycled content of up to 50% (w/w) was explored. The blown ability, dimensional stability and reproducibility were investigated. The REAP project led to the development of rPETbased material solutions allied with increased social awareness for sustainable practices of the UA community. Short Biography: {Max words limit 100} Sara Magalhães da Silva is a Junior researcher at CICECO - Aveiro Institute of Materials. In 2021, she obtained her PhD degree in Materials Engineering from the University of Aveiro (Portugal). Her research is focused on the development of cork-based materials adapted for injection moulding; the development of biobased thermoplastic materials; and, the development of new biobased materials adapted to additive manufacturing technologies (extrusion and powder-based). Sara Silva has published 13 papers in international peer-reviewed multidisciplinary high-impact journals plus 3 conference papers, +310 citations (h-index 7), presented at 40 poster/oral national/international conferences, and is a referee in 3 journals.

Influence of Expanded Graphite on Fire Hazard Parameters Composites of EPDM Rubber

Przemysław Rybiński

Jan Kochanowski University, Institute of Chemistry, Kielce, Poland

Abstract:

The paper presents research results on the influence of expanded graphite, also in a synergistic system with an organic organophosphorus compound, on the fire hazard of EPDM rubber composites. Fire hazard is understood as flammability, smoke emission, but also the amount of toxic gases, including gases from the group of carcinogens such as PAHs or PCDDs/Fs.

The obtained test results showed that expanding graphite, by creating an intumescent boundary layer, effectively reduces both the flammability of the tested composite as well as smoke emission.
Reduction of smoke emissions, which is a carrier of organic toxic compounds, results in reduced emissions of both PAHs and PCDDs/Fs.

A radical increase in the fire resistance of the tested composites was achieved as a result of the synergistic action of expanding graphite and melamine polyphosphate (MPP). The introduction of an additional component to the elastomer mixture in the form of MPP does not increase the amount of toxic gases from the PAH and PCDDs/Fs groups.

EPDM composites containing the expanding graphite-MPP system are characterized by good mechanical parameters (elongation at break, tear strength, as well as elongation at break).

Short Biography:

Przemysław Rybiński works at the Jan Kochanowski University in Kielce as a professor. Przemysław Rybiński's scientific interests concern issues related to thermal stability and fire hazard of polymer composites and nanocomposites.

Valorization of Marine Residues for Textile Application

Sandra Sampaio[a]*, Carolina Barros[a] and Renato Reis[a]

[a]*PIEP - Pólo de Inovação em Engenharia de Polímeros,4800-058 Guimarães, Portugal*

Abstract:

The large amount of oceans plastics waste produced makes imperative the search for alternative procedures for recycling these materials, since they are not biodegradable. Abandoned, lost or discarded fishing nets represents one of the largest parts of marine waste in the oceans. The objective of this work is to utilize oceans waste plastics, from fishing nets, after remove contaminations by washing and to reduce the size of the material by shredding, and transform it into new products. Therefore, recovered fishing nets, from a supplier in Portugal, was used. The main component of the recovered fishing nets is the polyamide 6 (rPA6), as analysed by FTIR, DSC and selective dissolution in formic acid, and its composition is 98 % of rPA6 and 2 % of contaminations. Different kinds of mixtures were produced through twin screw extrusion process: a mixture of neat rPA6, a mixture of neat rPA6 further washed, a nanocomposite with rPA6 and 0,2 % of chain extender (EC), a nanocomposite with rPA6 and 1 % of EC, a nanocomposite with rPA6 and 1 % of EC and with 2% nanopartículas de dióxido de titânio (TiO2), and a nanocomposite with rPA6 and 1 % of EC and with 4% TiO2. Two tests were performed, melt flow index (MFI) to check rheology and material degradation and tensile tests to study mechanical strength of the materials. By knowing the material properties for every recycled batch, it will be easier to match it to textile product applications.

Short Biography:

S Sampaio completed a PhD degree in Textile Chemistry and Biotechnology at De Montfort University, England in 2002. She was awarded a post-doctoral fellowship in 2003 at Stazione Sperimentale per la Seta, Italy, and at 3B's Research Group, University of Minho. In 2008 she worked at Centre for Textile Science and Technology, University of Minho. In 2012 she was invited to create a start-up company from Minho University. In 2017 she worked as a post-doctoral fellow at IPC, Polymer Engineering Department, University of Minho. And currently, she is working at PIEP (Pólo de Inovação em Engenharia de Polímeros). Her expertise is in natural and synthetic materials for textile and plastic industry applications, synthesis of green metallic nanoparticles and in functionalizing silica nanoparticles with many active properties such as hydrophobic, antibacterial, UV protection, etc.

Plenary Presentations

Moisture Kinetics and Long-Term Durability of Ambient Cured Polymer Composites

Vistasp M. Karbhari*

[*]Department of Civil Engineering & Department of Mechanical and Aerospace Engineering; University of Texas at Arlington; Arlington; Texas, USA 76019

Abstract:

Ambient/moderate temperature cure non autoclave processed fiber reinforced composites are increasingly used for applications in the civil, naval, and offshore sectors due to their greater ease of fabrication, high specific performance attributes and tailorability. The non-corrosive nature and potential high durability make them attractive for applications requiring long service lives with low maintenance in harsh and changing environments that often include varying levels of humidity and immersion in water and/or seawater in addition to temperature variations. This paper discusses the development and use of a two-stage uptake model that includes determination of the traditional diffusion coefficient and also the inclusion of a relaxation/deterioration term and links phenomena directly to stages and ratios of moisture uptake. This is then used to determine long-term durability based on moisture uptake and its effects on the composite providing a greater level of mechanistic understanding and ability to consider the probability of failure over extended periods of use thereby enabling better and more effective designs.

Short Biography:

Vistasp M. Karbhari is a Professor in the Departments of Civil Engineering, and Mechanical and Aerospace Engineering, at the University of Texas at Arlington. An internationally reputed researcher, Prof. Karbhari is an expert in the processing and mechanics of composites, durability of materials, infrastructure rehabilitation, and multi-threat mitigation. He is a fellow of the American Association for the Advancement of Science (AAAS); the National Academy of Inventors (NAI); the American Society of Civil Engineers; ASM International; the International Institute for Fiber-reinforced Polymers in Construction; the International Society for Structural Health Monitoring of Intelligent Infrastructure; ASCE's Structural Engineering Institute and is an elected member of the European Academy of Science and Arts.

ChAgG-PCL/PVP Electrospun Fibers and their Potential Application as Wound Dressing

Luis Jesús Villarreal Gómez[*1,2], Yoxkin Estévez Martínez[3*], Victoria Leonor Reyes Guzmán[1], Yesica Itzel Méndez Ramírez[3], Juan Antonio Páz González[1], Arturo Zizumbo López[3,] Hugo Borbón[5], Eder Germán Lizarraga Medina[1], José Manuel Cornejo Bravo[1], Graciela Lizeth Pérez González[1,2], Arturo Sinue Ontiveros Zepeda[7], Armando Pérez Sánchez[1], Elizabeth Chavira-Martínez[4]

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[7]Facultad de Ciencias de la Ingeniería, Administrativa y Sociales, Universidad Autónoma de Baja California, Tecate, Baja California, México

Abstract:

Wound dressings have been used to clean, cover, and protect the wound from the external environment. However, choosing an adequate dressing will reduce the time of healing, provide cost-effective care, and improve the patient's quality of life. Electrospun fibers have gained attention in this area due to their variety of properties such as biocompatibility, biodegradability, adequate mechanical properties, and moisture. An additional property such as bioactivity against microorganisms is always desired, for that reason, the objective of this work is to propose a wound dressing system made of functionalized electrospun nanofibers of poly (caprolactone)/poly (vinyl pyrrolidone) (PCL/PVP) with a nanocomposite of Chitosan/Silver Nanocrystals/Graphene Oxide (ChAgG). The ChAgG nanostructured composite material is composed of Chitosan from corn (Ch), silver nanocrystals from garlic (Allium sativum), and Graphene Oxide (G), therefore, these fibers were functionalized with ChAgG nanocomposite solution using blending electrospinning in different proportions (1, 5, and 10%). By infrared spectroscopy (FTIR) and through the deconclusion of the bands by X-Ray photoelectron spectroscopy (XPS) and images by transmission electron microscopy (TEM), the nanocomposites were characterized for the presence of the different elements that compose them. On other hand, resulting fibrous dressings were characterized using scanning electron microscopy, to observe the morphology and obtain fibers diameters data. Thermal analyses (TGA and DSC) and FTIR in order to evidence the incorporation of ChAgG in/on the fiber's polymeric matrix. Mechanical properties indicated that fibers with 5% of the ChAgG formulation were the most interesting formulation and the best candidate for wound dressing applications. For future work, citotoxicity, antimicrobial activity and animal testing demonstration of the capacity of the chosen system can be done. These results will lead to an optimized wound dressing with antimicrobial properties that can compete on the actual market.

Biography:

Dr. Luis Villarreal is a research professor at the Faculty of Engineering Sciences and Technology, Autonomous University of Baja California, Tijuana, Baja California, Mexico. So far, Dr. Villarreal has published 42 indexed articles, with a total of 618 citations in Scopus. He has participated in more than 55 national and international congresses. Founder and editor-in-chief of the Revista de Ciencias Tecnológicas (RECIT), member of the editorial board of important publishers such as Bentham, MDPI, Hindawi and referee of 161 articles. Evaluator of research projects in Mexico, Italy, Malaysia and Peru. His research lines Biomaterials, Tissue Engineering, Drug-Release Systems and Biotechnology.

Surface Modification of Biomimetic Moth Eye-like Patterned Polymer Films by Functional Materials via Interfacial Reaction

Priyanka Kulshrestha, Bokyoung Shin, and Do Sung Huh*

Department of Nano Science and Engineering, Center for Nano Manufacturing, Inje University, Gimhae-si, Gyeongsangnam-do, South Korea

Abstract:

Biomimetic moth eye-like patterned (MEP) polymer films with a hexagonal array of microdomes mimicking natural moth eye were surface modified by pouring a polymer solution on a honeycomb-patterned porous polyvinyl alcohol film using as a template. The surface of microdomes on the MEP film was functionalized by including one reacting materials such as ferrocene, benzoyl peroxide (BPO), and cadmium chloride into the polymer film, then the fabricated MEP films were immersed into aqueous solution with $AgNO_3$, aniline, and Na_2S (Se, Te) to functionalize the dome surface with Ag nanoparticles, polyaniline, and cadmium chalcogenide, respectively, via interfacial reaction. The surface modified MEP film was confirmed by UV–visible spectroscopy, scanning electron microscopy and EDX analysis. Due to the excellent light absorption ability of ME pattern, the functionalized polymer film can have many applications.

Short Biography:

Prof. Huh has completed his PhD from Korea Advanced Institute of Science and Technology, S. Korea and postdoctoral studies from West Virginia University, USA. He has published more than 100 papers in reputed journals and has been serving as an editorial board member of repute.

Recent Progress in Polyurethanes Using Renewable Resources

Ram K. Gupta

Pittsburg State University, Pittsburg, KS 66762, United States

Abstract:

Polymers industries are among the fastest growing industries with applications ranging from construction to aerospace to biomedical. Among various types of polymers, polyurethanes are attracting considerable research and industrial attention due to the easy tuning of their properties which make them suitable for a wide range of commercial applications. Current environmental issues due to the use of excessive fossil fuel-based chemicals encourage scientists and industries to find out alternative chemicals for polymer synthesis. Renewable resources such as oils (editable or non-editable), animal fats, etc. provide an opportunity to be used in polymer synthesis. The presence of unsaturation in these compounds provides active sites for chemical reactions. In this talk, recent development in polyurethanes using renewable resources will be covered. Various chemical transformations to convert them into polyol, a starting material for polyurethanes, will be discussed. The physicochemical, thermal, and flammability of polyurethane foams will be covered. It was observed that the addition of flame-retardants (reactive or additives) can significantly affect the properties of the foams. Recent progress in green flame-retardant (non-halogenated) for polyurethanes will be discussed.

Short Biography:

Dr. Ram Gupta is an Associate Professor of Chemistry at Pittsburg State University. Dr. Gupta has been recently named by Stanford University as being among the top 2% of research scientists worldwide. Dr. Gupta's research spans a range of subjects critical to current and future societal needs including: semiconducting materials & devices, biopolymers, flame-retardant polymers, green energy production & storage using nanostructured materials & conducting polymers, electrocatalysts, optoelectronics & photovoltaics devices, organic-inorganic heterojunctions for sensors, nanomagnetism, biocompatible nanofibers for tissue regeneration, scaffold & antibacterial applications, and bio-degradable metallic implants. Dr. Gupta has published over 270 peer-reviewed journal articles, made over 350 national/international/regional presentations, chaired/organized many sessions at national/international meetings, wrote several book chapters (90+), worked as Editor for many books (30+) for American Chemical Society, CRC, Springer, Elsevier, etc. and received several million dollars for research and educational activities from external agencies. He is also serving as Editor, Associate Editor, Guest editor, and editorial board member for various journals.

Controlled-release Protein-based Matrices from Agrowastes: A Novel Method of Fertilization

Mercedes Jiménez-Rosado[a]*, Victor M. Perez-Puyana[a], Antonio Guerrero[a] and Alberto Romero[a]

[a] *Department of Chemical Engineering, University of Seville, Seville, Spain*

Abstract:

Nowadays, the increase of the population and its tendency to a healthier diet has intensified horticultural production. This is not possible without the use of fertilizers since the soil is not capable of regenerating its nutrients as quickly as this type of horticulture requires. Nevertheless, its ineffectiveness is generating a environmental impact. For this reason, new technologies are currently being tested, with controlled release systems generating the greatest interest. In this way, the use of biopolymers could benefit the use of these systems due to their biodegradability and non-toxic products. For this, the main objective of this work was the development of a biodegradable and sustainable controlled release system (matrix) to supply micronutrients to horticultural crops. To this end, a protein-rich soy agrowaste was revalued as raw material for the development of the matrix. In addition, the different processing stages were studied in order to achieve the most optimal system, in terms of its functional properties, to supply the nutrients to the crop. This work has opened a new possibility of creating more efficient fertilizers, improving the benefits of conventional fertilization. These matrices are expected to revolutionize the market, causing the method of fertilizing to change in the next years towards a more sustainable fertilization.

Short Biography:

International Doctorate in “Industrial & Environmental Chemistry”. Her research is based on the development of biopolymeric-based matrices from agro-wastes for different applications (horticulture, biomaterials, hygienic products). She has published 46 JCR articles (548 cites, h-index 13) and various book chapters. She has participated in the work team of 5 international and national projects. She has also carried out various international stays: in INRAE of Nantes (France), CONICET (Argentina) and University of Bologna (Italy). All this emphasizes the importance of the transversality of her projects in an international framework.

Virtual Oral Presentations

Vacuum Pyrolysis of Waste Plastics into High-Purity Monomers Using Spirit Lamp Flame for Convenient Chemical Recycling

Eri Yoshida*

Toyohashi University of Technology, Toyohashi, Aichi, Japan

Abstract:

Increasing plastic waste pollution has become a pressing global issue. The main pollutants consist of non-biodegradable C-C main chain polymers produced from fossil fuel-based monomers. It is crucial to address the issue of plastic waste pollution by implementing a closed-loop recycling system that includes the recovery and reuse of component monomers to reproduce the original products. To establish this closed loop, this study presents a convenient method for the chemical recycling of waste plastics through vacuum pyrolysis using a spirit lamp flame. Waste polystyrene (PS) foam was subjected to vacuum pyrolysis in a Pyrex tube, ignited with a spirit lamp, for 20 minutes. This process yielded a 55% styrene recovery with a purity of 98%. The recovered styrene contained 2% toluene, which had a minimal impact on the PS production through radical polymerization using AIBN at 60°C under N2 for 7 h. The recovered styrene resulted in PS with Mn = 22,300 (84% conversion) and pure styrene in PS with Mn = 27,900 (96%). GPC and NMR analyses revealed that depolymerization into styrene competed with backbiting, which hindered depolymerization by forming a 5-membered cyclic trimer. The pyrolysis in the presence of molecular sieves 4A prevented backbiting and increased the styrene yield to 67%. The simple and convenient vacuum pyrolysis method, which requires no temperature regulation or monomer fractionation, can be applied to various waste plastics with C-C main chain structures. It promises not only to reduce waste plastics but also to diminish fossil fuel consumption.

Short Biography:

Eri Yoshida is an Associate Professor at Toyohashi University of Technology. After completing her Ph.D. in polymer engineering at the Tokyo Institute of Technology in Japan, she joined the Kyoto Institute of Technology as an Assistant Professor. In 1999, she served as a visiting scientist at the University of North Carolina at Chapel Hill, and in 2016, she participated in a faculty exchange program at City University of New York, Queens College. Her current research interests include chemical recycling of waste plastics, CO2 capture materials, block copolymer self-assembly, and controlled/living radical polymerization.

Approach to Fool Proof Selectivity of Synthetic Analogues of Biological Receptors (MIPs)

Meenakshi Singh*, Manjeet Harijan, Akriti Srivastava and Ritu Singh
Department of Chemistry, MMV, Banaras Hindu University, Varanasi, INDIA

Abstract:

Molecularly imprinted polymers (MIP) are polymers which are prepared in presence of a template molecule with monomers, cross linkers and other constituents of a general polymer. Addition of template molecule in the pre-polymerization mixture transformed the whole purpose of polymerization and created an unusual state-of-the-art branch. Epitope imprinting, a facile method for protein imprinting, has made protein sensing feasible and accessible in a facile manner. Proteins have specifically contoured geometry maintained by covalent and non-covalent binding forces, which often disnature while working on them. The selective and specific imprint created on imprinted surface induces the binding of whole protein through this specific epitope. To obtain flawless binding, as specific and selective as enzymes are towards their substrates, attempts are made by imprinting two or more epitope sequences simultaneously, for a protein. Selectivity obtained by imprinting a single epitope sequence towards other peptide sequences comprising of constituent amino acids of template peptide sequence but positioned differently from template peptide sequence is not failproof. To achieve flawless selectivity and specificity, two epitope sequences of a single protein were chosen for imprinting. Through the dual-epitope imprinted electrode (DEIP), absolute selectivity for the disease causing bacteria is achieved.

E7 Nematic Liquid Crystal Encapsulated in a Polymeric Photonic Crystal

Edina Rusen [a 1], Aurel Diacon [a 1], RaulAugustin Mitran [b], Adrian Dinescu [c], Cristina Nistor [d], Raluca Șo moghi [d e], Aurelian Cristian Boscornea [a], Doina Mănăilă-Maximean [f]

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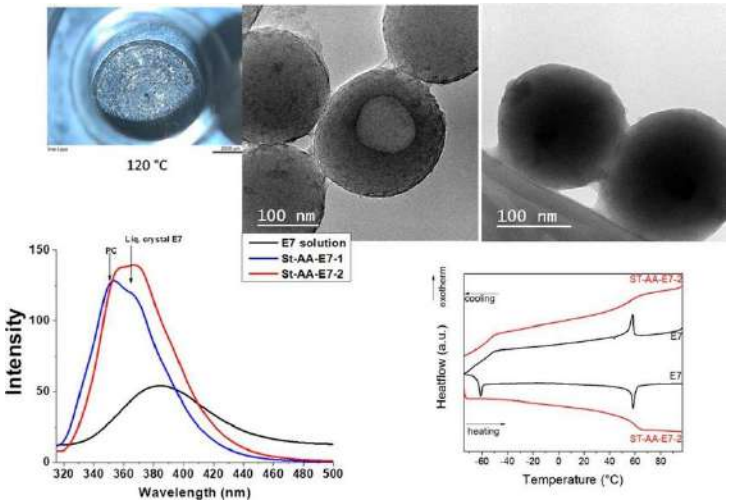
Abstract:

This study presents the synthesis and characterization of nano encapsulated liquid crystals in the polymer (nano-ELCP) obtained by the soap-free emulsion polymerization of the system styrene (ST) and acrylic acid (AA) in the presence of the liquid crystal E7 (LC). The obtained emulsion and the photonic crystal film (PC) were characterized by optical microscopy, SEM, DLS, UV–Vis, DSC, TEM, GPC, TGA, and fluorescence spectroscopy to highlight the encapsulation of E7 in the polymer particles and

their properties. The DLS and SEM analyses confirmed a narrow polymer particle size distribution and the possibility to form highly arranged PCs, which contain the dispersed LC. The DSC, TEM, and TGA analyses sustain the encapsulation of E7 with an LC content of 11.87 % and 25.19 % (weight %) for ST-AA-E7-1 and ST-AA-E7-2, respectively. An increase in the fluorescence response was demonstrated for the polymer encapsulated LC which can be attributed to PCs that augments the intensity of the nematic crystal fluorescence response, in the absence of external stimuli.



Oxygen Scavenger and Antioxidant LDPE/EVOH/PET-based Films Containing β-Carotene Intended for Fried Peanuts (Arachis hypogaea L.) Packaging: Pilot Scale Processing and Validation Studies

Ana Beltrán Sanahuja[1]*, Adriana Juan-Polo[1], Salvador E. Maestre Pérez[1], María Monedero Prieto[2], Carmen Sánchez Reig[2], Ana María Tone[2], Nuria Herranz Solana[2].

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Abstract:

The aim of this study was to develop an oxygen scavenger and antioxidant active packaging material for fried peanuts. The packaging solution, which has been made at the laboratory previously, has been developed by cast film extrusion and is composed of low-density polyethylene-ethylene vinyl alcohol-polyethylene terephthalate (LDPE/EVOH/PET)-based films containing β-carotene (CAR). In comparison with film without additive, developed film presented an orange colouring (higher L* and b* values and lower a* values) and an increase in oxygen induction time (OIt) from 4.5 to 14.1 min. The incorporation of β-carotene to the formulation also brings about a significant effect on the thermal stability as maximum degradation temperatures increased around 1%. Regarding the oxygen absorption capacity of the films, values of 1.39 ± 0.10 mL O_2 per g of film at laboratory scale and 1.7 ± 0.3 mL O_2 per g of multilayer (ML)/LDPE_CAR were obtained, respectively, after 3 days, proving the suitability of the packaging solutions as oxygen absorbers. To validate the packaging solution, the oxidative stability of fried peanuts packed in fabricated multilayer β-carotene bags was evaluated for 3 months at 40 °C. The hexanal content remained constant during this period.
Meanwhile, peanuts packed in ML without β-carotene increased their hexanal content to 294%. This fact indicated a lower extent of oxidation in fried peanuts compared to food samples packaged in control films, suggesting the potential of ML/LDPE_CAR films as sustainable and antioxidant food packaging systems to offer protection against lipid oxidation in foods. Sensory evaluation confirmed that ML/LDPE_CAR films provided the peanut samples with an extra aroma due to the volatile degradation products of β-carotene (such as β-cyclocitral or 6-methyl-5-hepten-2-ol).

Short Biography:

Ana Beltrán Sanahuja (PhD Chemistry) joined the Group "Analysis of Polymers and Nanomaterials" in 2010. During the years 2012-2016, she continued her research career at the Packaging, Transport and Logistic Technological Centre, ITENE as a senior researcher in new active and biodegradable packaging materials. She is the author or co-author of 46 scientific articles published in high-impact journals in chemistry, food or polymers, with a total number of citations of 1552 and an h-index of 21. Currently, she works as Assistant Professor of the Department of Analytical Chemistry, Nutrition and Food Science of the University of Alicante.

Poloxamer-407-induced Model of Triglyceridemia

Tatiana A. Korolenko* (1), Thomas P. Johnston(2)

Institute of Neurosciences and Medicine, Novosibirsk, Russia (1);

University of Missouri-Kansas city, MO, USA (2)

Abstract:

Recently, evidence suggests that *elevated triglyceride levels* likely contribute independently to increased risk of cardiovascular diseases. However, there are few models of hypertriglyceridemia in experiment. Poloxamer 407 (P-407) is well known as a model of dyslipidemia, developed by Prof. T.P. Johnston, which was used to study mechanisms of development of atherosclerosis and its prevention. Repetitive P-407 administration for a long-time (2-3 months) was followed by the development of significant dyslipidemia and atherosclerosis in mice.

At the same time, in acute P-407 administration increase of serum lipids was normalized during short period and was dependent from the dose used. We compared effects of acute single administration of P-407 in C57BL/6 mice as dose-dependent effect on the serum TG levels. P-407 as a single dose 500 mg/kg, 250 and 125 mg/kg i.p. was used in experiment. In higher doses (500 or 1000 mg/kg) there was very high hypertriglyceridemia, which was not possible to correct by hypolipidemic drugs. In the dose of 250 mg/kg increase of serum lipids, mainly TG level was shown, about 10 times compared to the control (and in less extent total cholesterol and LDL-C). Fenofibrate (50 mg/kg, preliminary administration to mice) exerted hypolipidemic action on serum TG levels in mice with dyslipidemia model induced by P-407 (250 mg/kg). One can conclude that such model of hypertriglyceridemia (P-407, 250 mg/kg, single, 24 h) can be used for testing drugs with suggested hypolipidemic effects.

Special Aspects of Fatigue Testing for Composites

Aleksandr Elkin*, Stepan Konev, Ivan Sergeichev
Skolkovo Institute of Science and Technology, Moscow, Russia

Abstract:

We would like to share our experience regarding fatigue testing of pultruded glass laminates. Such materials are widely used in civil engineering and often sustain cyclic tensile and compressive loading that leads to the early failure. To address this problem, we designed a specific fixture for a standard testing machine that allows applying off-axial loads and conduct fatigue tests for various stress ratios, including tension-compression cycles (R<0). We tested two groups of specimens for low-cycle fatigue ($N_{max}=10^5$) with and without tabs to understand how the tabs affect fatigue life. Then, we checked the residual compressive strength after certain fatigue load cycles were applied on the same specimens. Experiments with the designed fixture revealed crucial factors that influence on fatigue life of the material such as fixture alignment, clamp force distribution etc. The fatigue tests indicated a difference in failure modes: loads of $S_{amp}>0.4S_{max}$ caused crushing and buckling failure at the number of cycles $N\sim10^3$-10^4, and small loads ($S_{amp}<0.4S_{max}$) caused shear failure near the clamped zones at $N\sim10^5$. Pultruded specimens with tabs might show a better fatigue performance at $N>10^4$; however, the scatter of the data is significant. It seems that, the initial defects in specimens have more effect on fatigue performance than the presence of the tabs.
In conclusion, we defined the fatigue performance of pultruded glass laminates and their residual compressive strength. In addition, we attempted to determine the role of initial defects and fixture alignment on fatigue.

Short Biography:

Aleksandr Elkin is a PhD student at the Skolkovo Institute of Science and Technology in the Mechanical Testing Laboratory. His research field is fatigue of composite materials and stress analysis. Currently, he develops the generalized fatigue degradation model of composites that works in conjunction with the finite element method.

The Impact of Different Inorganic Fillers on the Thermal Conductivity of Crosslinked Polytartaric Acid

Alexandrina Nan*, George Ispas, Izabell Crăciunescu, Monica Dan, Iolanda Ganea and Teodora Radu

Department of Physics of Nanostructured Systems, National Institute for Research and Development of Isotopic and Molecular Technologies, Cluj-Napoca, Romania

Abstract:

As the electronics industry continues to integrate devices and reduce their size, the importance of effective thermal management has become increasingly critical. Proper management of temperature within these devices is essential to ensure their optimal performance and longevity. This can be done by creating thermal management materials that ensure effective heat dissipation in electronic equipment. These materials typically require high thermal conductivity, good insulation, processability, flexibility, and more. The goal of this study was to gain a deeper understanding of how these inorganic fillers can influence the thermal conductivity of the crosslinked polytartaric acid matrix. This work investigated the structural and properties differences between PTA, crosslinked PTA, and crosslinked PTA-fillers. The polymeric composite materials underwent comprehensive analysis through the utilisation of FTIR spectroscopy. Furthermore, scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were employed to examine the morphological characteristics of the composites. The thermal conductivity and diffusivity of the polymeric materials were investigated through the transient plane source techniques, Hot Disk. The process of crosslinking PTA resulted in a decrease in the κ value. However, by introducing various types of inorganic fillers (magnetic nanoparticles, aluminium oxide and silica mesoporous SBA-15 doped with silver), the κ value was further enhanced.

Acknowledgements:

This work was supported by a grant from the Ministry of Research, Innovation and Digitization, CNCS/CCCDI – UEFISCDI, project number PN-III-P4-ID-PCE-2020-1595, within PNCDI III

Short Biography:

Alexandrina Nan works as a Senior Researcher at the National Institute for Research and Development of Isotopic and Molecular Technologies in Cluj-Napoca. She earned her MSc and PhD degrees in Chemistry from Babeş-Bolyai University in Cluj-Napoca, Romania, in 2000 and 2005, respectively. After joining the aforementioned Institute, she began working as a researcher in the domain of magnetic nanostructures. Her present research efforts are directed towards preparing innovative polymers and polymeric materials to facilitate heat dissipation in contemporary electronic devices. This is crucial for ensuring their functionality, dependability, and longevity.

A Metamaterial Absorber for Energy Harvesting and Specific Absorption Rate Applications in 28 GHz 5G Band

Buket AKIN

Affiliation Information: Istanbul Technical University, Istanbul, Turkey

Abstract:

Metasurfaces are used to create pseudo materials with negative refractive index which do not exist in nature, and widely used in specific absorption rate (SAR) reduction, sensing and energy harvesting applications. This paper presents a metamaterial absorber (MMA) to reduce SAR in 5G n257 band at 28 GHz and harvest energy from the existing mm-wave signals on air. The proposed structure uses polytetrafluoroethylene (PTFE) as the substrate for durability with ring resonators etched on a thin-film resistor foil. The design achieves at least 80% absorption at 26.4-28.2 GHz according to the finite element method (FEM) based full-wave EM simulations performed using Ansys HFSS simulation software.

Short Biography:

Buket Akin is currently working at Turkish Aerospace Industries as a Senior Lead Design Engineer since 2018. Her responsibilities are electro-optic systems design and hardware/software requirements verification for air vehicles. She previously joined Nanomagnetics Instruments as an R&D engineer, designing scanning probe microscopes in 2014. She received a Ph.D. in Condensed Matter and Material Physics from Gazi University and M.S. in Software Engineering from Hacettepe University, Turkey.

She is an Adjunct Professor at Istanbul Technical University's Department of Aerospace Engineering, teaching Infrared Systems and Applications. Her research includes photonics, plasmonics, zero-index optics, electro-optic systems metamaterials, and thermal camouflage applications.

Covalent Immobilization of Glucoamylase from *Aspergillus niger* on Epoxy Activated Supports

Yakup Aslan* and Derya Ömerosmanoğlu[a], Musa Anter Yaşar[a], Hatice Rumeysa Turan[a], Songül Dursun[a], Mehtap Yağmur[a]
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Abstract:

Glucoamylases (EC 3.2.1.3) are important enzymes used in the hydrolysis of starch and in many applications, on a large scale. Immobilization of *Aspergillus niger* glucoamylase (GAN) has been widely studied by using various matrix and methods: cross-linking, physical adsorption, entrapment and covalent bonding. However, in the previous studies related to immobilization of GAN, activity yields generally are below than 100% and the operational and storage stabilities aren't well for industrial applications. Therefore, studies on the immobilization of ANGA to achieve higher activity using more economical matrices are still ongoing. In the present study, GAN was immobilized on various commercial supports. The highest immobilization efficiency was achieved with Eupergit CM. By optimization of immobilization conditions the 100% immobilization yield and the 100% activity yield were obtained. Characterization of free and immobilized GAN was also studied. Optimum pH (5.5) and optimum temperature range (55-60 °C) weren't affected by immobilization. pH stability and thermal stability of GAN were improved by immobilization. After immobilization, Vmax value decreased from 151.5 µmol D-Glucose/L.min to 147.1 µmol D-Glucose/L.min, while Km value decreased from 116.3 g maltodextrin/L to 109.9 g maltodextrin/L. The initial activity of immobilized GAN decreased to 99.3% after the repeated twenty uses under optimum conditions and to 98.3% after thirty days under optimum storage conditions. These results are the best achieved in immobilization of GAN. Consequently it can be said that the immobilized GAN obtained in this study can be used in the industrial production of glucose syrup in the continuous processes.

Keywords: *Aspergillus niger*, epoxy activated supports, enzymes, immobilization, glucoamylase

Short Biography:
Name: Yakup Aslan
Job Title: Associated Professor
Company: Department of Food Engineering Faculty of Engineering Siirt University
Born: 1966, Gaziantep, Turkey
The school you graduated from: PhD in Gebze Technical University, Turkey
Personal and professional goals: Production of functional foods in Turkey
A related achievement or achievement: Having an article published in the SCI-Expanded indexed journal and the field indexed journal while in the Netherlands for three months.
Hobbies: Walking, swimming, biking, driving, playing table tennis, shopping and chatting
Skills and areas of expertise: Carpenter, biochemistry, enzyme immobilization, functional foods

Applications of Polymers to Help Reduce Water Pollution from Synthetic Dyes

Januka Budhathoki-Uprety

North Carolina State University, Raleigh, NC, 27695, USA

Abstract:

Colored industrial effluent has received a considerable attention in recent years because untreated/or improperly treated effluent could discharge various toxic contaminants to water sources. Among these contaminants, dyes are the most visible pollutants in the wastewater that can reduce the aesthetics of water resources and pose serious threats to the environment and the public health. In this talk, I will discuss development of polymers and their applications in removing synthetic textile dyes from contaminated water sources. We found that these polymers facilitated efficient removal of dyes from aqueous media resulting in visibly clean water. Furthermore, we showed that both the polymers and the dyes could be recovered for potential re-use. This work illustrates that the polymeric materials have great potential to effectively remove such contaminants from water resources and improve water quality. Short Biography: Dr. Januka Budhathoki-Uprety is an Assistant Professor at North Carolina State University. Her research team focuses on developing advanced macromolecules (polymers and nanomaterials) and their applications in societal need areas. She received BSc (Chemistry, Botany, and Zoology) and MSc (Organic Chemistry) degrees from Tribhuvan University, Nepal, MS (Chemistry) from Western Carolina University and Ph.D. (Chemistry) from NC State University, USA. She worked as a postdoctoral fellow at Memorial Sloan Kettering Cancer Center, New York, USA. Dr. BudhathokiUprety is the recipient of Barbara Stowe Award (2020), the MSK Society Scholar Prize (2018), Tow Postdoctoral Fellowship (2015-2018), ACS Graduate Student Travel Award (2011), and Academic Excellence for Teaching Award, KMC (2003-2005).

Proposing a Framework for the Digital Transformation Maturity of Electronic Sports Businesses in Developing Countries

Arman Heidari

Department of Sport Management, University of Kurdistan, Sanandaj, Kurdistan province, Iran

Abstract:

Digital transformation has become the top priority for 80% of sports companies worldwide, but statistics show that between 70% to 95% of all digital transformation projects fail. This is because strategy, not digital technology, drives digital transformation, and without a mature digital transformation model, success is unlikely. Moreover, the developing and developed countries model is not the same, and it cannot be blueprint. Therefore, the aim of this research was to propose a framework for the digital transformation maturity of electronic sports businesses in developing countries. Semi-structured interviews were conducted with a sample of 15 stakeholders of electronic sports businesses in Iran. Thematic analysis was used to analyze the interviews, and three main perspectives were identified: (1) Enablers, (2) Digital Resilience and Capabilities, and (3) Digital Transformation Maturity Stages. Additionally, it was found that digital transformation maturity stages are based on four stages of digital beginners, digital followers, digital conservatives, and digital leaders. The findings indicate that moving towards digital transformation and achieving digital resilience in electronic sports businesses will be impossible without synergy between enablers and digital resilience and capabilities. This framework can be useful for digital sports businesses to evaluate their current digital status and effectively guide them towards desirable digital status. Furthermore, electronic sports businesses can prioritize their efforts and resources for digital transformation by focusing on targeted capabilities and enablers and ensure more effective and efficient allocation of resources towards digital transformation. Short Biography: I am Arman Heidari, holding a Ph.D. in Sports Management and a member of Iranian Outstanding Talents. I have successfully published three international articles and fourteen conference papers in the field of sports management. Additionally, I have authored three books and have coaching experience in over 7 sports disciplines. I am passionate about the digital transformation in sports, changes in sports business, and utilizing electronic devices in the realm of sports. With these skills and experiences, I strive to enhance athletes' performance and contribute to the development of the sports industry as a sports management specialist.

Preparation of Herbal Loaded Alginate Based Hemostatic Dressing

Ankita Sharma[a]*, Chetna Verma[a], Samrat Mukhopadhyay[a], Amlan Gupta[b], Bhuvanesh Gupta[a]

[a]*Bioengineering Laboratory, Department of Textile and Fiber Engineering, Indian Institute of Technology Delhi, New Delhi-110016, India*
[b]*Sikkim Manipal Institute of Medical Sciences, Gangtok, Sikkim-737102, India*

Abstract:

Traumatic wounds often lead to the excessive blood loss which impose great burden to the public health. Thus, hemorhhage control is the great challenge which upon control may enhance the rescue time of the patient. Desirable features of an ideal hemostatic dressing include rapid blood clotting, antimicrobial activity, and antioxidant nature. Sodium Alginate (SA) is an anionic biopolymer having features like high absorption capacity, biocompatibility, and rapid wound healing properties which makes it suitable for different biomedical applications. In this study, SA based blend membranes were prepared and characterized with varying concentrations of glycerol. Further, increasing concentrations of tannic acid (TA) was added to optimized blend of SA:Gly to impart hemostatic and antimicrobial activity. These blends were coated on the cotton fabric by dip coating method. Mechanical analysis of prepared membranes revealed an exponential increase in the flexibility of the membranes with increase in glycerol content due to the plasticization effect of glycerol. Similarly, XRD analysis indicated the increase in the amorphous nature of the membranes due to the polymer chain relaxation upon incorporation of glycerol. Antimicrobial potential of the dressings was studied with the help of colony count method and TEM analysis which indicated more than 95% viable colony reduction. Further, dressings were investigated for their in-vitro blood clotting activity by using blood clotting time analysis and FESEM analysis. Our investigation revealed an excellent hemostatic activity with infection resistant property. Thus, it can be concluded that such formulations hold great potential in the field of hemostatic material development.

Short Biography:

Ankita Sharma is a dedicated Ph.D. Research Scholar from Indian Institute of Technology Delhi, New Delhi, India with a passion for advancing healthcare through functional biomaterials. With a profound understanding of materials science, she aspires to improve hemostatic materials and enhance patient experiences. Ankita's journey embodies the spirit of exploration and a relentless pursuit of knowledge, positioning her as a promising contributor to the future of healthcare technology.

Comparison of Fibre Reorientation of Short-and Long-fibre Reinforced Polypropylene by Injection Molding With a Rotating Mold Core

David Diring*, Prof.Dr.-Ing. Thorsten Krumpholz[a], Philipp Land[a], Prof. Dr.-Ing. Hans-Peter Heim[b]

[a]*University of applied Sciences Osnabrück, Osnabrück, Lower Saxony, Germany*
[b]*University Kassel, Hesse, Germany*

Abstract:

With a rotating mold core during the injection molding of fibre-reinforced plastics, the rotational shear caused by the rotation is superimposed on the injectioninduced shear. This allows the fibre orientation in this area to be intentionally manipulated so that, for example, in the case of internal pressure loading, the fibres can be oriented in the tangential main loading direction. This paper deals with the impact of a rotating mold core on the fibre orientation and burst strength of short-and longfibre-reinforced polypropylene. It is shown that the fibre orientation and strength can be significantly influenced for both short and long fibres, whereby increases in bursting strength of mostly over 80%, in some cases over 200%, could be achieved. The ultimate strength depends, among other things, on the wall thickness used and the fibre content. Major differences between the short-and long-fibre-reinforced polypropylene are less evident in the strength and more in the fibre orientation.

Short Biography:

After completing his bachelor's degree in plastics engineering at Osnabrück University of Applied Sciences, David Diring stayed on as a research assistant in the Plastics - CAE laboratory department and is currently completing his master's degree in "Applied Materials Science". In doing so, he combines his studies with research work. He is currently working on a research project in the field of additive manufacturing at the Lingen campus.

E-Poster Presentations

Use of Peruvian Native Potato Starch (Kulli Papa) in the Production of Biodegradable Films

Leandro Neodini Remedioa* and Diana Carolina Parada Quinayáa aUniversity of Engineering and Technology - UTEC, Department of Chemical Engineering, Lima, Peru.

Abstract:

Starch and polyvinyl alcohol (PVA) are easily accessible biodegradable materials with significant commercial appeal, especially in food packaging production. The use of potato starch for packaging production is highly attractive due to its low gelatinization temperature and excellent elastic, gas and water barrier properties. However, these characteristics can vary depending on the source of starch due to differences in their functional groups (amylose and amylopectin). Native Peruvian potato, therefore, presents an alternative potato starch, harnessing a natural and abundant product found in Peru. Thus, this study focused on characterize films based on PVA blended with two potato starch: native Peruvian potato starch (APN) and commercial starch. Films were produced by tape-casting, using 7g polymer/100g solution, with a 75:25 (PVA:APN) ratio, and sorbitol (40g/100g polymer) as a plasticizer. The films were analyzed for their moisture content, water solubility, and water vapor permeability (WVP). The use of APN led to an increase in film moisture content, rising from 8.77 to 9.88 g/100g. However, no statistical differences in solubility values were observed regardless of the starch used, with a solubility of 79.1% for both cases. WVP values of 0.57 ± 0.02 and 1.32 ± 0.59 g.mm/kPa.h.m² were obtained for films with industrial starch and APN, respectively. The utilization of starch from different sources results in variations in the final properties of the films, and despite the differences when compared to the commercial starch, the use of APN holds significant potential for producing biodegradable food packaging, using a natural raw material native from Peru. Short Biography: Bachelor's, master's, and doctoral degree in Food Engineering from University of São Paulo (USP - Brazil). My expertise lies in the field of biodegradable films and orally disintegrating films based on different polymers, including chitosan, HPMC, gelatin, potato starch, and PVA. I have produced films incorporated with different active compounds, such as antioxidants and anti-inflammatory agents, like propolis, nisin, and potassium sorbate. Currently, I am a postdoctoral researcher at the Universidad de Ingenieria y Tecnologia (UTEC – Lima/Peru), where I am developing films based on native Peruvian potato starch with anthocyanins for use as smart packaging.

Ciprofloxacine Loaded Mixed Polymeric Micelles as Effective Antibiofilm Agents

R. Stancheva,[a] Ts. Paunova-Krasteva,[b] T. Topouzova-Hristova,[c] S. Stoitsova, [b] P. Petrov [a], Emi Haladjova,[a]*

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[b]*The Stephan Angeloff Institute of Microbiology, Bulgarian Academy of Sciences, Sofia, Bulgaria*
[c]*Faculty of Biology, Sofia University "St. Kliment Ohridski", Sofia, Bulgaria*

Abstract:

Bacterial infections are a serious threat to human health and usually are related to the formation of bacterial biofilms, preventing the effective penetration of active substances into bacterial cells. Polymeric micelles (PMs) are perspective drug delivery carriers exhibiting a number of advantages. PMs carrying a positive charge have been found to exhibit antibacterial activity themselves, however, the usage of polycations was associated with strong cytotoxicity. Contrary, nonionic PMs are characterized by excellent biocompatibility. Therefore, the preparation of mixed polymeric micelles (MPMs) bearing both cationic and nonionic moieties might be a good alternative for developing effective biocompatible anti-biofilm agents.

In this work, MPMs based on a cationic poly(2-(dimethylamino)ethyl methacrylate)-b-poly(ε-caprolactone)-b-poly(2-(dimethylamino)ethyl methacrylate) (PDMAEMA29-b-PCL70-b-PDMAEMA29) and a non-ionic poly(ethylene oxide)–b-poly(propylene oxide)–b-poly(ethylene oxide) (PEO99-b-PPO67-b-PEO99) triblock copolymers, blended at different molar ratios, were developed. The key physicochemical parameters of MPMs, including size, size distribution, and critical micellar concentration, were evaluated. Ciprofloxacin (CF) was solubilized by the micelles via hydrophobic interaction with the micellar core and electrostatic interaction with the polycationic blocks from the micellar shell. The effect of a polymer-to-drug mass ratio on the drug-loading content and encapsulation efficiency of MPMs was assessed. A prolonged release profile was observed for the mixed compositions. All micellar systems demonstrated their capability to detach pre-formed Gram-positive and Gram-negative bacterial biofilms suppressing their metabolic activity. The cytotoxicity test reveals composition-dependent cell viability without cell destruction or morphological signs of cell death.

Acknowledgements:
This work was funded by the National Science Fund of Bulgaria, Project № КР-06-Н41/8.

Short Biography:

Dr Emi Haladjova has received a PhD degree in Macromolecular Chemistry from University of Chemical Technology and Metallurgy in Sofia, Bulgaria. Her thesis has been prepared in collaboration with Institute of Polymers, Bulgarian Academy of Sciences, where currently she has an Associate Professor position. She has been awarded various national prizes for young scientist during the period 2012-2017. Her research interests include preparation and characterization of polymeric and hybrid nanocarriers for delivery of therapeutic agents such as drugs, nucleic acids, proteins etc.

Preparation of Novel Polymeric Nanocarriers for Immobilization and Controlled Delivery of the Proteolytic Enzyme Serratiopeptidase

Katya Kamenova*, Eric Dimitrov, Petar Petrov

Institute of Polymers, Bulgarian Academy of Sciences, Akad. G. Bonchev St. 103A, 1113 Sofia

Abstract:

Serratiopeptidase is a proteolytic enzyme defined as a "super enzyme" with proven powerful anti-inflammatory activity. Clinical use of the enzyme has been reported for many diseases such as arthritis, sinusitis, inflammatory bowel disease, fibrocystic breast disease, chronic bronchitis, post-operative swelling and pain, atherosclerosis, etc. The critical problem in enzyme therapy arises from the large size of the protein molecule, susceptibility to denaturation and degradation, short half-life, and poor bioavailability. One of the promising strategies to solve these problems is the use of polymeric nanocarriers.

The report presents the results of research aimed at developing a new type of functional polymer micelle nanocarriers of serratiopeptidase. Core-shell mixed polymeric micelles were formed from two amphiphilic block copolymers - poly(ethylene oxide)-block-poly(ε-caprolactone)-block-poly(ethylene oxide) (PEO_{113}-b-PCL_{35}-b-PEO_{113}) and poly(2-(dimethylamino) ethyl methacrylate)-block-poly(ε-caprolactone)-block-poly(2-(dimethylamino)ethyl methacrylate) ($PDMAEMA_9$-b-PCL_{35}-b-$PDMAEMA_9$) by co-assembly in aqueous media. The amphiphilic triblock copolymer $PDMAEMA_9$-b-PCL_{35}-b-$PDMAEMA_9$ was synthesized by RAFT polymerization of DMAEMA. The amphiphilic PEO_{113}-b-PCL_{35}-b-PEO_{113} triblock copolymer were successfully synthesized by the ring opening polymerization with biodegradable ε-CL and biocompatible mPEG. Serratiopeptidase was loaded into the micellar carriers by means of electrostatic interactions between the functional groups included in the composition of the enzyme and the polymers. The hydrodynamic diameter, zeta potential and colloidal stability of the obtained systems was investigated using dynamic and electrophoretic light scattering.

Acknowledgments:

This research was funded by the Bulgarian National Science Fund (Grant KP-06-M-69/3). The authors thank the INFRAMAT project for the research equipment that was used in this investigation.

Short Biography:

Dr. Katya Kamenova achieved her PhD degree in 2021 in the Institute of Polymers, Bulgarian Academy of Sciences where currently occupied an assistant professor position. Her research focuses mainly on synthesis, modification and characterization of amphiphilic block copolymers as well as on the preparation of polymer micelles for application in biotechnology, medicine and pharmacy.

Design of Nanosized Drug Delivery Systems: Surface Modification of Niosomes by Amphiphilic (Co) Polymers

Rumena Stancheva[a*], Natalia Toncheva-Moncheva[a], Erik Dimitrov[a], Denitsa Momekova[b], Stanislav Rangelov[a]

[a] *Institute of Polymers, Bulgarian Academy of Sciences, Sofia, Bulgaria*
[b] *Faculty of Pharmacy, Medical University of Sofia, Sofia, Bulgaria*

Abstract:

Research in the field of drug delivery systems has expanded in scope and potential in the past few decades. As the focus shifts to the development of new drug delivery vehicles and carriers which can optimize the therapeutic effect, challenges such as biocompatibility and toxicity persist. New opportunities arise through the design of novel drug delivery systems. At present, nanocarriers such as micelles, liposomes, polymersomes, niosomes, dendrimers, etc. are some of the most common subjects of applied research. Niosomes are unilamellar or multilamellar non-ionic surfactant-based vesicles which are analogues of liposomes. Their ability to entrap both hydrophilic and hydrophobic agents and to facilitate targeted delivery allows them to be used as potent drug carriers.
This work presents the preparation and characterization of niosomes. They were obtained by the thin film-hydration method. Non-ionic surfactants with different molar masses were used in combination with a stabilizing lipid (cholesterol) and a series of amphiphilic copolymers based on polycaprolactone/polyglycidol of non-linear chain architecture as well as non-phospholipid conjugates of poly(2-isopropyl-2-oxazoline) or polyglycidol. The physicochemical properties of the vesicles were explored using dynamic and electrophoretic light scattering to determine their size and zeta potential. The morphology of the niosomes was investigated by cryogenic transmission electron microscopy. Membrane permeability assessment by fluorescence quenching indicated that the surface-modified niosomes possess physical and chemical stability.

Acknowledgements:
This work was funded by the National Science Fund of Bulgaria, Project No КР-06-Н43/3.

Short Biography:

Ms. Rumena Stancheva is a student at the University of Chemical Technology and Metallurgy in Sofia, Bulgaria in the field of biotechnology sciences. She is currently holding a position of chemist at the Institute of Polymers, Bulgarian Academy of Sciences. Her research interests include preparation of various drug and gene delivery systems based on polymer and lipid materials.

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