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ABSTRACT BOOK

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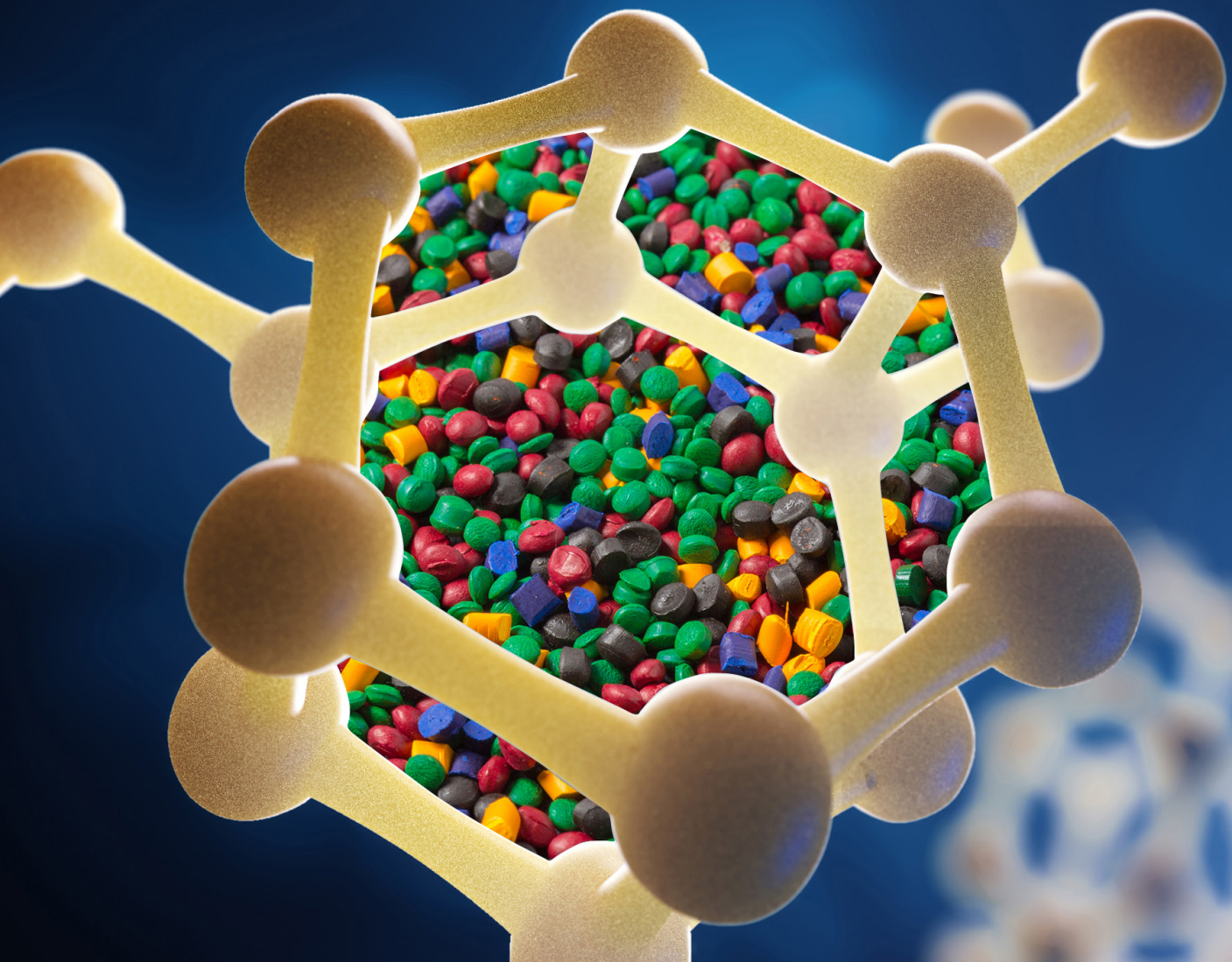

ABSTRACTS

PLENARY TALK

Polymers of Intrinsic Microporosity: Why They are so Interesting as Membrane Materials, but so Complicated Too

Johannes C. Jansen[a]*, Marcello Monteleone[a], Elisa Esposito[a], Alessio Fuoco[a], Mariagiulia Longo[a], Bibiana Comesana-Gandara[b] and Neil B. McKeown[b]

[a]*Institute on Membrane Technology, Rende (CS), Italy*

[b]*School of Chemistry, University of Edinburgh, United Kingdom*

Abstract:

Since their first introduction nearly two decades ago, Polymers of Intrinsic Microporosity (PIMs) have been among the most studied materials for gas and vapor separation membranes. This popularity is due to their high permeability, in combination with a remarkably high selectivity for various gas pairs, which places these materials at the top of the current state of the art[1]. They owe their exceptional performance to the combination of a highly rigid and highly contorted polymer backbone, creating stiffness[2] and a high free volume. This high free volume is also the reason for a number of anomalies in the transport properties of PIMs, which may change as a function of time (physical ageing), measurement technique (sorption vs. permeation), gas pressure (dual mode sorption, dilation, plasticization), gas composition (competitive sorption), permeation method (cross-flow with sweeping gas vs single gas by the time lag method), etc. Extreme care is therefore required when reporting the permeability data of PIMs.

This presentation will address a number of anomalies that may be encountered when measuring the gas and vapor transport in PIMs. In particular, it will describe a powerful new permeation method, based on the simultaneous analysis of the individual components in a gas mixture with a quadrupole mass-spectrometric residual gas analyzer[3]. The latter has the unique possibility to determine the diffusion coefficient of the individual species during mixed gas permeation experiments. This will provide deep insight into all phenomena which make the study of the transport phenomena of PIMs a challenging task.

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Biography:

Johannes Carolus (John) Jansen is a Research Director at the CNR Institute on Membrane Technology in Rende, Italy. He obtained his PhD in Polymer Technology (1996) at the TU Delft (NL). He was the coordinator of the EU's FP7 project *DoubleNanoMem* and PI in about 15 public and private projects. His scientific production comprises over 150 publications in peer reviewed journals, including prestigious journals such as Science, Nature Materials, Energy & Environmental Science and Advanced Materials, and he has an h-index of 44. He is currently group leader Nanostructured and nanocomposite membranes for gas and vapour separation, with transport phenomena as his main area of interest.

INVITED TALK

Tuning Optical and Structural Properties with Gold Nanoparticles/P3HT blends

Souren Grigorian[a,b], Laura Fontana[a], Sara Cerra,[a] Ullrich Pietsch[b], Francesca A. Scaramuzzo[c], Ilaria Fratoddi[a*]

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Abstract:

In this work the optical, structural and the electrical behaviors of a new active layer system composed by functionalized gold nanoparticles (AuNPs) and conjugated polymers, were investigated. For this purpose, gold nanoparticles with diameter of about 5 nm were chosen, coated with the bifunctional π-conjugated ligand (9,9-didodecyl-2,7-bis(acetylthio)fluorene, FL) for their high stability and easy dispersibility in organic solvents. The blends based on AuNPs and regioregular poly-3-hexylthiophene (P3HT) were prepared by adding an increasing percentage by weight of nanoparticles, i.e. from 10% to 90 wt%, in the P3HT polymeric matrix. The optical characterization of the composites demonstrated the possibility to tune the optical behavior of the P3HT by adding increasing percentages of AuNPs into the polymer matrix. Their inclusion results in a loss of P3HT crystallinity and in a simultaneous increase of the π-π interaction between the polythiophene chain and fluorene ligand. Grazing Incident X-ray Diffraction (GIXD) measurements were carried out and the blend containing 30 wt% of AuNPs in P3HT reveals an optimal condition, combining good structural order and interconnectivity in the polymer matrix. The electrical characterization of the AuNPs/P3HT blends reveals an improvement of the electrical conductivity with higher conductivity values compared to the pristine AuNPs and P3HT materials. The best performance is achieved adding 30 wt% of AuNPs to P3HT resulting in an enhancement of conductivity by about 350% compared to that of the pure polymer. This result could be of great interest for the realization of new conductive film composites to use in opto-electronic devices.

Biography:

Ilaria Fratoddi is Associate Professor at Sapienza University of Rome, Department of Chemistry. Her main research interests concern the topics of Inorganic Chemistry, and specifically chemical synthesis, structural and functional study of innovative and nanostructured materials with the final aim of developing knowledge-based materials for advanced technological applications. In particular, she is interested in the synthesis methods for organometallic complexes and rigid rod polymers, nanostructured polymers, and functionalized metal nanoparticles. She is also interested in structural and functional characterization of the materials, that are suitable for applications in optoelectronics, sensors, photonics, nanomedicine and biotechnology.

KEYNOTE TALK

Circular Economy: New Opportunities in Sustainable Nano Materials and Polymer Bio-Nanocomposites

Prof. (Dr) Sabu Thomas

[a]*Affiliation Information: Mahatma Gandhi University, Kottayam,Kerala,India*

Abstract

Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. All are under the polysaccharides family in which cellulose is one of the important structural components of the primary cell wall of green plants. Cellulose nanoparticles (*fibers*, *crystals and whiskers*) can be extracted from agrowaste resources such as jute, coir, bamboo, pineapple leafs, coir etc. Chitin is the second most abundant biopolymer after cellulose, it is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (*fibers*, *whiskers*) can be extracted from shrimp and crab shells. Chitosan is the derivative of chitin, prepared by the removal of acetyl group from chitin (*Deacetylation*). Starch nano particles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalization through chemical modifications (*esterification*, *etherification*, *TEMPO oxidation*, *carboxylation and hydroxylation etc*) due to presence of large amount of hydroxyl group on the surface. The preparation of these nanoparticles includes both series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Transmission electron microscopy (*TEM*), scanning electron microscopy (*SEM*) and atomic force microscopy (*AFM*) are used to investigate the morphology of nanoscale biopolymers. Fourier transform infra-red spectroscopy (*FTIR*) and x ray diffraction (*XRD*) are being used to study the functional group changes, crystallographic texture of nanoscale biopolymers respectively. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nano particles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials. These nanocomposites are being used as biomedical composites for drug/gene delivery, nano scaffolds in tissue engineering and cosmetic orthodontics. The reinforcing effect of these nanoparticles results from the formation

of a percolating network based on hydrogen bonding forces. The incorporation of these nano particles in several bio-based polymers have been discussed. The role of nano particle dispersion, distribution, interfacial adhesion and orientation on the properties of the ecofriendly bio nanocomposites have been carefully evaluated.

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Biography

Sabu Thomas is currently the Vice-Chancellor of Mahatma Gandhi University, Kottayam, Kerala, India. He is a Professor at the International and Inter University Centre for Nanoscience and Nanotechnology and Full Professor of Polymer Science and Engineering at the School of Chemical Sciences of Mahatma Gandhi University, Kottayam, Kerala, India. His ground-breaking research has covered the areas of polymer science and engineering, polymer nanocomposites, elastomers, polymer blends, interpenetrating polymer networks, polymer membranes, green composites and nanocomposites, nanomedicine and green nanotechnology. Prof. Thomas has received several national and international awards in recognition for his work, and recently received Honoris Causa (DSc) from the University of South Brittany, Lorient, France, in recognition for his contributions to polymer science and engineering. Prof. Thomas has published over 1400 peer- reviewed research papers, reviews and book chapters. He has co-edited more than 160 books. Currently he is having an H index of 118.

ORAL PRESENTATIONS

Carbon Black Functionalization as Efficient Tool to Improve the Thermomechanical Stability and Crystallization Rate of Biodegradable Polyester Nanocomposites.

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[b]*Department of Chemical Engineering, University of Salerno, Via Giovanni Paolo II, 84084, Fisciano (SA)-ITALY*

Abstract:

The emergent application of carbon materials as cheap and metal free catalysts has attracted much attention[1] and the introduction of different functional groups can improve their application as solid catalyst in organic and thermoset crosslinking reaction[2-4].

Furthermore it is well known, that the addition of functionalized carbon materials in polymer matrices can improve thermal and mechanical resistance, as well as gas barrier properties.[5]. Recently, much attention was devoted to biodegradable polymers mainly to those made from renewable sources, but the reduced thermal stability and the slow crystallization rate inevitably limit the range of applications and the manufacturing processes.

In this study we assess that the incorporation of CBO in several commercial biodegradable polyesters induces polymer degradation during melt processing. On the contrary, the covalent functionalization of CBO minimizes polymer degradation in melt processing, thus allowing the production of polyesters/CBO nanocomposites.

Furthermore, a nucleation effect was observed able to increase the crystallization kinetic ten times more than the usual filler. We carried out functionalization of CBO (fCBO) by introduction of alkyl groups by a well-known methodology [5] improving melt stability and faster crystallization kinetic were achieved.

Biography:

M. Rosaria Acocella received her BSc and PhD in Chemistry at Department of Chemistry and Biology of University of Salerno in 2001 and 2005 respectively. During her PhD she was for six months at Catalysis Center of Aarhus. From 2006 to 2017 she worked as postodoctoral and fellow researcher at University of Salerno, collaborating with Prof. Guerra and many industrial companies, on the study of new carbon catalysts operating in sustainable conditions. She is presently interested in synthesis, characterization and application of functionalized carbon materials. She is currently researcher at Department of Chemistry and Biology at University of Salerno.

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Development of Zno/Polyhydroxyalkanoate Nanocomposites for Packaging Applications Fabricated Using Melt-processing and Centrifugal Fiber Spinning

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[a]*Materials and Packaging Research & Services, Institute for Materials Research (IMO-IMOMEC), Hasselt University, Wetenschapspark 27, 3590 Diepenbeek, Belgium*

[b]*SIRRIS – Smart Coatings Lab, Wetenschapspark 3, 3590 Diepenbeek, Belgium*

Abstract:

Innovative polyhydroxyalkanoate (PHA) biopolymers are among the main drivers of growth in the field of biobased and biodegradable plastics, with production capacities estimated to increase in the coming years. PHA polymer processing has been studied using different techniques, tough the relationship between specific processing parameters and mechanical performance remains to be further elucidated. Especially for the fabrication of nanocomposite films, different processing conditions can influence the dispersion of the nanoparticles in the polymer. We have produced zinc oxide (ZnO)/PHA nanocomposite films using a combination of dry mixing polymer powder and nanoparticles, twin-screw extrusion and compression molding. Alternatively, nanoparticles were incorporated during centrifugal fiber spinning and nanocomposite films were produced from these fibers. Finally, the functionality of the ZnO/PHA nanocomposite films was investigated for use as flexible packaging material based on mechanical, thermal, optical and barrier properties.

Biography:

Prof. Dr. Ir. Mieke Buntinx is associate professor at the Faculty of Engineering Technology and staff member of the Institute of Materials Research IMO-IMOMEC (research group MPR&S) at Hasselt University in Belgium. Her research activities are focused on the development and evaluation of sustainable, smart and safe packaging materials with special focus on functional barrier and (gas) barrier measurements, (bio)plastics, fibre-based materials, biodegradation, nanotechnology, coatings, thermoforming, sealing, active and intelligent packaging.

She also teaches courses such as research engineering skills, polymer chemistry, biotechnology, food contact materials, and sustainable, smart & safe packaging to future engineers.

Adsorptive Behavior of HA520E-Fe for Simultaneous Nitrate and Phosphate Removal from Aquaculture Wastewater Using Combination of MXRF, EXAFS, XPS and DFT Techniques

Surapol Padungthon[a]*, Antika Pranudta[a], and Satanu Patra[a]

[a] *Environmental Engineering Program, Faculty of Engineering, Khon Kaen University, Khon Kaen, Thailand*

Abstract:

In this study, hybrid hydrated Fe(III) oxide (HFO) nanoparticles impregnated with polymeric anion exchange containing triethylamine functional group, HA520E-Fe, was synthesized for co-removal of both nitrate and phosphate from aquaculture wastewater. The combination of μXRF and gravimetric quantification of iron content of synthesized material demonstrated that increasing of iron content in the materials can enhance phosphate uptake capacity. EXAFS and DFT analysis demonstrated that phosphate ions can selectively bind with HFO through the formation of inner-sphere complexes while other competing ions such as nitrate, sulfate, can interact with HFO through weakly outer-sphere complex. Moreover, XPS analysis confirmed that nitrate interact through chloride ion bound with triethylamine functional groups through exchange mechanism under the presence of high competing positively-charged anions. From breakthrough curve fixed-bed column studies, near zero concentrations of nitrate and phosphate were obtained approximately 300 and 200 bed volumes (BV), respectively, at initial nitrate 150 mg NO_3^--N/L and phosphate 10.0 mg PO_4^{3-}-P/L of typical aquaculture wastewater. High nitrate and phosphate recovery (> 90%) can be achieved either separate or mixed stream using 5 BV of 10% KCl and 5% KOH solution. These results suggest that a novel hybrid material can be effectively and economically used for co-removal of nutrient (nitrate and phosphate) from a aquaculture wastewater and have a high potential to recovery as liquid fertilizer.

Keywords: nutrient, EXAFS, XPS, μXRF, triethylamine, hybrid sorbent, kinetics, column runs.

Biography:

Surapol Padungthon is an associated professor in the Environmental Engineering department of Khon Kaen University, Thailand. He is served as head of laboratory named Advanced Functional nanomaterials and Membrane for Environmental Remediation: AFMER. His research is mainly focused in development of industrial grade hybrid polymeric ion exchanger impregnated with various metal oxide nanoparticles specifically with target inorganic pollutants such as arsenic, fluoride, nitrate, phosphate, heavy metals. Moreover, hybrid ion exchange and membrane processes are also developed for water reclamation for various applications.

Organosilicon Coatings Prepared by Plasma-enhanced Chemical Vapor Depositiona

Štěpánka Kelarová[a]*, Roman Přibyl[a], Monika Stupavská[a], Richard Václavik[a], Anna Charvátová Campbell[b] and Vilma Buršíková[a]

[a]*Department of Physical Electronics, Faculty of Science, Masaryk University, Brno, Czech Republic*

[b]*Czech Metrological Institute, Brno, Czech Republic*

Abstract:

Plasma-polymerized organosilicon coatings are unique in a wide range of applications, including protective coatings for metals and plastic substrates, low-k dielectrics in microelectronics, moisture barrier films, coatings for medical implants, and the like. Hexamethyldisiloxane (HMDSO), tetramethyldisiloxane (TMDSO), and tetraethoxysilane (TEOS) are among the most widely used monomers for the preparation of organosilicon materials. The present work focuses on preparing and characterizing organosilicon coatings based on novel monomer trimethylsilyl acetate (TMSAc). Low-pressure RF capacitively coupled discharges in mixtures of TMSAc with $Ar/O_2/CH_4$ carrier gases were used to prepare $SiO_xC_yH_z$ organosilicon thin films. This study compares the structure and properties of resulting thin films, including chemical composition, mechanical properties, surface microstructure, and environmental stability. The present work focuses primarily on investigating the relationships between the resulting properties of prepared coatings and the discharge parameters.

Biography:

Štěpánka Kelarová is a graduate with a master's degree in plasma physics (Masaryk University, Brno) and a bachelor's degree in materials science and technology (Brno University of Technology). As part of these studies, she gained experience researching amine-rich coatings and photon-upconversion nanoparticles. Currently, she is engaged in a Ph.D. study in plasma physics at Masaryk University, Brno. Her current work focuses primarily on developing and characterizing the original organosilicon coatings prepared by PECVD. In the long term, she mainly deals with the following characterization methods: FTIR, XPS, ellipsometry, spectrophotometry, Raman spectroscopy, and surface free energy determination.

Strategies to Improve the Antibacterial Performance of 3d Printed Poly(Ether-Ether-Ketone) Based Nanocomposites for Dental Applications

Graciela Morales[a]*, Diana Ramírez[a] and Roberto López[a]

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Abstract:

The development of new materials in modern dentistry must promote optimal integration with the surrounding tissues and also prevent/avoid bacterial infections. Poly(ether-ether-ketone) (PEEK) is a resin with recognized biocompatibility with bone, resistance to mechanical and biological degradation, thermal stability, with an elastic modulus of 3-4 GPa, suitable for bone applications, much more than current metals used which lead to clinical complications due to fracture, corrosion, hypersensitivity, and generation of high stress in the surrounding bone. However, PEEK is a bio-inert material, which limits osseointegration, and its behavior against infections and bacterial proliferation has been scarcely reported. On the other hand, zinc oxide has been widely reported for exhibiting antibacterial properties, with selective bacterial toxicity with minimal effect on human cells.

In this work, 3D PEEK-based nanocomposites were obtained with unmodified and silane surface-modified ZnO nanoparticles at different concentrations to improve their antibacterial properties and cell interaction. Surface modification of ZnO nanoparticles and ultrasound (US) treatment, allowed a better dispersion/distribution of the nanoparticles in the 3D printed PEEK prototypes matrix. Annealing treatment improved the interface between the crystalline and amorphous zones, delimiting the non-homogeneity of possible surface imperfections. In any case, the mechanical properties were improved.

US and annealing treatments showed enhanced antibacterial activity, and argon plasma allowed the surface exposure of ZnO nanoparticles in the PEEK nanocomposites obtaining materials with growth inhibition of around 99.82 % against *Staphylococcus aureus*, even at low concentrations of ZnO. Prototypes thus obtained showed high potential to be used for applications in dentistry treatments.

Biography:

G. Morales, Ph.D. in Science and Technology of Polymers, Mexico, 1998. Leader in several projects with the productive and academic sector. Experience in the synthesis/modification of polymers; metallic/ceramic nanoparticles with controlled morphology, polymeric nanofibers by electro-hydrodynamic/centrifugal techniques, and additive manufacturing for medical devices. More than 60 publications in international journals. Experience in the training of specialized Human Resources: 40 completed Thesis Directions, 5 book chapters, 3 National patents, and 3 International patents. Since 1998 date, she has been working as a titular researcher in the Research Center for Applied Chemistry in the Macromolecular Synthesis and Nanomaterials Department.

Nanoparticles and Nanofibers Based on Poly(Methyl Methacrylate-Co-Methacrylic Acid) for the Development of Ph-Responsive Drug-Loading Systems

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[b]*Institut de Chimie et des Matériaux Paris-Est (ICMPE), Thiais, France.*

Abstract:

Different nanostructures such as liposomes, micelles, and metallic nanoparticles have been widely studied for loading and releasing countless drugs. Polymeric nanoparticles (PNP) and nanofibers (PNF) are also used for these purposes due to their greater stability and loading capacity, less toxicity, better control of the drug release due to the possibility to modulate the polymeric chain lengths and crosslinking degree, and the high surface area-volume ratio of PNF.

This work deals with polymerization conditions for obtaining PNP of poly(methyl methacrylate-co-methacrylic acid) by Semicontinuous Heterophase Polymerization stabilized in a relatively high solids content latex (around 11%), with a composition methyl methacrylate/methacrylic acid molar ratio = 2/1 (similarly to Eudragit S100, a commercially available pH-dependent soluble copolymer, widely used as excipient), number average molecular weight higher than 200 Kg/mol and an average particle size around 15 nm. It also discusses the methodologies for obtaining

acetylsalicylic acid, ibuprofen, and doxorubicin (DOX)-loaded PNP systems with the desired average particle sizes, i.e. during polymerization reaction or through treatments of the produced latex. On the other hand, both copolymers, the commercial and the one synthesized in our lab, were electrospun with different amount of DOX (3, 5, and 10 %-wt) to obtain drug-loaded PNF. Characterization of the fibers, biological tests, and drug release behavior as a function of DOX concentration and copolymer molecular weights are also discussed.

Biography:

Javier Enríquez hold in 2010 a PhD in Polymer Chemistry and Technology from the Centro de Investigación en Química Aplicada (CIQA) in Saltillo-Mexico. Javier´s research interest lies within polymer synthesis, living radical polymerization techniques, polymerization of bio-sourced monomers such as terpenes, polymeric nanomaterials for drug loading systems. Since 2017 to date, he has a Researcher position at CIQA in the Department of Polymer Synthesis.

Quadratic ODE and PDE Models of Drug Release Kinetics from Neat and Blended Biodegradable Polymer Films

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Abstract:

In order to achieve prescribed drug release kinetics over long therapeutic periods, bi-phasic and possibly multi-phasic releases from blends of biodegradable polymers are currently envisioned. The modelling of drug release in the presence of degradation of the polymer matrix and surface erosion is quite complex. Yet, simple reliable mathematical models validated against experimental data are now available to classify neat polymers and to predict the release dynamics from polymer blends (G. Blanchet, M.C. Delfour, and A. Garon [*Quadratic models to fit experimental data of paclitaxel release kinetics from biodegradable polymers*, SIAM J. on Applied Mathematics **71** (2011), 2269-2286]). We survey our two-parameter quadratic ODE model that has been validated against experimental data for the release of paclitaxel from a broad range of biodegradable polymers and our quadratic semi-permeable membrane PDE model that mimics the ODE model and readily extends to curved complex geometries of drug eluding stents (A. Garon and M.C. Delfour, [Three-dimensional quadratic model of paclitaxel release from biodegradable polymer films, SIAM J. Appl. Math., 74 (5) (2014), 1354-1374]). This approach avoids resorting to time-dependent or nonlinear diffusion in the polymer. In the context of drug eluting stents, it is a practical and economical tool to theoretically and numerically simulate the 3D release of drug from the thin polymer film to the integrated wall and lumen of the blood vessel for evaluation and design (M.C. Delfour, A. Garon, and S. Lamontagne, [*Three-Dimensional Drug Release in the Stent-Polymer-Wall-Lumen of a Blood Vessel*, SIAM J. Appl. Math. 79 (2019), No. 5, 1850-1871]).

Biography:

M. C. Delfour is a professor of Mathematics and Statistics at the University of Montréal. He is a Fellow of the Royal Society of Canada (Academy of Sciences) and a former president and Fellow of the Canadian Mathematical Society. He is a SIAM Fellow, a former Guggenheim Fellow and Killam Fellow. His areas of research are shape and topological optimal design, analysis and control of delay and distributed parameter systems, control and stabilization of large flexible space structures, numerical methods in differential equations and optimization, drug release, design and control of endoprotheses, and transfinite interpolation.

Influence of Biopolymer Characteristics and Surfactants in the Microencapsulation of Essential Oils

Manuel José Lis Arias[1]- Arianne López[1] –-Xu Meng[3] -- José Alexandre Borges Valle[2]- Rita de Cássia Siqueira Curto Valle[2], Cristiane Da Costa[2] and Joanna Curto Valle[4]

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[2]*Universidad Federal de Santa Caterina, Blumenau ,Brasil*

[3]*Shaoxing University. Textile Department, Shaoxing, China*

[4]*Universidade de Beira Interior. Portugal*

Abstract:

The fight against nosocomial infections in hospitals has prompted the use of microencapsulated essential oils in medical uniforms to prevent transmission through skin contact. These types of microcapsules can be enhanced by the use of antimicrobial polymers in the shell structure. Chitosan is one of the most widely used biopolymers due to its diverse properties that are affected with its molecular weight. Treatment efficacy can be increased by combining chitosan chains of different molecular weights. This modification in the composition of the coating structure allows to control the rate of hydrolysis and thus the amount of its cationic form.

The main objective of this work is to define a methodology to obtain microcapsules with different coating compositions using surfactants as stabilizers in its first step. Once the microcapsules are obtained, they are going to be impregnated to the fabric, with the aim of functionalizing the textile substrates and being able to use them in medical surgical clothing to spread the antibacterial effect, both in the health personnel and in the patient himself. In the microencapsulation process, the molecular weight distribution of the polymers strongly influences the delivery mechanisms of the active ingredient, as well as the chemical characteristics of the textile substrate used in each case.

In this work, several chitosan biopolymers and surfactants have been tested to achieve essential oil stabilization. The structural changes in the first stabilization step and the influence of the extent of crosslinking that have been related to the final antibacterial effect when fixed on different substrates.

Biography:

BSc on Chemical Engineering, MSc on Industrial Engineering, Textile Engineering Intensification, PhD on Industrial Engineering. Since 1984, teaching Chemical Engineering in ESEIAAT, UPC.

Member of the Textile Instituto, Member of the AOCS, Directive Board of AEQCT. Belongs to different Editorial Boards on fields as Drug-Delivery Letters, Biophysics Journal, or World Textile Journal Science and Engineering. Author of more than one hundred indexed articles and more than 100 Congress participations.

Has been Tutorizing along these years of more than 150 BSc Degree, MSC Degree and five PhD Thesis.

Polysaccharide-based Capsules for Potential Treatment of Coronavirus Infection

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[2]*The Stephan Angeloff Institute of Microbiology, Bulgarian Academy of Sciences, Sofia, Bulgaria*

Abstract:

This study aims to develop a possible innovative scenario in the therapy against the coronavirus infection through design of stable biopolymer-based platforms (capsules) to deliver *in vitro* with high bioavailability of potential therapeutics (synthetic antiviral agents and natural extracts) with expected pharmacological activity in the treatment of the disease.

The capsules are produced from natural, biocompatible and biodegradable polymers (chitosan and hyaluronic acid) through completely safe and eco-friendly techniques. The overall concept of the study is developed on the basis of a hypothesis for the combined effect of co-encapsulated aptamer with high binding affinity to spike glycoproteins located on the viral surface and potential therapeutic agent intended for inhibition of the infection and the viral replication in host cells. The properties of produced capsules, their behaviour in the presence of model biological membrane, cytotoxicity and antiviral activity are studied.

This work is funded by Bulgarian National Science Fund, contract No КП-06-ДК1/3.

Biography:

Assoc. Prof Viktoria Milkova is a Head of Interfaces and Colloids Department at the Institute of Physical Chemistry, Bulgarian Academy of Sciences. Her expertise is the field of Colloid chemistry and Electrokinetics. At the present

time her studies are focused on design and characterization of the surface properties and stability of nanoparticles or advanced polysaccharide-based (nano)structures.

Antimicrobial Activity and Mineralization Potential of Polyacrylamide – Silver Decorated Carbon Nanotubes Composites

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[b]*Faculty of Chemical Engineering and Biotechnologies, University Politehnica of Bucharest, Bucharest, Romania*

Abstract:

Nanostructured hydrogels were fabricated through a two-step procedure, entailing (1) silver-decoration of the carboxyl functionalized carbon nanotubes (CNTs) and (2) embedding of the obtained nanospecies in a semi-interpenetrated network of linear polyacrylamide (PAAm) entrapped in the cross-linked 3D network of the same polymer. The antimicrobial activity of composites having various ratios monomer:filler was assessed against both Gram-negative (E. Coli) and Gram-positive (S. Aureus) species using the indirect contact method. For comparison reasons, composites using non-decorated CNTs were also synthesized. The mineralization potential of the composites was evaluated after incubation in simulated body fluid (SBF) for 4 weeks. The influence of mineral formation on the mechanical properties and morphometric parameters of the materials were assessed through uniaxial compression tests and imagistic analyses, respectively (micro-computed tomography and scanning electron microscopy). Our results indicated that increasing the AAm:Ag@CNT loading ratio to over 100:0.5 leads to composites with strong antimicrobial activity for both Gram-negative and Gram-positive species. In addition, more robust hydrogels are obtained following incubation in SBF.

Acknowledgement: The research was supported through project NanoSHAC within PNCDI III, PN-III-P1-1.1-TE-2019-1161.

Biography:

Dr. Serafim works at the University Politehnica of Bucharest, in the Advanced Polymer Materials Group, where she is involved in various projects aiming the design of materials with applications in the biomedical field. Her research interests span from protein modification and nanoparticles' functionalization to the synthesis and characterization of various hydrogels and hydrogel-based nanocomposites with precise biomedical applications. Dr. Serafim specialized in different characterization techniques such as rheology, mechanical testing of hydrogels, micro- and nano- computed tomography, QCM-D, spectroscopy (FT-IR, UV-Vis). Presently, she is the working on developing double-network materials with adequate mechanical properties for articular tissue applications.

MRI Study of Plasma-Synthesized Pyrrole-Derived Polymer Evolution Implanted in Rhesus Monkey Spinal Cord Transection Model

Axayacatl Morales-Guadarrama[1,2,3,*], Hermelinda Salgado-Ceballos[4,5] , Israel Grijalva[4,5] , Juan Morales-Corona[6], Braulio Hernández-Godínez[7], Alejandra Ibáñez-Contreras[7], Camilo Ríos[8], Araceli Diaz-Ruiz[8], Guillermo Jesus Cruz[3], María Guadalupe Olayo[3], Stephanie Sánchez-Torres[4,5], Rodrigo Mondragón-Lozano[5,9], Laura Alvarez-Mejia[4,8], Omar Fabela-Sánchez [2,10] and Roberto Olayo[6]

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[7]*Investigación Biomédica Aplicada S.A.S. de C.V., CDMX, Mexico;*

[8]*Departamento de Neuroquímica, Instituto Nacional de Neurología y Neurocirugía Manuel Velasco Suárez S.S.A., CDMX, Mexico;*

[9]*Catedrático CONACyT-Instituto Mexicano del Seguro Social, Unidad de Investigación Médica en enfermedades Neurológicas, Hospital de Especialidades, Centro Médico Nacional Siglo XXI,*

[10]*Departamento de Química Macromoléculas y Nanomateriales, Centro de Investigación en Química Aplicada, Saltillo, Mexico.*

Abstract:

In a spinal cord injury (SCI), nerve tissue is injured, giving rise to paraplegia or tetraplegia depending on the level of which the injury occurred. Currently, there is no effective therapeutic strategy for motor functional recovery. Several studies have demonstrated the growth of neurons in cell culture on plasma-synthesized pyrrole-derived polymers (PPPy), as well as a greater recovery of motor function after PPPy implantation in acute states of SCI in rat injury models. In the process of transferring these advances to the clinic, it has been recommended to test in larger species, such as non-human primates, prioritizing in these studies the use of non-invasive techniques in order to evaluate the progression of the lesion with the applied treatments. In humans, MRI studies commonly used in SCI are qualitative, so the use of diffusion tensor imaging (DTI) in the clinic could be an important tool to evaluate and monitoring SCI in humans. This work shows the follow-up by standard MRI and DTI of the evolution of the SCI transection, in non-human primates by means of volumetric analysis (VA), fractional anisotropy (FA) and tractography calculation by diffusion tensor (DTT) around injury and the PPPy. Injury progression and PPPy status were analyzed up to three months after the day of injury using VA, FA, and DTT. VA preservation, AF recovery, and DTT restabilization were observed in the experimental subject implanted with PPPy, in contrast to the non-implanted subject. MRI-derived parameters are consistent with histology as well as recovery of motor function demonstrated.

Biography:

Dr. Axayacatl is a professor-researcher of biomedical engineering and a member of the scientific committee of the CI3M of the Universidad Autonoma Metropolitana-Iztapalapa. He has a doctorate in Biomedical Engineering, and a specialty at the National Institute of Nuclear Research.

He is author of more than 20 scientific publications and 7 national and international patents. He has collaborated closely with various universities and health institutes for the generation of new knowledge. He has received awards for his scientific activity from prestigious organizations such as the Society of Engineering in Medicine and Biology (EMBS), the Mexican Society of Biomedical Engineering (SOMIB).

Acute Response Evaluation of a PLA-pPPy/I Scaffold Implant by MRI in a Rat Spinal Cord Transection Model

Diana María Osorio Londoño[a]*, Axayácatl Morales Guadarrama[b] and Roberto Olayo González[c]

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[b]*Medical Imaging and Instrumentation Research National Center, Universidad Autónoma Metropolitana, Iztapalapa, Mexico City, Mexico*

[c]*Physics Department, Universidad Autónoma Metropolitana, Iztapalapa, Mexico City, Mexico*

Abstract:

Biomaterials research focused on spinal cord injury (SCI) recovery is a prevailing field since currently there are no effective treatments for the complete restoration of sensory motor function, which is potentially affected by SCI. Plasticity plays a fundamental role in the nervous system, so it is necessary to clearly differentiate the recovery by endogenous mechanisms from improvement due to the therapy. In this work, a fibrillar scaffold based on polylactic acid treated with iodine-doped plasma pyrrole polymer (PLA-pPPy/I) was implanted as treatment for a rat spinal cord transection injury model. The injury and tissue response to the implant was investigated postoperatively using MRI and locomotion analysis, to characterize the accuracy of the injury model and the acute effects of the polymer implant. MRI evidenced that the model of injury had completely disrupted the spinal cord structure, clearly dividing the tissue in two segments, with the implant between them. Spectrum metabolite concentrations were significantly altered at the injury site. These results suggest that since the complete injury model was established, in this study the fibrillar implant played a key role promising recovery.

Biography:

Diana Osorio Londoño is a PhD student in Biomedical Engineering, in the Tissue Engineering area at Universidad Autónoma Metropolitana-Iztapalapa. With a bachelor's degree in Electrical and Electronical Engineering from Universidad Nacional Autónoma de México, and a master's degree in Biomedical Engineering from Universidad Autónoma Metropolitana-Iztapalapa, her research focuses on polymeric scaffolds for neural tissue engineering, nervous system repair and regeneration.

Numerical Approach for the Determination of Global Mechanical Properties of a Flame Retardant Class Material (FR4)

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Abstract:

The present investigation aims to propose a numerical method for the prediction of effective mechanical properties of a FR4 laminate. Since FR4 designs a class of materials, a characterization is mandatory to find the precise properties of an unknown FR4. To this end, an inverse method based on numerical homogenization is developed. This numerical homogenization based on the mechanics of structure genome (MSG) provides all elastic properties of FR4 laminate composite through a single computation. In addition, a homemade software based on a Python script called Cmbsfe was written. The microstructure of the FR4 laminate was identified through some microscopic observations and ImageJ software: glass fiber volume fraction and yarn geometric parameters in warp and weft directions were evaluated. A two-step homogenization procedure was then performed. The first one deals with effective elastic properties of yarn in both warp and weft directions. The effective properties of yarns, matrix elastic properties provided by nano-indentation and geometric parameters, as revealed by microscopic observations, were then handled for the determination of elastic properties of FR4 laminate. Since the elastic behavior of the matrix between yarns remains unknown, some deviations between predicted properties and experimental data were noticed and solved via an optimization procedure. A quadratic cost function and a Nelder-Mead algorithm were applied to perform the optimization. The developed numerical method provides relevant elastic properties of FR4 composite structure and enables to perform a numerical simulation of the thermomechanical response of a printed circuit board structure when subjected to typical operational thermomechanical loads.

Biography:

Ange Grégoire Odjoutchoni Atintoh is a PhD candidate working both at the French Atomic Energy and Alternative Energy Commission Technology unit (CEA Tech) and the University of Lorraine. His research focus on modeling the thermomechanical behavior of a printed circuit board. This modeling can enhance the reliability of electronic card.

Ange sings as a tenor in the choir of the cathedral of Metz and like to hone his programming skills

Potentiality of Flax Gum-filled Epoxy Resin for Composite

Bastien Watbled[a*] and François Delattre[a]

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Abstract:

The incorporation of flax gum as a reinforcement for the manufacture of biocomposites seems to be an interesting solution for the production of interior linings by thermo-molding of composites for automotive and aviation industries. Indeed, it has been shown that the introduction of polysaccharides in the materials, which form a mixture with the thermosetting resin, allows to reduce the curing time of the composites and to obtain low density materials while

preserving interesting mechanical properties.

In this context, a new range of composites has been developed by thermo-molding from short flax fibers, biosourced epoxy resins and polysaccharides extracted from flax seeds. In a first step, different foams were produced by chemical modification of the flax gum (TEMPO oxidation, epoxidation) in order to evaluate the impact of these structural variations on the mechanical properties of the materials and with a view to improve the fiber-matrix interface. Secondly, in order to improve the fire behavior of the composites, the epoxy resin was phosphorylated by microwave and ultrasound in order to modulate and optimize the phosphorylation rate.

Finally, the new materials were characterized by SEM, densimetry, calorimetry (ATG, DSC). The thermal (conductivity, effusivity, diffusivity) and mechanical (compression test) performances were evaluated.

Biography:

Bastien Watbled is a 3rd year PhD student in organic, inorganic and industrial chemistry at the Université du Littoral Côte d'Opale (ULCO) in Dunkerque, France. He is working on the development and characterization of a new biocomposite from flax with fire retardant properties. He was a research collaborator at the Département de Pharmacochimie Moléculaire (DPM) in Grenoble, from 2018 to 2019 on functionalization of cellulose nanofibrils for the development of biobased medical devices. He received his Master's Degree in Green Chemistry at the Université Savoie Mont Blanc in Chambéry, France, in 2018.

Design and Fabrication of Green Nanocomposites of Poly(N-vinyl pyrrolidone)

Ayse Cagil Kandemir[a]*, Fatma Donmez[b] and Hatice Kaplan Can[b]

[a]TED University, Faculty of Engineering, Mechanical Engineering, 06420 Cankaya, Ankara, Turkey

[b]Hacettepe University, Faculty of Science, Division of Polymer Chemistry, 06800, Beytepe, Ankara, Turkey

Abstract:

Water-solvent based eco-friendly route has been followed in this study for the production of the biocompatible polymer nanocomposites. As the polymer matrix, Poly(N-vinyl pyrrolidone) (PVP) was chosen because it is water soluble, biocompatible and non-toxic. As for additive, Nanoclay was utilized, since in addition to its biocompatibility, it is non-toxic, abundant in Nature and cost effective. In addition to them, its large surface area enables enlarged interaction zone with polymer chains which provides superior mechanical and thermal properties for polymer nanocomposites. Two different types of nanoclays, which are tubular halloysite nanotube (HNT) and layered bentonite (BNT) were utilized in this study. In addition to the pristine usage of HNT, aminopropyltriethoxysilane (APTS) surface-functionalized HNT was also produced. Characterization and structure-property relations are carried out by Fourier Transform Infrared (FTIR), X-ray Diffraction Spectroscopy (XRD) and thermal stability analysis was accomplished by Thermal Gravimetric Analysis (TGA). The XRD results of the BNT nanocomposite showed that without any surface modification, the silicate layers of pristine BNT were able to exfoliate in the PVP matrix. TGA results revealed that the improvement in thermal stability increased nearly equally by %8 when either pristine HNT or pristine BNT were added in PVP matrix. While the highest improvement in thermal stability was achieved when APTS-modified HNT was chosen as additive; as the thermal stability improvement was raised to %11 with modified halloysite. This achievement was attributed to hydrogen bond formation between the amine group on HNT surface and the carbonyl group of PVP.

Biography:

Dr. Ayse Cagil Kandemir received her bachelor's (2004-2008) and master's degrees (2008-2011) from METU Metallurgical and Materials Engineering Department (Ankara/Turkey). She started her academic career as a research assistant in the same department. She conducted her doctoral studies in the Materials Science Department of ETH Zurich (Zurich/Switzerland) between 2011-2016. She worked as a research assistant in ETH Zurich for four years. Her research interests include composite and nanocomposite materials, biopolymer/biocomposites, surface science/thin films, atomic force microscopy/lithography. Since June 2018, she has been a faculty member at TEDU Mechanical Engineering Department.

Diazirine-Based Universal Polymer Crosslinkers: Applications in Material Strengthening and Composite Material Fabrication

Jeremy E. Wulff*

[a]*Department of Chemistry, University of Victoria, Victoria, BC, Canada*

Abstract:

Adding chemical crosslinks between the chains of existing polymer materials provides increased mechanical strength, improved high-temperature performance, and enhanced solvent resistance. We recently developed a family of rationally designed, diazirine-based crosslinker reagents that allow for the facile introduction of strong covalent bonds to virtually any aliphatic polymer material, through rapid C–H, O–H, and N–H insertion reactions [1–3]. This presentation will focus on several recently published and not-yet-published applications of diazirine-based crosslinkers, which arise through operationally simple, topical treatment of existing polymer materials using these newly developed reagents. Selected applications include upgrading the mechanical strength of ballistic protective fabric [4], construction of novel fiber-reinforced UHMWPE–epoxy composites [5], development of self-sterilizing fabrics [6], and enhancement of the mechanical robustness of omniphobic PDMS coatings [7].

[1] *Science*, **2019**, *366*, 875; [2] *Chemical Science*, **2021**, *12*, 4147; [3] *Chemical Science*, **2021**, *12*, 12138; [4] *ACS Applied Polymer Materials*, **2021**, *3*, 6008; [5] *ACS Applied Polymer Materials*, **2022**, *4*, 1728; [6] *Scientific Reports*, **2021**, *11*, 19029; [7] *Chemical Engineering Journal*, **2022**, *in press*.

Biography:

Jeremy Wulff is a professor of organic chemistry at the University of Victoria. His research focuses on the development of innovative molecules that can be used to solve real-world problems in medicine and materials. Projects in the group range from the total synthesis of structurally complex (un)natural products through to detailed chemical biology studies aimed at understanding the biological function of the group's synthetic targets. In addition, the Wulff lab develops new functional polymers, as well as novel diazirine-based reagents that are capable of installing crosslinks and new functionality into commodity polymer materials.

Sustainable Polybenzoxazines: Upcoming Class of Phenolic Polymers

Bimlesh Lochab*

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Abstract:

Depleting fossil fuel reserves and increasing waste reservoirs are amongst the world's most pressing problems. This calls for an exploration of naturally occurring building blocks for developing bio-based polymers. Polybenzoxazines is a new class of thermally curable thermosets being pitched as superior alternates of phenolics. In this work we intend to exploit the options of synthesizing partially bio-based polybenzoxazines following green chemical principles of atom economy, bio-renewable feedstock, solventless synthesis and nontoxic waste generation. In addition, the molecular flexibility of benzoxazine moiety has been utilized by studying the relation between higher functionality and properties. These polymers have shown improved thermal stability compared to their non-green counterparts and ability to copolymerize with another industrial wastes/resources thus finding wide applicability from adhesive, antibacterial materials to cathodes for energy storage devices.

Biography:

Professor in Department of Chemistry at SNU, M.Sc., M.Tech. from India and D. Phil. From the University of Oxford, and PDF University of Nottingham, UK. She is a recipient of several research grants, awards: The First Most Creative Research Award, Research Excellence Award, GYTI award, CRSI Bronze award, Distinguished alumna award. Her pioneering work on Green Chemistry more specifically inverse vulcanization copolymers for Li-S battery application cited in several newspapers. She has been invited as an expert on "LIB" for Panel discussion, Vigyan Prasar, DST. She has been invited several times to Chair sessions in National and international conferences. Invited to give first Lecture in the Young Talents and Upcoming Investigators. Received many honors/fellowships FRSC, Young Scientist Award, Fellowship from C. R. Barber Trust Fund (IoP, UK, 2005), Felix Scholarship, CSIR–JRF, Radha Sai Ram Memorial prize.

She is a Chief Executive member of Sustainability Forum and National Advisory Committee Member in Asian Polymer Association (APA).

Elaboration of Composites Based on Polypropylene or High Density Polyethylene and Cork Wastes

PETLITCKAIA Svetlana*, BARBONI Toussaint, SANTONI Paul-Antoine

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

Abstract:

The use of the waste materials as filler and as matrix for the composite materials is receiving increasing attention as an approach to increasing the economic value of streams.

In this study, new composite material based on polymer waste (PP or PEHD caps) and cork powder from unused cork (male cork) was developed. The composite based on polymer waste and modificated cork powed used as flame retardant was also tested. The interest the use of cork is a high capacity for thermal insulation.

The composite materials were obtained by twin-screw extrusion and by injection molding. The maximum incorporation of cork on the matrix was 20 % in weight. These composites were investigated in term of mechanical, structural and thermal properties. Evaluation of the flammability of the composites was performed using cone colorimeter. Results show, for example, that the peak HRR value for composites based on PP an PEHD with 10 % of cork is 534 kW/m2 and 686 kW/m2 respectively. The value of thermal conductivity for composites for composites PP/cork and PEHD/cork is about 0.170 W/mK and 0.230 W/mk respectively.

The feasibility of the composites based on cork and PP or PEHD wastes opening new ways of valorization of male cork and plastic wastes. The thermal insulation and fire resistant properties will be optimized.

Biography:

Svetlana PETLITCKAIA is a Postdoctoral in material science at the University of Corse. She holds a PhD in condensed matter physics from University of Montpellier in 2018. Her research interests include organic and inorganic materials such as polymers, plasters, cements, geopolymers and composites based on these materials.

Magnetic Field Distribution in Moulds for Injection of Hard Ferrite-based Magnets

José Silvaa*, J. Fonsecaa, J. Camarinhaa, D. Dias*a, P. Costab, M. Silvab

[a]*CeNTI – Centre for Nanotechnology and Smart Materials, V. N. Famalicão, Portugal*

[b]*GLN, Leiria, Portugal*

Abstract:

In the automotive industry, where accuracy and lightness are of utmost importance, plastic injection moulding is an important manufacturing process. The presented work aims to investigate the production of composite magnetic gear wheels to replace plastic gears with an embedded magnet typically used in sensors to assist driving. In the injection process of the magnetic gears, a sufficient magnetic field must be in the injection mould cavity to ensure the composite material's complete magnetisation. The magnetic field is generated by permanent magnets incorporated into the mould designed to produce composite magnets. Numerical simulation studies were crucial to assessing the influence of mould materials and magnets' position and geometry on the cavity field and have assisted in the mould design process and mould material selection.

The developed composite magnets were mainly composed of hard-ferrite and PA12. The percentage of hard-ferrite in the composite determines the maximum remanent magnetic field of the resultant magnet. Although an increase in ferrite results in an increased remanent field, it also increases the viscosity and makes the injection process more difficult. A good compromise between magnetisation and injection conditions was achieved with a composite with 85% hard-ferrite and 15% PA12 (weight percentages).

The Magnetized Gears project consortium is constituted by GLN Molds, the promoting company, and GLN Plast, CeNTI, PIEP and University of Minho as co-promoters. The project is co-financed by Portugal 2020, under the

Operational Programme for Competitiveness and Internationalization (COMPETE 2020), from European Regional Development Fund (ERDF).

P(pressure)-T(Temperature) Path Based Control Technology to Achieve High Weight Reduction and Foaming Quality for Thermoplastic Polyurethane (TPU)

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[b]*R&D Center for Semiconductor Carrier, Chung Yuan Christian University, Taoyuan 32023, Taiwan (R.O.C)*

Abstract:

Microcellular injection molding technology (@MuCell) using supercritical fluid (SCF) as a foaming agent is an important green molding solutions for reducing the part weight, saving cycle time and molding energy, and improving dimensional stability. Thermoplastic Polyurethane (TPU) is a common material for molding the outsole of shoes because of its outstanding properties such as hardness, abrasion resistance, and elasticity. Although many shoe manufacturers have tried to applying Mucell® processes to TPU midsoles, the main problem remained to be overcome is the non-uniformity of the foaming cell size in the molded midsole. In this study, the MeCell process combined with T-P based control technology, namely, gas counter pressure (GCP) and dynamic mold temperature control were carried out to for TPU foaming. Hopefully, the new processing can achieve high foaming qualities for TPU.

The results show that in addition to the gas counter pressure and the variable mold temperature when the gas-pressure holding time and gas-pressure relief speed are included to construct a wider range of T(Temperature)-P(Pressure) variations and paths, the foaming control become more effective. The multi-stage GCP leading to 15% increase in cell density and the standard deviation of cell diameter is reduced from 12.30μm to 1.67μm in the case of 4mm thick part. The optimized molding conditions for the various T-P combination can achieve high foaming uniformity, namely, over 80% of the cell size ranging within 20~40μm meanwhile with 60% weight reduction. The successful possibility for microcellular injection molding of shoe midsole is greatly enhanced.

Biography:

He did his Bachelor, graduate in 2019 from Department of Industrial and Systems Engineering (ISE), Chung Yuan Christian University and perusing his Ph. D. in Department of Mechanical Engineering (ME)

His Research areas are Advance injection molding technique: Microcellular injection molding (MuCell) foaming technology, gas assist technology (Gas Counter Pressure, GCP; Gas Assisted Injection Molding, GAIM), in-mold sensing technology, etc. Application of computer aided engineering on injection molding.

Control of the Final Morphology of Epoxy-Thermoplastic Blends

Anne Cologner[1,2*], Marie-Laure Michon[2], Claude Billaud[2], Didier Long[1]

[1]*Matériaux, Ingénierie et Sciences (MATEIS), UMR 5510 CNRS - INSA de Lyon, France*

[2]*Solvay Research and Innovation Center, St Fons Cedex, France*

Abstract:

Thermosetting epoxy resins are used to lighten materials weight in aerospace and automotive industries. High performance resins exhibit excellent physical properties with high temperature performance and chemical resistance. Nevertheless, high crosslink density makes the resins brittle. To improve mechanical properties, thermosets can be toughened by the dissolution of a thermoplastic into resin monomers followed by a phase separation during curing cycle [1]. By controlling final morphology, mechanical properties can be enhanced for composite applications.

The main parameters that control final morphology have to be determined. The associated length scale is a key parameter regarding mechanical properties and toughness of the materials. Previous thesis [2] has allowed to identify two key parameters for controlling the morphology. Solubility parameters between constituents control the phase separation onset and the corresponding conversion stage. Glass transition temperature of the blend at phase

separation controls the rate of morphology growth.

Thermoplastic-modified epoxy resins consist of different epoxy monomer structures modified with a fixed amount of commercial thermoplastic and cured with different curing agents. Mechanism of phase separation process which takes place during curing of epoxy-thermoplastic blends has been studied. Also, synthesizing thermoplastic copolymers from different monomers will give access to a broader range of glass transition temperatures and solubility parameters.

For systems containing commercial thermoplastic, it has been demonstrated that the scale of morphologies depends on the initial solubility parameters of each component. For large values of solubility parameters, early phase separation and micron-scaled morphology were observed. With more compatible curing agents, late phase separation occurs and morphologies of few hundred nanometers have been observed.

References:

[1] Pascault J.-P ; Sautereau H. ; Verdu J. ; Williams R. J. J., Thermosetting polymers, **2002**.

[2] Mathis E., Thermoplastic toughened thermoset composites: control of morphology, in relation with applicative properties, **2020**.

Biography:

She Graduated of engineering school at ENSIC (Ecole Nationale Supérieure des Industries Chimiques, Nancy, France), I am pursuing a PhD thesis in order to integrate myself into the research field. This thesis is carried out within industrial funding from SOLVAY in partnership with the CNRS and the Mateis laboratory. My work is directed by Didier Long, researcher at the CNRS, and supervised by Marie Laure MICHON and Claude BILLAUD, research engineers at Solvay.

Weathering of Polymers: Investigations from Molecular Scale Towards Material Properties

Jean-Luc Gardette*, Pierre-Olivier Bussiere, Sandrine Therias

Université Clermont Auvergne, CNRS, Clermont Auvergne INP, ICCFF-63000, Clermont-Ferrand, France

Abstract:

One major problem associated with polymers is their instability to outdoors ageing and particularly to daylight. The UV light and the short wavelengths of the visible light can indeed induce photochemical processes that result in dramatic changes of the properties, usually referred as degradation. The weathering of polymers has then been the subject of intensive scientific research over the past 50 years. In addition to the academic interest for understanding the mechanistic behaviour of polymers, developing and adapting rational strategies to improve material performance and predicting the service life of polymers are most valuable for practical applications of polymeric materials.

It is now well admitted that, in outdoors weathering conditions, most of the properties degradation results from chemical changes of the macromolecules. In a majority of cases, the main cause of property deterioration is photooxidation. Effects from heat, moisture, pollutants, mechanical stresses, and biological attack can come into play, but usually the weathering process begins with a photochemical event. The main photochemical processes involved result in fixation of oxygen, rearrangements, chain scissions, cross-linking. All these processes contribute to a decrease of the properties of the materials, such as physical, mechanical, barrier, aspect, electrical ... properties.

This talk focuses on both the fundamental and technical aspects of polymer weathering. Several examples in the fields currently covered by the activities of our research group will be presented.

Biography:

Jean-Luc Gardette is currently Emeritus Professor at University Clermont Auvergne (France). He received his Ph. D. degree in Photochemistry in 1976 and a Doctorat-ès-Sciences in 1983 in the field of polymer photodegradation. From 1992 to 2004 he was Director of the Laboratoire de Photochimie, a research unit of 45 persons. Professor Gardette's current research interests are centred primarily on the fundamental aspects of photodegradation and photostabilization of polymers. Professor Gardette is the author of more than 280 journal papers. He was Chairman of MoDeSt Society (Modification, Degradation and Stabilization of Polymers) (2008-2012) and Editor-in-Chief of "Polymer Degradation and Stability" (2010-2020).

Multiscale Analysis of the Photodegradation of Polymer Blends and Composites

Sandrine Therias *, Pierre-Olivier Bussiere, Jean-Luc Gardette

Université Clermont Auvergne, CNRS, Clermont Auvergne INP, ICCFF-63000, Clermont-Ferrand, France

Abstract:

Predicting the service life of polymeric materials exposed to environmental stresses has been a need of the polymeric community for over tens of years. One of the critical stress for polymers is UV-light irradiation, and photodegradation is studied thanks to accelerated artificial devices.

The degradation process in polymer blends and composites needs to be investigated at different levels of analysis as well as the influence of fillers and nanofillers. Depending on the filler functionality and morphology, the polymer photodegradation kinetics can be impacted. Modifications of the polymer properties are measured using macroscopic techniques and are followed as functions of the irradiation time. These modifications are explained in light of the modifications of the chemical structure. Chromatographic methods, such as size exclusion chromatography (SEC), also give molecular information on the modifications of the molecular weight during ageing. Gel fraction analysis and swelling of polymer films irradiated in presence of oxygen can reveal an insoluble fraction. Thermal analysis by Differential Scanning Calorimetry (DSC) characterizes the macromolecular architecture and the cristallinity. Atomic Force Microscopy (AFM) has demonstrated that this technique is a powerful tool to monitor the polymer surface modifications due to ageing. On the basis of a multiscale analysis methodology, qualitative and quantitative correlations can be obtained between the main relevant criteria, characterizing the degradation of the properties such as the surface degradation or the mechanical properties and the chemical structure. This presentation will be devoted to examples illustrating the methodology developed for multiscale analysis of polymer degradation in blends and composites.

Biography:

Dr. Sandrine Therias is a Research Director at the French CNRS (National Center for Scientific Research) at the Institut de Chimie de Clermont-Ferrand (ICCF). She is currently head of the Photochemistry team, and head of "Chemistry and Materials" topic at ICCF. The focus of her research is the photochemical behavior of polymers and nanocomposites. Dr. Therias develops a multiscale approach based on physico-chemical analysis of polymer degradation, to understand the degradation mechanisms, the impact of nanofillers and the reactivity at interfaces. She has published 125 scientific papers, 1 patent, presented 7 invited talks in international conferences and 115 oral presentations.

Ordering in Thin Block Copolymer Films Induced by In-Plane Alternating Electric Field

Yaroslav I. Derikov[a], Alexei S. Merekalov[a], Alexander A. Ezhov[a,b] and Yaroslav V. Kudryavtsev[a,c]*

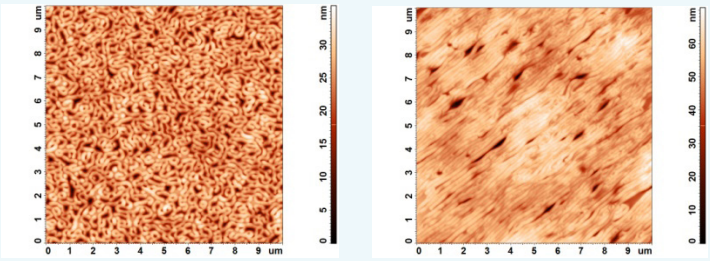
[a]*Faculty of Physics, M. V. Lomonosov Moscow State University, Leninskie gory, Moscow, Russia*

[b]*Topchiev Institute of Petrochemical Synthesis RAS, Moscow, Russia*

[c]*Frumkin Institute of Physical Chemistry and Electrochemistry RAS, Moscow, Russia*

Abstract:

It is known that electric fields can align microphase-separated patterns in block copolymers along the field lines. In a recent paper (Merekalov et al *Polymers* **13**, 3959 (2021)) we demonstrated the possibility to rearrange standing cylinders of the minor component by lining them up in the direction of an in-plane DC field and to force their partial merging into standing lamellas on the tens of microns scale. In this study, we refine the approach by using an AC field instead DC one. It also causes the copolymer realignment but lowers the electric breakdown probability, eliminates effects related to ionic transport in the presence of solvent vapor, and makes it possible to adjust the dielectric contrast by changing the frequency of the applied field. We use thin films of cylinder-forming PS–P4VP and lamella-forming PS–P2VP diblock copolymers to study the role of such factors as the exposure time, field strength and frequency.



Morphology of the PS–P2VP copolymer film (left) before and (right) after applying an in-plane AC field

Acknowledgement: The study was supported by the Russian Science Foundation (project 21-13-00411).

Biography:

Yaroslav V. Kudryavtsev has obtained his Ph.D. in 1997 from the Lomonosov Moscow State University, passed Habilitation in 2005 at the Semenov Institute of Chemical Physics, and become a professor of the Russian Academy of Sciences in 2016. He is the head of the Laboratory for Polymer Modification at the Topchiev Institute of Petrochemical Synthesis in Moscow. His scientific interests are focused on studying macromolecular reactions and copolymer ability to self-assemble in various media.

Self-Assembly of Diblock Copolymers with Thermoresponsive Blocks in Solution

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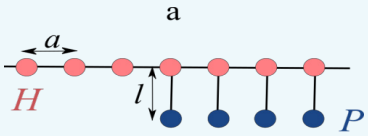
[b]*Topchiev Institute of Petrochemical Synthesis RAS, Moscow, Russia;*

[c]*A. N. Nesmeyanov Institute of Organoelement Compounds RAS, Moscow, Russia.*

Abstract:



Many thermoresponsive polymers are characterized by a locally amphiphilic chain structure. Self-assembly of such polymers in solution is controlled, in particular, by surface activity of monomer units or side chains. We theoretically study the condensed state of diblock copolymer molecules consisting of hydrophobic blocks and amphiphilic (thermoresponsive) blocks which contain hydrophobic groups in the backbone and pendant polar groups. Using the mean-field approach, we construct morphological diagrams depending on the molecular parameters. In particular, appearance of granular micelles consisting of spherical or nearly spherical particles is predicted[1] in agreement with the experimental data in the literature. The diagrams are compared with those of copolymer molecules with the same fraction of amphiphilic monomer units which are regularly distributed along the chains.[2]

Acknowledgements: The study was supported by the Russian Science Foundation (project 19-13-00398).

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Biography:

Elena N Govorun is an Associate Professor at the Moscow State University, Faculty of Physics, Chair of Polymer and Crystal Physics since 2011. Her research interest is the theory of macromolecular systems, in particular, self-assembly phenomena and models of diffusive and reacting systems. She is involved in the collaboration with the groups performing computer simulations.

Mechanisms of Luminescence in Lanthanide Materials: A Crucial Role of Metal-Ligand Covalency

Liviu F. Chibotaru[a]*, Bernat Szabo[a], Zeid A. AlOthoman[b], Abdullah A. S. Al-Kahtani[b], and Liviu Ungur[c]

[a]*Theory of Nanomaterials Group, Katholieke Universiteit Leuven, Leuven, Belgium*

[b]*Department of Chemistry, King Saud University, Riyadh, Saudi Arabia*

[c]*Department of Chemistry, National University of Singapore, Singapore*

Abstract:

Optical spectroscopy of rare-earth ions or lanthanides is a continuously active research topic, first of all, due to numerous applications. Thus rare-earths often serve as hybrid materials and agents in magneto-resonance imaging, are widely used in lasers and optical amplifiers, for up-conversion luminescence and in a variety of near-field optical sensors and as phosphors, in particular, in display screens. Current understanding of luminescence of lanthanide complexes is based on the phenomenological Judd-Ofelt (JO) theory. However, the mechanisms of electric-dipole transitions lying at its ground was never subject to a rigorous analysis. Here, we investigate the contributions to the intensity of the green band in the Er-trensal complex by using state-of-the-art *ab initio* calculations. We find that the conventional JO mechanism based on electrostatic crystal field yields only a quarter of the integral intensity of this band. The rest is contributed by covalent binding of Er and ligand orbitals via three major mechanisms, the 4f-ligand and the ligand-ligand electric dipole transitions and the covalent enhancement of hybridization of 4f and even empty orbitals of erbium. We expect that these findings will inspire the design of efficient rare-earth luminescent materials.

Biography:

Dr. Liviu Chibotaru received his Ph.D. degree from the Institute of Chemistry of the Academy of Science of Moldova. He is currently Associate Professor at the Department of Chemistry of KU Leuven. His research includes the theory of magnetic and vibronic interaction in transition metal compounds; the theory of anisotropic exchange interaction and relaxation in magnetic materials; the theory of multiband and mesoscopic superconductors.

Plasma Pen in Surface Modification and Crosslinking of Natural Polymers

Renata Antoun Simão

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Centro de Tecnologia, Bloco F, Sala F-214, Av. Horácio Macedo, 2030 - Cidade Universitária, Rio de Janeiro - RJ, CEP: 21941-598

Abstract:

Plasma pen is being used to modify different natural polymers and change their physico-chemical properties. Usually used on solid substrate, recent studies have observed interesting phenomena when plasma jets were applied in liquid medium, like water. It was possible to notice that the interface region between plasma and liquid chemically active, which can promote chemical reactions through photolysis, caused by UV radiation, and by the reactive species generated. Despite the area of contact of the liquid with the plasma tip to be very small, the effects of plasma can be perceived throughout the liquid medium through the flow that is generated. When chemicals are added in liquid medium several additional reactions can be observed, such as the formation of surface reticulation and polymerization inducing the formation of nanoparticles. In this talk, we will present some results and discuss mechanisms related to the modification of starch, polylaticacid (PLA), lignin and natural fibers when they were treated by plasma in different liquids with different gases. Thermal properties as well as morphological changes were observed leading to materials that can present diverse properties opening a new field of applications for these materials.

Utilization of Bio-sourced Terpene Monomers to Produce More Sustainable Elastomers

Ramón Díaz de León[a]*, Maiby Valle[a], Teresa Córdova[a], Ilse Magaña[a], Marisol Gálvez, Arnulfo Banda[a], Javier Enriquez[a], Ricardo López[a]

[a]Research Center for Applied Chemistry, Saltillo, Coahuila, México

Abstract:

Due to the negative environmental impact of using petroleum as raw material, upcoming regulations are promoting the use of natural raw materials to produce bio-based polymers. The search for sustainable alternatives has attracted interest in bio-source terpenes, which are natural unsaturated hydrocarbons constituents of resin plants and essential oils that can it extracted by distillation and are considered as renewable resources. One of the main molecular features of terpenes is their carbon skeletons build for isoprene units, which contain an electronic environment similar to isoprene, and some of them for instance β-myrcene and trans-β-farnese have the potential to be polymerized and copolymerized by the same mechanisms as the conjugated dienes among them isoprene and 1,3-butadiene. In an effort to contribute in this field, in this work the coordination polymerization in solution and free radical polymerization via emulsion were used in order to produced a vast scenario of sustainable terpene elastomers. The obtained polyterpenes were characterized by size exclusion chromatography (SEC), nuclear magnetic resonance (NMR) and differential scanning calorimetry (DSC) in order to determine their molecular weights, microstructures and thermal behaviors. Additionally the vulcanization was also performed in polymircene and polyfarnese using both graphene and cellulose structures as reinforcing alternatives. The materials were evaluated in mechanical and dynamic mechanical terms and their properties were related with the molecular structure and physicochemical characteristics.

Biography:

Ramón Díaz de León received his PhD in Polymer Chemistry from the Research Center for Applied Chemistry in Saltillo, México, in 2003. He has published several works and dedicated his career to the synthesis of polymers, working with several kinds of catalysts based on zirconium and titanium to polymerize olefins, and mainly neodymium to polymerize 1,3-dienes and terpenes to produce bio-elastomers. Since 2007 to date, he has been working as a researcher in the Research Center for Applied Chemistry in the Department of Polymerization Processes.

A Study of Thermal and Mechanical Properties of Recycled Polypropylene Obtained from Packaging Waste

Tatiana Zhiltsova[a*], Laura S. Prior[a], Mónica Oliveira[a] and Joel Vasco[b]

[a]*Department of Mechanical Engineering, Center for Mechanical Technology and Automation (TEMA), University of Aveiro, 3810-193 Aveiro, Portugal*

[b]*Polytechnic Institute of Leiria, Institute for Polymers and Composites/I3N, University of Minho, Portugal*

Abstract:

As the need for reutilization of plastic materials is constantly growing in the pursuit of environmental damage reduction, it is becoming critical to understand the effect of recycling on the properties of these materials. Moreover, the mechanical recycling of plastics retrieved from waste recycling facilities requires several additional preparation steps that may influence the quality of new products obtained from the latter. In this study, the recycling effects on the crystallinity and mechanical properties of the post-consumer polypropylene (PP) originated from the waste of food or non-food packaging were investigated. Besides thermomechanical degradation, these plastics are contaminated from their primary use and/or collection methods. To understand the influence of contamination, three different washing procedures were applied to post-consumer PP collected from waste treatment facilities. Thermal properties of recycled PP were assessed by Differential Scanning Calorimetry (DSC), and crystallinity evaluation was complemented by X-ray diffraction (XRD). Moreover, mechanical properties of these materials were evaluated in tensile mode. Degradation of recycled PP samples was demonstrated through the DSC results by a decrease in the melting temperature and crystalline content and increase in crystallization temperature. Oxidation induction time (OIT) tests corroborated this data, as significantly less time was required to induce oxidation than in the reference virgin PP sample. The latter was further confirmed by drastic reduction of ductility in all the samples of recycled PP and, hence, a significant decrease in the elongation at break. It should be stressed, nevertheless, that slight ductility improvement was observed in the samples decontaminated by washing.

Biography:

Dr. Tatiana Zhiltsova is an assistant researcher at TEMA (Centre for Mechanical Technology and Automation), Department of Mechanical Engineering, University of Aveiro. She was awarded her PhD by University of Aveiro, Portugal in the field of computational simulation of heat and mass transport phenomena in non-Newtonian fluids at microscale. Prior to her assistant researcher position, she was a postdoctoral research fellow at TEMA where she

dedicated herself to computational simulation of mass transport phenomena in reactive and non-reactive porous media. Her current activities focus on the areas of computational fluid mechanics in its modelling, simulation, and optimization aspects of technological processes.

Chemical and Physical Aging in Diglycidylether of Bisphenol A (DGEBA) Epoxy Thermosets and Predicting Structural Implications of the Aging

Jamie M. Kropka[a*], Gabriel K. Arechederra[a], Kelsey M. Wilson[a], John D. McCoy[b], Kevin N. Long[a], and Kenneth N. Cundiff[a]

[a]*Sandia National Laboratories, Albuquerque, NM, USA*

[b]*New Mexico Institute of Mining and Technology, Socorro, NM, USA*

Abstract:

Epoxy thermosets are ubiquitous in high-reliability packaging applications. The availability of specialized formulations, high-performance properties, and reliability make them an attractive option as encapsulants and adhesives. While the high covalent cross-link density common to epoxy thermosets makes them less susceptible to "falling apart" than their elastomer counterparts, they do undergo chemical and physical changes over their lifetime than can significantly impact their performance. This presentation will focus on two technologically relevant epoxy thermosets, an epoxide-rich mixture of DGEBA and diethanolamine (DEA) and a stoichiometric mixture of DGEBA with Jeffamine T-403 (T403). While the DEA-cured material contains remaining epoxide groups after its standard cure process, the T403-cured material essentially extinguishes all epoxide-amine reactivity during cure. The remaining reaction potential in the DGEBA/DEA offers an additional route of "aging" in the material. Some signatures of the differences in material evolution over time between these two formulations will be illustrated. Experimental work aimed at identifying key material changes with time that are relevant to structural performance will be summarized. The measurements form a basis to assess the ability of physics-based solid mechanics models to predict the material evolution. Some comparisons between measurements and predictions will be given and discussed in terms of the current understanding. If time allows similar measurements on commercial epoxy formulations will also be reviewed.

Biography:

Jamie is a chemical engineer that has specialized in polymer physics, with interests in areas of adhesion, polymer glasses, thermal analysis, and viscoelastic/stress-strain response of organic materials, especially as applied to packaging of electronic/mechanical/optical devices. He has spent considerable time collaborating with solid mechanics practitioners to understand stress in polymers. When the demands of science/engineering lessen, mountain hiking, running, cycling, and family sports draw his attention.

The Role of Electrostatic Interactions in the Mechanics of Solids-state Biopolymers

Suellen Pereira Espíndola[a*], Jure Zlopasa[a] and Stephen Picken[a]

[a]*Delft University of Technology, Delft, South Holland, The Netherlands*

Abstract:

Biopolymers are a great alternative to petroleum sources as they are abundant, renewable, and biodegradable. They are commonly used as gelling agents in the food and cosmetics industries as well as in medical and packaging applications. There are plenty of cost-effective, lightweight, and high-performance materials being proposed. Even though there is demand, industrial production is still very limited because of the lack of control over (solid-state) mechanical and thermal properties. Upon investigating the stiffness (Young's or Storage Modulus) of biopolymers, one finds remarkably high values, as much as E' = 13 GPa in dry form. We hypothesized that higher attractive forces arise due to functional ionic groups, i.e., strong Coulombic interactions. We carefully determined the charge density (ρ) values for a substantial list of various (bio)polymer classes, which could be nicely correlated to experimentally obtained modulus values. Our experimental efforts lead to a simple linear relationship of E' vs. ρ. Indeed, the elastic modulus of polymers is vastly influenced by ionic interactions. Biological organisms tend to produce biopolymers with ionic groups, resulting in higher resistance to deformation due to charged pairs. Additionally, to a lesser extent, E' is increased by secondary interactions, such as H-bonds and polar. We find that the baseline neutral modulus

of biopolymers is generally higher than of standard engineering polymers, 4-5 GPa in contrast to 2-3 GPa. This illustrates a characteristic rigidness that is inbuilt by nature. The design of novel bio-based materials can have more unknowns but starts at an advantageous point when aiming for high performance.

Biography:

Suellen Pereira Espíndola obtained her MSc degree in Water Technology at WETSUS (Netherlands) and her BSc in Environmental Eng. (Brazil). She has also worked as a junior consultant on bioprocesses at Royal Haskoning DHV (Netherlands). Currently, she is a Ph.D. researcher at the Advanced Soft Matter group of Delft University of Technology (Netherlands). She works under the supervision of prof. Stephen Picken in a project focused on valorizing biopolymers from wastewater by processing them into novel bio-nanocomposite materials.

Polylactic Acid (PLA) based Avionics Table Design Optimization for Unmanned Aerial Vehicle (UAV) with Additive Manufacturing Technique

Ecem Baskın*[a], Berkan Öztürk[a], Cevher Yusuf İnan[a], Pınar Yücel Sevimçok[a], Görkem Muttalip Şimşek[a]

[a]*Turkish Aerospace, Ankara, Turkey*

Abstract:

Weight is one of the most crucial constrain in the aerospace industry. Productive design is another challenge in particular for Unmanned Aerial Vehicle (UAV) due to limited fuselage area. Flight control cards, servo motors, batteries, backup circuit and harness are commonly used in UAVs as avionic equipment and all those should be placed safely on a plate that called avionics table. This research aims to design an optimum avionics table for a UAV using an additive manufacturing method. In this study, experimental studies are structured on investigating the effects of PLA materials (PLA, tough PLA and PLA+), color of filaments and printing orientations. These effects are examined by using standard tensile test. According to test results, the sample that has the optimum mechanical properties is selected in design process. Avionics tables are designed with different weight reduction approaches including hexagon, circle, slot, keyhole and square. Structural analyzes are performed for all designed tables with commercial finite element analyses software. The masses and dimensions of the avionics equipment are determined in accordance with the placement on the table. Afterwards, the masses are defined as point masses and distributed over the avionic table surface by taking the size of equipment into account. The stress and displacement values of different patterned avionic tables are computed and compared in order to select optimum table geometry. The table with the optimum weight, stress, and production duration is manufactured with tough PLA by 3D printers.

Biography:

Ecem Baskın received her B.Sc. degree in Metallurgical and Materials Engineering from Middle East Technical University (METU) in 2021. During undergraduate studies, she focused on nanostructured materials, material characterizations, polymers, polymer based composites, structural design and additive manufacturing. Currently Ms. Baskın works for Turkish Aerospace Industry as a structural design engineer in the department of Engineer Development Programs.

Exploration of the Adsorption Reduction of the Pigment Aggregates Strength Under the Effect of Surfactants in Water-dispersion Paints

Antonina Dyuryagina[a], Aida Lutsenko[b]

[a]*M. Kozybayev North Kazakhstan University, Department of Chemistry and Chemical Technology Petropavlovsk 150000, Kazakhstan.*

[b]*M. Kozybayev North Kazakhstan University, Department of Chemistry and Chemical Technology Petropavlovsk 150000, Kazakhstan.*

Abstract:

We present the results of a study of the disaggregation of titanium dioxide in water-dispersion compositions based on an acrylic film former under the action of a surfactant. The possibility of using polyether siloxane copolymer (PC) and sodium polyacrylate (NaPA) in paint and varnish compositions as modifying additives of the dispersing effect is proved. The correlation between the dispersing effect of surfactants and the amount of their adsorption

on the pigment is proved. NaPA, which provides a greater reduction in adsorption strength, demonstrates a greater dispersing effect than PC. It was found that the larger the size of the aggregates of pigment particles, the greater the disjoining pressure created by the surfactant. An equation is derived that generalizes the cumulative contribution of surfactant concentration and the content of the film-forming agent in suspensions to the average particle diameter of pigment.

Biography:

Dyuryagina Antonina - Candidate of Chemical Sciences, Associate Professor, Head of the Department of Chemistry and Chemical Technologies, NAO SKU named after. M. Kozybaeva.

Main scientific direction Development of modified paintwork materials and coatings with improved properties.

Awards, incentives received by Dyuryagina Antonina: Diploma of the Rector (05/04/2013, in connection with the celebration of the Day of the scientist, for participation in innovative exhibitions); Large gold medal (04/09/2014, in connection with the celebration of the Day of the scientist, for achievements in the field of chemistry); Medal 80 years of NKSU; Bronze medal at the exhibition of inventions "INOVA - BUDI UZOR 2018";Winner of the Republican competition of video lessons "Panorama of pedagogical ideas", in the nomination "Teaching staff of universities", 2018; The title of "The best teacher of the university of the Republic of Kazakhstan - 2019"; Diploma of the Department of Entrepreneurship in the development of small and medium-sized businesses for active participation in the regional competition: "The Best Innovative Project"; A letter of thanks from the Akim of the North Kazakhstan region for many years of conscientious work and a great personal contribution to the development of the education system of the region. She is the Author of more than 250 scientific papers.

Lutsenko Aida, master of technical sciences, PhD student of the North Kazakhstan State University named after. M. Kozybaeva. Main scientific direction Development of modified paintwork materials and coatings with improved properties.

She is the author of more than 15 scientific papers, 2 of which were published in journals with Q1 and Q2 quartiles. Author of a textbook on theoretical inorganic chemistry. Member of multiple international conferences.

Enhancing the Fire and Smoke Safety of Bio–Based Rigid Polyurethane Foam via a Reactive Flame Retardant and Silica Aerogel Powder

Guangxu Bo, Shuhan Dai, Xiaoke Tian, Jianxing Su, Yunjun Yan*

Key Laboratory of Molecular Biophysics of the Ministry of Education, College of Life Science and Technology, Huazhong University of Science and Technology, Wuhan 430074, China

Abstract:

Rigid polyurethane foams (RPUFs) are widely employed as building insulation materials, but they are easy to been ignited and burn quickly in air due to their urethane bonds and many cells, and a lot of heat and smoke are released when RPUFs burn, seriously affecting people's escape. In this study, a phosphorus-nitrogen-containing reactive flame retardant, namely tetraethyl(1,5-bis(bis(2-hydroxypropyl)amino)pentane-1,5-diyl)bis(phosphonate) (TBPBP), was successfully synthesized and used to improve the fire safety of RPUFs, and silica aerogel (SA) powder was utilized to enhance the smoke safety. A castor oil-based RPUF (labelled as RPUF-T45@SA20) was prepared via inserting TBPBP and blending SA powder. Compared with neat RPUF, RPUF-T45@SA20 remarkably improved with the compressive strength and the limiting oxygen index (LOI) value respectively increased by 93.64% and 44.27%, and gained the V-0 rank of vertical burn testing. In contrast to neat RPUF, the total heat release (THR) and total smoke production (TSP) of RPUF-T45@SA20 were respectively reduced by 44.66% and 51.89%. A possible flame-retardant mechanism of RPUF-T45@SA20 was considered to be the double flame retardant effect of gas phase and condensed phase. This study is instructive for the prosperous potential application of castor oil-based RPUFs with the fire and smoke safety via utilizing TBPBP and SA powder in building insulation field.

Biography:

Selected as Chief Scientist of National Major Strategic Projects, Ministry of Education New Century Excellent Talents Program, Hubei Province Outstanding Young Talents Program, Young and Middle-aged Experts with Outstanding Contributions in Hubei Province, Distinguished Post I of Outstanding Scholars in Central China, FIAAM (Fellow of International Association for Advanced Materials). Mainly engaged in research work in the fields of synthetic

biology and biomaterials, energy biotechnology and enzyme engineering, aquatic biology, etc., including: gene editing technology, synthetic biology components (including field-sensitive components), cell factories, biological intelligence, bio-based materials, bio-living materials, bio-cement, bio-adhesive, anti-fouling and drag-reducing materials.

Multi-functionalities on the Moth-eye Surfaces

Yoshihiro Uozu

Science & Innovation Center, Mitsubishi Chemical Corp. 1000 Kamoshida-cho, Aoba-ku, Yokohama-shi, 227-0053 Japan

Abstract:

The living body surface develops many functions with one structure. It is hoped that the structure formed by technique of biomimetics also develops many functions. We have to verify the multi-functionality of the moth-eye surface.

Moth-eye structures can prevent reflection. We have been developing a continuous manufacturing process of moth-eye structures on a polymer film with the roll mold. We verified the multi-functionality of our moth-eye films: reflection, contact angles with water, insect-slipping phenomena.

As for the moth-eye surface consisting of a hydrophobic polymer, the contact angle of the water is around 140 degrees. On the other hand, the value for a hydrophilic polymer is around 20 degrees. We put an insect on the plastic plate and turned the plastic plate 180 degrees. When the surface was smooth, the insect was getting on the plastic board. In contrast, on the moth-eye surface, the insect slipped down from a plastic board for 90 degrees. Most insects slipped down on moth-eye surfaces.

There was a presentation of the results of the study that bacteria were annihilated on the wing of the cicada which had the moth-eye structure in 2013. Like this, the creature defends itself against bacterial infection by various surface of a body structure. The study on correlation of virus and bacteria and microstructure represented by the living body surface is practiced flourishingly now.

Recently, aiming at confirmation of new functionalities, we have been researching the moth-eye surface.

I'd like to report multi-functionalities on the moth-eye surface on that day.

Biography:

Dr. Yoshihiro Uozu is the R&D Fellow of Mitsubishi Chemical of photonics polymer and polymer forming. He received his master degree of Engineering in 1986 from Kyoto University. He is a fellow of the Society of Polymer Science, Japan and a senior member of the Optica. He received the Engineering Doctor's degree of Polymer Science in 2004 from Tokyo University of Agriculture and Technology. He got the award of the society of polymer science, Japan in 2000. He also got the Monodzukuri Nippon Grand Award from the Ministry of Economy, Trade and Industry Japan in 2012.

Harnessing the Pseudo-Doping Effect of Hfp/Tfe Solvent System – Physico-Chemical and Biological Studies

Fábio FF Garrudo[*,a,b,c], Paiyz Mikael[d], Ana Charas[a], Luís F Vieira Ferreira[c,e], Ana M Ferraria[c,e], Ana M Botelho do Rego[c,e], Joaquim MS Cabral[b,c], Robert J Linhardt[d], Frederico C Ferreira[b,c] , Jorge Morgado[a].

[a]*Department of Bioengineering, Universidade de Lisboa, and Instituto de Telecomunicações, Av Rovisco Pais, 1049-001 Lisboa, Portugal*

[b]*Department of Bioengineering, Institute for Bioengineering and Bioscience, Instituto Superior Técnico, Universidade de Lisboa, Av Rovisco Pais, 1049-001 Lisboa, Portugal*

[c]*Associate Laboratory i4HB - Institute for Health and Bioeconomy, Portugal.*

[d]*Department of Chemical and Biological Engineering, Biology and Chemistry and Chemical Biology, Center for Biotechnology and Interdisciplinary studies, Rensselaer Polytechnic Institute, 110 8th street, 12180 Troy, NY, USA*

[e]*BSIRG, iBB-Institute for Bioengineering and Biosciences, Departamento de Engenharia Química, Instituto Superior Técnico, Universidade de Lisboa, 1049-001, Lisboa, Portugal*

Abstract:

Electrical stimulation (ES) of neural stem cells (NSCs) enhances differentiation into matured neural cells, important for tissue engineering strategies for the treatment of chronic diseases such as neurodegenerative. Polyaniline doped with camphorsulfonic acid (PANI:CSA) can be used to produce electroconductive platforms for ES. However, their performance depends on the establishment of efficient chain-chain packing for optimal electron hopping. Such is enhanced by using substances with pseudo-doping properties in PANI:CSA formulations that are easily removed after processing.

In this work we developed different solvent formulations for the production of PANI:CSA based substrates. Different amounts of hexafluoropropanol (HFP) and trifluoropropanol (TFE), are predicted to maximize electroconductivity through a pseudo-doping effect on PANI:CSA chain packing.

In a first approach we studied the effect on PANI:CSA thin films. Electroconductivity was high for all TFE:HFP formulations tested and was dependent on the deposition method. Complementary physico-chemical analysis (AFM, Raman, XPS) evidenced changes in PANI:CSA chain organization.

Secondly, PANI:CSA was incorporated into electrospun poly(caprolactone) (PCL) fibers. Under high humidity (e.g. 50%), electroconductivity increased with higher HFP to TFE content on the solvent system and topped 2 X 10^{-1} S cm^{-1} when equal amounts of both solvents were used.

Finally, PCL-PANI:CSA composites were used for the design of biodegradable coaxial electrospun platforms. Electroconductivity stability was improved in saline solution for 21 days and the fibers supported NSC differentiation under electrical stimulation.

Acknowledgements: Fundação para a Ciência e Tecnologia through IT (UIDB/50008/2020), iBB (UIDB/04565/2020, UIDP/04565/2020 and UID/BIO/04565/2022), Laboratório-Associado I4HB (LA/P/0140/2020), BioMaterARISES (EXPL/CTM-CTM/0995/2021) and PORL 2020 through PRECISE (16394).

Biography:

Fábio Garrudo, PhD and PharmD, is a Post-doc Researcher at Instituto de Telecomunicações, Lisbon, and PI for project BioMaterARISES. He concluded is PhD in 2021 in Bioengineering at Instituto Superior Técnico, Lisbon. As a PhD student, Fábio has published 8 research papers (5 as first author, 1 as co-corresponding author) and presented his work at several conferences through oral (16) and poster (11) presentations. He is the recipient of Julia Polak doctoral award (2021), member of the EBS and reviewer for numerous journal (e.g. MDPI, Elsevier).

Synthesis and Mechanical Properties of Thermoplastic Cellulose Esters

Tessei Kawano* and Yoshito Andou

Department of Life Science and Systems Engineering, Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, Kitakyushu, Fukuoka, Japan

Abstract:

Cellulose is the most abundant and virtually inexhaustible natural polymer on earth. Up to now, various types of cellulose derivatives including cellulose ethers and cellulose esters have been developed. However, most of the reported cellulose derivatives have been utilized as cast films, additives in polymer composites, or viscosity modifiers. In this work, toward the development of eco-friendly and sustainable alternatives for petroleum-based plastics, thermoplastic cellulose esters (CEs) were synthesized by heterogeneous esterification in pyridine/*p*-toluenesulfonyl chloride (*p*-TsCl) medium with mixed fatty acid salt (MFAS) containing structurally diverse fatty acids. The effects of reaction conditions on the structure and mechanical properties of CEs were investigated by varying the concentration of *p*-TsCl and MFAS. The chemical structure and thermal properties of CEs were analyzed using Fourier transform infrared spectroscopy (FTIR), the nuclear magnetic resonance of proton (1H NMR), as well as differential scanning calorimetry (DSC). The prepared CEs can be readily processed into transparent and flexible films by hot-pressing at 120 °C, while the thermal degradation was about 250 °C. It suggests that the obtained CEs have a wide processing window compared to cellulose acetate which is one of the most widely used cellulose derivatives. Furthermore, it was confirmed that CEs possess a hydrophobic surface with a water contact angle of 100° to 120°.

Biography:

Tessei Kawano is a doctoral degree student at the Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology. His research interest includes synthesis, characterization, and compositing of bio-based polymers, especially those derived from lignocellulosic biomass. He has previously achieved the control of crystal structure and mechanical properties of regenerated cellulose film and surface modification by plasma treatment. Currently, his work focuses specifically on the synthesis and property tuning of thermoplastic cellulose esters to develop materials that can replace petroleum-based plastics.

Superabsorbent Polymer (SAP) Solubilized Instantly by Decrosslinking with Sodium Hypochlorite

Kazuya Yanaze[a] and Nobuhiro Kihara[a]*

[a]*Department of Chemistry, Faculty of Science, Kanagawa University, Hiratsuka, Japan*

Abstract:

Poly(diacylhydrazine) can be rapidly decomposed and solubilized by the action of sodium hypochlorite solution, although diacylhydrazine exhibits stability under acidic and basic conditions and is not affected by heat or oxygen. Thermosets crosslinked with diacylhydrazine can be rapidly decrosslinked similarly. A superabsorbent polymer (SAP) crosslinked with diacylhydrazine was prepared. The swollen gel was instantly solubilized by treatment with a small amount of sodium hypochlorite solution. Since the product is the simple poly(sodium acrylate), it can be disposed safely into the sewage.

Biography:

He studied at The University of Tokyo and then worked at the Research Institute of Resources Utilization at Tokyo Institute of Technology on the reaction of carbon dioxide with epoxide and the application of the resulting cyclic carbonate. He was a postdoctoral fellow at Fribourg University, Swiss, and worked as an Associate Professor at Osaka Prefecture University. He moved to Kanagawa University as a professor in 2005. His present research interest is on polycatenane, artificial molecular motor, the reaction field based on the molecular recognition, the chemistry of heteroatom-heteroatom bonds, and the oxidatively degradable polymer.

Esterification of Microcrystalline Cellulose with Fatty Acid Chain via Mechanochemical-Assisted Method

Jacqueline Lease* and Yoshito Andou

Department of Life Science and System Engineering, Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, Kitakyushu, Fukuoka, Japan

Abstract:

The actively engaged in lignocellulose biomass over the last few years from the worldwide researchers can be connected with a growing demand for renewable and low-carbon resources. It is regarded as an extraordinary potential raw material to replace petroleum-based plastics. Among lignocellulosic materials, cellulose is the most abundant biopolymer in nature. It has an array of excellent properties such as high mechanical properties, non-toxic, low cost and biodegradability. Despite the captivating properties, the evolution of cellulose biomass into the existing bio-plastics is still a challenge due to its inherent recalcitrance. Here-in, mechanochemical reaction, a green synthetic esterification route was utilized to prepare long-chain cellulose esters from microcrystalline cellulose in this work. Mechanochemical method which involved the mechanical shearing force in the reaction promoted the availability of hydroxyl group from the cellulose backbone. This approach is preferable than the traditional methods in the aspects of reduced chemical dosage and improved sustainability to fabricate melt-processable cellulose esters. Apart from that, we also prepared cellulose esters by altering the types of carboxylic acids and molar ratio of reagent, in order to elucidate the effect of reaction conditions on the degree of substitution (DS) of cellulose esters. Besides, mechanical properties, thermal stability, and the chemical structure of the cellulose esters were also identified.

Biography:

Jacqueline Lease is a doctoral student in the Department of Life Science and System Engineering at the Kyushu Institute of Technology, Japan. She holds a Master degree of engineering from the current university and a Bachelor

degree of Materials Engineering from the University of Science Malaysia. Jacqueline is currently working on the modification of cellulose via mechanochemical method under the supervision of Associate Professor Yoshito Andou. Her research interested mainly focused on the biopolymer.

Photocurable Bio-based Acrylates for Industrial Protective Coatings: Processing and Performance

Pieter Samyn[a]*, Joey Bosmans[a], Patrick Cosemans[a]

[a]SIRRIS – Department Circular Economy and Renewable Materials, Smart Coatings Lab, Diepenbeek, Belgium

Abstract:

Bio-based protective polymer coatings are increasingly finding interest in industrial applications and stepwise replacing traditional organic coatings. In parallel with the increasing availability of bio-based monomers and oligomers for coating formulations, however, their processing properties such as viscosity and thermal stability needs to be compared with their fossil-based analogues in order to optimize their performance. In this study, the photocuring kinetics were followed for a range of acrylate monomers with different functionalities, leading to comparable progress of the curing and cross-linking density with their fossil-based counterparts. The testing for mechanical performance in terms of abrasion resistance and hardness revealed lower wear rates and better ductility for the bio-based coatings in parallel. The microstructure of the bio-based acrylates seems to be more complex with internal nanoscale organizations that cause reduced brittleness. Alternatively, the performance of coatings at different intensities of the photochemical curing was tested under so-called transient conditions. In particular, a remaining hydrophobic monomer layer at the top of bio-based coatings after induces higher hydrophobicity and lubricating properties.

Biography:

Dr. ir. Pieter Samyn received Ph.D. in Materials Science and Engineering 2007 at Ghent University and followed an academic career at University Freiburg and Hasselt University, until 2021 when he joined the collective research center Sirris as a Senior Research Engineer. He has broad experience on the synthesis, processing ans characterization of bio-based materials for composite and coating applications. His research focusses on surface functionalization and he subsequently led research projects on bio-inspired adhesion mechanisms, functional coatings for paper substrates and the development of (nano)composite materials from bio-based building blocks (cellulose, biopolymers).

Electroconductive Platforms for the Electrical Stimulation of Stem Cells – An Approach to the Design of Artificial Human Tissue Microenvironments

Fábio FF Garrudo*[,a,b,c], João C Silva[b,c], Carlos AV Rodrigues[b,c], João Meneses[d], Carla Moura[d], Diogo ES Nogueira[b,c], Marta MS Carvalho[b,c], Pedro Marcelino[b,c], Mariana R Gomes[b,c], Frederico Barbosa[b,c], Joaquim MS Cabral[b,c], Paula Pascoal-Faria[d], Robert J Linhardt[e], Deepak Vashishth[e], Jorge Morgado[a], Frederico C Ferreira[b,c].

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Abstract:

The construction of an artificial vertebrae requires the development of biomimetic artificial tissue microenvironments, capable of supporting the complex cell interactions of native tissues. The three-dimensional structure and chemistry of polymeric materials can impact how effectively cell differentiation occurs. Moreover, the presence of bioactive cues can direct stem cell colonization and create different domains mimicking the in vivo complexity. Finally, electrical

stimulation can be applied to promote cell differentiation and increase tissue maturation and functionality. These key contributors are paramount for building reliable artificial transplants for both bone and neural tissues.

Our group has worked on different material-based approaches to create suitable electroconductive platforms for the electrical stimulation of stem cells for neuronal and bone tissue engineering applications. Such strategies include the processing of poly(3,4-ethylenedioxythiophene) (PEDOT) into different constructs, including (a) cross-linked coatings for 3D-extruded scaffolds for MSC osteogenic differentiation, (b) acid-precipitated PEDOT films for iPSC neural differentiation, (c) electrospun fibers and (d) preparation of biodegradable PEDOT:PSS-based composites. The composites were characterized in terms of their physico-chemical properties, biocompatibility and suitability for culturing iNPCs/MSCs under electrical stimulation.

Our results evidence clear improvements on the performance of cells cultured on the novel composite materials and after electrical stimulation. In the future, such strategies can be used to improve the engineered tissues' functionality and integration after transplantation.

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Biography:

Fábio Garrudo, PhD and PharmD, is a Post-doc Researcher at Instituto de Telecomunicações, Lisbon, and PI for project BioMaterARISES. He concluded is PhD in 2021 in Bioengineering at Instituto Superior Técnico, Lisbon. As a PhD student, Fábio has published 8 research papers (5 as first author, 1 as co-corresponding author) and presented his work at several conferences through oral (16) and poster (11) presentations. He is the recipient of Julia Polak doctoral award (2021), member of the EBS and reviewer for numerous journal (e.g. MDPI, Elsevier).

Influence of Yarn Structure on Biodegradability

Ivana Schwarz*, Ruzica Brunsek, Snjezana Brnada

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Abstract:

The aim of this research was to investigate the influence of yarn structure on biodegradability. Soil burial tests, under real conditions, for a period of 25, 50 and 100 days, were used to observe the biodegradability, evaluated by analysing yarns' fineness and tensile properties. Two types of yarns, composed of 60% Modacrylic, 38% Cotton and 2% Polyamide, and the same fineness of 30 tex were tested, with only difference in yarn structure (sample A represents a single, while sample B plied yarn).

By increasing the burial time period, the yarn fineness increase; i.e. yarn count decreases by 33% for single and 30% for plied yarns. A more significant difference between the tested yarns is evident in the decrease of breaking forces, where after 100 days, the decrease is twice as great for single yarns (31%) than for plied yarns (14%). Consequently, the breaking elongation is greatly increased and amounts to 252% for single and 211% for plied yarns. The greatest increase was recorded in the period of the first 25 days with amounts of 133% for single and 126% for plied yarns. In the following periods, the elongation decreases linearly. This research demonstrates the importance of yarn structure by emphasizing the differences in the degradation process. The increase in fineness, a two-fold decrease in force, and an increase in elongation, indicate that the degradation process is more pronounced in single than in plied yarns. By plying two single yarns, the structure is strengthened and the degradation process is slowed down.

Keywords: Yarn structure, Single yarn, Plied yarn, Biodegradability, Soil burial test.

Acknowledgment:

She works as an Associated Professor at the Department of Textile Design and Management. At the moment she is a coordinator for the Project: Development of multifunctional non-flammable fabric for dual use, KK.01.2.1.02.00064, and was an associate in 8 international and national projects. She has published 4 book chapters, 76 scientific papers in scientific journals and conference proceedings, co-authored 3 patents, and edited 5 conference proceedings. She is the editor of the international scientific journal Textile & Leather Review and was the editor of the Special Issue of the scientific journal Polymers, Multifunctional Advanced Textile Materials.

Hydrazone Bond-containing Di-Block Copolymers as Bio-responsive Vectors for Gene Delivery

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[a]Institute of Macromolecular Chemistry, Czech Academy of Sciences, Prague, Czech Republic

Abstract:

Gene therapy provides a causal treatment option for many serious human diseases in situations where conventional approaches are not feasible. However, the expansion of gene therapy into clinical practice is limited by the development of safe, efficient, and cost-effective delivery systems (so-called vectors) as the nucleic acids (encoding therapeutic genes) themselves are rapidly degraded by extracellular nucleases and inefficiently penetrate cell membranes. One way to provide nucleic acids with higher stability, to promote their cellular uptake and intracellular transport is to use bio-responsive polycationic vectors. In this work, synthetic polycationic vectors based on di-block copolymers consisting of positively charged and hydrophilic electroneutral blocks were prepared by reversible addition-fragmentation chain transfer (RAFT) polymerization. The positively charged blocks were formed by methacrylamide polymers differing in the type of ionizable group (primary, secondary, tertiary, or quaternary amine), which was linked to the polymer backbone via a pH-responsive hydrazone bond. To improve cellular uptake, ~20 mol. % of the hydrophobic comonomer N-butylmethacrylamide was further incorporated into the polycation block structure. The electroneutral block consisted of a hydrophilic biocompatible polymer based on *N*-(2-hydroxypropyl)methacrylamide (HPMA) or 2-methacryloyloxyethyl phosphorylcholine (MPC). Depending on the type of vector used and the mixing technique (stirring with a magnetic stirrer vs. microfluidic mixing), the addition of model nucleic acid (calf thymus

DNA) led to the formation of 30–160 nm complexes of various hydrolytic stability, which disintegrated in a slightly acidic solution (pH 5.5) modeling the intracellular environment. According to the results obtained, prepared polymer vectors are promising gene delivery systems.

Biography:

She is a first-year Ph.D. student in Macromolecular Chemistry at Charles University in Prague, Czech Republic. I am doing my Ph.D. thesis at the Department of Polymer and Colloid Immunotherapeutics, Institute of Macromolecular Chemistry, Czech Academy of Sciences under the supervision of Dr. R. Laga. My research interests include the development of polymer vectors for targeted delivery and controlled release of genetic vaccines, carcinostatics, and synthetic immunotherapeutics.

Distinctions of Soil Temperature and Humidity Beneath Different Nonwoven Mulch Raw Materials

Kopitar Dragana*, Paula Marasovic

University of Zagreb Faculty of Textile Technology, Zagreb, Croatia

Abstract:

The impact of nonwoven mulches of 400 g m^{-2} mass per unit area, produced from viscose, jute, hemp and PLA fibers and compared to conventional foil as well control field was investigated. The temperature and humidity of the soil under the mentioned mulches during 4 weeks of May 2022 were monitored. Using conventional foil, the temperature of soil is higher comparing to control field up to 2.6 °C that provides faster seedlings grow. There is a growing trend to produce biopolymers on a large scale for a variety of applications including biodegradable mulches. Recently, researches are focus on replacing conventional PE foil with biodegradable, renewable, and recyclable biopolymer PLA. Considering soil temperature below PLA nonwoven mulches showed same results as uncovered control field. Soil humidity below the PLA mulches were the lowest comparing to other tested mulches, ranged from 13.3% on the first week and increased. On the fourth week, humidity reached same humidity as it was on the control field. Reduced humidity under the PLA mulches during first weeks of plants grow could negatively affect on a plant growth and development. The lowest temperatures and highest soil moisture under the nonwoven mulches made of viscose fibers were recorded. It would be interesting to investigate the influence of viscose mulches on soil temperature and humidity during the hottest summer months, since it is believed that viscose mulches could provide plants with the necessary soil moisture and reduce plant stress caused by high soil temperatures.

Biography:

Dragana Kopitar finished her PhD in 2011 at the University of Zagreb Faculty of Textile Technology. In 2014 she became assistant professor and in 2020. associate professor. She actively teaches in the field of nonwoven and technical textile technology as well the structure and properties of nonwoven technical textiles. She teaches in the field of spinning technology too, about the structure and properties of conventional and unconventional yarns. Her scientific interests is research of yarns (ring and unconventional), nonwoven fabric and nonwoven composite structure and properties.

Biodegradability of Hemp Fibres Conditioned by Soil Type and Conditions

IVANA SCHWARZ*, DRAGANA KOPITAR, RUZICA BRUNSEK, NIKOLA JUGOV

**University of Zagreb Faculty of Textile Technology, Prilaz baruna Filipovica 28a, Zagreb, Croatia*

Abstract:

Investigation of biodegradation time of hemp fibres was performed by soil burial test (ISO 11721). The influence of soil type and environmental condition on hemp fibre biodegradability was determined by comparison of mass loss, physical-mechanical properties and morphological analysis by SEM microscope. Samples were buried into the soil (farmland soil and commercial flower soil-humus) during 2, 4, 7, 9 and 11 days in defined laboratory conditions, as well as under real weather conditions. The greatest decrease in tenacity was obtained in samples buried in farmland soil (66,18%) exposed to microorganisms under controlled laboratory conditions, where the better favorable conditions for the activation of microorganisms are ensured such as the availability of water, temperature, humidity

and pH of the soil. The decrease for samples buried in commercial flower soil-humus tested in controlled conditions was 49,55%, while exposing the samples to microorganisms under real conditions the decrease in tenacity was less (40,50%), because conditions of exposure to microorganisms depend on current climatic conditions. It can be noticed that the fibres which were buried in farmland soil, show a greater reduction in tenacity due to the presence of a larger amount of microorganisms, i.e. the total number of bacteria and fungi. Analyzing hemp fibres surfaces microscopic images before and after biodegradation processes shows higher attack intensities of the microorganisms on the fibres which were exposed to microorganisms under controlled conditions in a laboratory buried in farmland compared to fibres that were buried in commercial flower soil-humus, which confirms the above analysis.

Keywords: Hemp fiber, Biodegradability, Soil burial test, Soil type.

Biography:

Works as an Associated Professor at the Department of Textile Design and Management. At the moment she is an associate on the Project Development biodegradable nonwoven agrotextile from natural and renewable sources, and a coordinator for the Project: Development of multifunctional non-flammable fabric for dual use. She has published 4 book chapters, 76 scientific papers in scientific journals and conference proceedings, co-authored 3 patents, and edited 5 conference proceedings. She is the editor of the international scientific journal Textile & Leather Review and was the editor of the Special Issue of the scientific journal Polymers, Multifunctional Advanced Textile Materials.

Fabrication and Characterisation of Nanocomposites Based on Green Methods

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Abstract:

Among conductive polymers, Poly(3,4 ethylenedioxythiophene)polystyrene sulfonate (PEDOT:PSS) has been widely used as an electrode material for supercapacitors, solar cells, etc.. However, the processes of forming PEDOT:PSS-based thin films with good capacitive, electrical and biocompatibility properties are still a challenge. This work is part of this context, since it aims to fabricate and characterise ternary nanocomposites based on PEDOT:PSS+GO (graphene oxide), blended with green additives (glucose and ascorbic acid), with low environmental impact, low cost and easy to use.

Via drop casting and spin coating techniques, thin films of the ternary nanocomposites were produced and their main properties were evaluated such as: capacitive properties, electrical properties and biocompatible ones. Particularly, Cyclic Voltammetry, Sheet Resistance, indirect biocompatibility tests and Live/Dead assays were performed. In addition, the GO reduction process by means of the green additives was monitored through different tests, which confirmed that it took place in air within both ternary nanocomposites.

The inks were finally printed by Aerosol Jet® Printing (AJ®P), an innovative direct writing technique belonging to the Additive Manufacturing for printed electronics applications. The rheological and surface tension properties of the inks were indeed studied and showed that the viscosity and surface tension were in the optimal range of AJ®P. The inks were then printed in the form of thin films (10 layers, 8x8mm) and were chemically analysed by FT-IR to investigate whether all components of the formulation were successfully aerosolised and printed.

Reduce the density with enhanced flame retardancy of the urethane-silicone hybrid foam by application of physical blowing agent

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[a]Department of Chemistry and Chemical Engineering, Education and Research Center for Smart Energy and Materials, Inha University, Incheon 22212, Korea

Abstract:

The urethane-silicone hybrid foam has low density and excellent flame retardancy which is the advantage of the urethane foam and silicone foam. However, compared to commercial silicone foam, the hybrid foam has relatively high density, and the foam with a relatively low density is less competitive because of its poor flame retardancy. Therefore, in this work, physical blowing agents were used to reduce the density while the flame retardancy of the foam were enhanced. In particular, the physical blowing agent used n-hexane (boiling point 69 °C), cyclohexane (80.75 °C), and n-heptane (98.42 °C) in consideration of the curing temperature of 100 °C, and the density, pore size, uniformity, and peak heat release rate (PHRR) according to the type of blowing agents were compared. When heptane was used, the density, PHRR and pore size of the foam were the lowest. Also, the pore uniformity of the foam blowing with heptane were more excellent than others. Therefore, heptane is the most suitable physical blowing agent for urethane-silicone hybrid foam to reduce density.

Biography:

Asell Kim is currently a MS student at the Polymer Engineering Lab in the Inha University. His research interest is development of 250 ℃ high heat resistant flame retardant and ecofriendly silicone foam elastic material to meet the demand of high-tech industries.

Synthesis of crosslinker containing fluorine to maintain fluorine content during fluorosilicone curing

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Abstract:

Recently, as the demand for developing functional materials increases, organic polymers with new properties are also increasing. Particularly, in the automobile and electronic industries, a polymer that satisfies cold resistance and oil resistance is required. Fluorosilicone contains both silicone and fluorine polymer properties due to Si-O bonding as the main chain and fluorine functional groups around it, so it has excellent heat, acid, cold, oil and weather resistance than common silicone and carbon base polymer. Herein, in the synthesis of a crosslinker to increase the fluorine which give outstanding properties in a polymer after curing fluorosilicone, octamethylcyclotetrasiloxane(D4), tetramethylcyclotetrasiloxane(HD4), 1,3,5-Tris[(3,3,3- trisfluoropropyl)-methyl]cyclotrisiloxane(FD3) are required, and the reason why 1,3-divinyltetramethyldisiloxane(Vinyl End-blocker) and tetramethyltetravinylcyclo tetrasiloxane(ViD4) are used is that the H atom of the polymer chain is crosslinked. For this reason, a small amount of ViD4 is also added to the silicone for curing. In order to increase the fluorine in crosslinker, FHMQ was synthesized using the reaction time, initiator amount(wt%) and the ratio of FD3 and D4 as variables. As a result of the experiment, the optimal reaction time is 3 hours, and the optimal ratio of FD3 and D4 is 7:3. As the initiator was added much, the reaction was too explosive, so the amount of initiator is fixed at 0.1wt%. It is worth noting that when synthesizing FHMQ, the Si-H group in HD4 has high reactivity and thus the reaction is so fast, so it should be added in a very small amount through dropping-wise unlike FD3 and D4.

Biography:

After graduating from INHA University, He is currently working on a master's degree in polymer engineering lab at INHA University. He conducted studies on the functionalization if fluorosilicone-based liquid solid fluorine silicone elastomer and semiconductor industrial fluorine silicone and the development of component.

Effects of Fluorosilicone Rubbers on Electrochemical Performance and Durability of Proton Exchange Membrane Fuel Cell

Yoolim Sim*, Jaewon Lee and Sang Eun Shim

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Abstract:

Gasket is a sealing material in proton-exchange membrane fuel cells (PEMFC) to prevent leakage and to prevent mixing of hydrogen and oxygen. Silicone is an ideal candidate for gasket of PEMFC because of its excellent chemical stability and heat resistance. However, contaminants eluted from the silicone gasket can greatly affect the electrochemical performance and durability of PEMFC. Therefore, in this work, a silicone gaskets containing fluorine groups were synthesized to give the gasket the characteristics of high acid resistance and low ion leaching, and the effect of the fluorine group content on the acid resistance and ion elution properties of the gasket was investigated. Electrochemical performance tests were performed to investigate the effect of fluorine group content on the performance of PEMFC. Optical microscopy was used to observe the surface change of the sample under an acidic environment and the mechanical strength was measured to confirm the acid resistance. Atomic absorption spectrometer analysis was employed to investigate silicone leachants eluted from the sample. In addition, inductively coupled plasma was used to analyze changes in ion elution according to the content of fluorine groups, and Fourier transform infrared spectroscopy was used to investigate changes in the surface chemistry of samples before and after exposure to the PEMFC environment. It was found that the silicone gasket containing fluorine groups has better acid resistance and ion elution properties compared to the general silicone gasket and that the higher the content of the fluorine group, the more pronounced that tendency.

Biography:

After graduating from Inha University with a bachelor's degree, He is conducting a master's program in the Polymer Engineering Lab of the Department of Chemistry and Chemical Engineering, Inha University. The research topic is the synthesis of silicon gaskets used in fuel cells. In order to improve the ion elution and acid resistance of existing silicone gaskets, research is underway to make silicone gaskets containing fluorine groups.

Investigation of Resin Functionality Effect on Powder Coating Formulations

Ayşenur ÖZDEMİR[a,b*], Göknil SÜSLER[a,b], and A.Ersin ACAR[a]

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[b]*Pulver Kimya San. Tic. A.Ş., Kocaeli, Turkey*

Abstract:

Powder Coatings are known as the most environmentally friendly coating system mainly because of their low volatile organic compound content. This coating system does not contain and use water or any organic solvent. Therefore, powder coating has come into prominence. Its formulation consists of a cross-linkable resin, a crosslinker known as a hardener, catalysts, flow modifiers, pigments, fillers, and other additives. During powder coating application, the powder is applied to a metal or other surfaces with the help of an electrostatic gun, and then the coated surface is heated. With the help of the heat, the end groups of resin and the hardener give a curing reaction. It creates the crosslinked network, which determines the properties of the cured film. In this presentation, the effect of the resin functionality on cured films is investigated. The test results that belong to cured films are presented.

Biography:

Ayşenur Özdemir is a PhD candidate in Chemistry Department at Boğaziçi University, Turkey and has been working at Pulver Kimya A.Ş. R&D department since 2018. She is responsible from the powder coating formulations for heat-sensitive substrates. She holds a BS degree (2013) and an MSc degree (2015) in chemistry at Boğaziçi University. Her master project was " Screening of Various Polyethylene Terephthalate Chain Extenders in a Melt Polymerization Set-Up". Her Ph.D. Thesis is about PET and other polyesters used in powder coating systems. Also, she is interested in solid state polymerization, reactive extrusion, crystallization, and curing kinetics of polyesters.

Investigation of Supramolecular Interactions Based on Polyester Chain Structure

Göknil SÜSLER[a,b], Ayşenur ÖZDEMiR[a,b] and A.Ersin ACAR[a]

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Abstract:

Supramolecular polymers are defined as materials whose constituents, which can be small molecules or polymers, are held together with dynamic covalent bonds such as Diels-Alder, disulfide bonds, urea bonds, and imine bonds or reversible non-covalent bonds, including host-guest interactions, metal-ligand coordination, π – π stacking, ionic interactions, and hydrogen bonds. These dynamic bonds exhibit association-dissociation upon exposure to an external stimulus such as heat, light, or chemicals, consequently enabling the as-formed materials to be reprocessed and recycled.

Each particular supramolecular interaction has its own distinctive bond strength and characteristics, which give rise to different architectural and dynamic parameters, such as chain dynamics, performance lifetime, mechanics, the degree of polymerization, and conformation. The reversible and tunable nature of supramolecular interactions provides these polymers with dynamic features such as the ability to change crosslinking degree, structure, and composition, potentially leading to properties like the ability to self-repair and self-heal, stimuli-responsiveness, and improved processing. Hence, it would be beneficial to incorporate thermoreversible non-covalent bonds as alternative crosslinks into polymers to attain the reprocessing and recycling of crosslinked materials at elevated temperatures.

Herein, we report the facile synthesis of different carboxy-terminated polyesters with aliphatic and cycloaliphatic monomers to further use as-formed polyesters to have ionic networks using different associative pairs consisting of di- or multi-functional amines and a metal salt.

Biography:

Göknil Süsler is a Ph.D. candidate in Chemistry at Boğaziçi University since 2019 and has been working as R&D Industrial Designs Assistant Specialist for Pulver Kimya San. Tic. A.Ş. since 2018. She graduated from the Chemistry Department of Yıldız Technical University in 2016 and got her MSc in Chemistry from Boğaziçi University in 2019. Her areas of interest are powder coatings, polyesters, supramolecular polymers, and the rheological properties of thermosets.

Evaluation of the Method for Determining Woven Fabric Roughness

Snjezana Brnada[a]*, Ana Kalazić[a], Stella Sabljak[a] and Ivana Schwarz[a]

[a]*University of Zagreb Faculty of Textile Technology, Zagreb, Croatia*

Abstract:

For the purpose of comparing the parameters of the arithmetic mean of the profile (Ra) and the mean value of the square deviation of the profile (Rq), the roughness of eight samples. The original profile was filtered on a suitable cutoff which was calculated according to the weft density. A filtered profile was obtained, ie a part of the profile that includes only wavelengths less than the cutoff, ie 1.02 mm, which includes irregularities in the fabric caused by thread interlacements and yarn morphology. The results show that in this choice of cutoff, the fabrics in plain and satin weave have the greatest roughness in relation to twill weave. In the case of fabrics in plain, with increase of weft density the roughness increases, which is in line with the theory. More interlacements per length will also result in greater roughness. In satin weave fabric, a sample with a lower weft density has higher roughness values, even more than fabric in plain weave. Since the roughness method was mechanical, the presence of a small sense of force on the fabric led to local compressive deformation at the points of contact where the weft system threads were registered regardless of floating warps. The denser structure of satin fabric had a lower roughness due to its greater compactness so the sensor of the test device encountered greater resistance from tensed, compacted weft threads. On the other hand, fabrics in twill weave (K22/ and K3/1) had the least roughness.

Biography:

Assist. Prof. Snježana Brnada, Ph. D. After graduation, she works at the textile factory in the position of Technology development engineer. She joined the Faculty of Textile Technology at the University of Zagreb in 2009, at the Department of Textile Design and Management, where she still works today as an assistant professor and teaches a group of courses related to weaving technology. She is the author of a large number of scientific and professional works and a university textbook. As a researcher, she actively participated in three scientific projects.

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Radiation Sensitivity of Adhesives and Potting Materials for Space Environments

Jamie M. Kropka,* Catherine Groves, Shianne Carroll, Estevan Martinez, Robert W. Hammerstein, Paul M. Thelen, and Elliott J. Leonard

Sandia National Laboratories, Albuquerque, NM, USA

Abstract:

Organic materials provide key functionalities in the construction of satellite assemblies that experience progressively accumulated total ionizing doses (TID) of radiation during mission life. Many materials used in space applications are of known good physical properties, but what is documented can be lacking when it comes to exposure to naturally occurring ionizing radiation. This work focuses on the results of tests examining the sensitivity of a commercial epoxy encapsulant, Scotchcast 281 (3M), commonly used in satellite assemblies to TID as high as 70 Mrad in an inert atmosphere. Mass changes of the material associated with the γ-ray (Co-60) irradiation are minimal, however, the thermomechanical properties of the material change significantly. The glass transition temperature and equilibrium shear modulus of the material increase by a factor of ~2 (in oC) and ~4, respectively, over the dose level range examined. Tensile and compressive stress-strain response also exhibit sensitivity to the irradiation, in some cases in quite unexpected manners. The compressive yield stress of the material exhibited the most sensitivity at low dose, more than doubling from the non-irradiated state after 1 Mrad TID (the lowest level assessed). These effects on thermomechanical properties are much larger than observed for other epoxy thermosets within the same experiment and previous reports for similar materials in the literature. Findings suggest the high sensitivity of the Scotchcast 281 material to irradiation are associated with the unsaturated nature of the castor oil-based curative used in its formulation and the consumption of C=C bonds upon dosing.

Biography:

Jamie is a chemical engineer that has specialized in polymer physics, with interests in areas of adhesion, polymer glasses, thermal analysis, and viscoelastic/stress-strain response of organic materials, especially as applied to packaging of electronic/mechanical/optical devices. He has spent considerable time collaborating with solid mechanics practitioners to understand stress in polymers. When the demands of science/engineering lessen, mountain hiking, running, cycling, and family sports draw his attention.

Preparation of Transparent Glass-fiber Reinforced Epoxy Matrix Composites and their Optical Characteristics

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Abstract:

In this study, a thermosetting resin (epoxy) cured product and glass fiber reinforced plastic (GFRP) were prepared to compare the optical properties of the amine curing agents. The optical properties of the cured product of EP/amine curing agent and transparent GFRP were analyzed with a lens refractometer and UV–Visible spectrophotometer. Among the amine curing agents, the aliphatic amine curing agent PPG-400 had the closest refractive index to that of glass fiber and the highest transmittance. It is judged that the small RI difference between glass fiber and EP/PPG-400 reduces the phase lag, and thus the transmittance is the highest. Based on the above results, it is judged that transparent GFRP with high transmittance can be made if fine adjustment is made by mixing an amine curing agent.

Biography:

Dong-Kyu Kim joined Ph.D. program from 2022. From 2021 to present he is working as a Senior Researcher at Korea Carbon Industry Promotion Agency.

Effect of Accelerated Thermal Aging on Dispersion Stabilities of Fine-denier Silicone Emulsions for Carbon Fibers

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Abstract:

Fine-denier silicone emulsions used for the polyacrylonitrile precursor treatment of carbon fibers have low surface tension, and they are used to prevent the precursor fibers from fusing. The raw materials are based on polydimethylsiloxane composed of high-molecular polymers, and water is added to the products by various emulsion polymerization methods. Silicone polymers are used as raw materials with various functional groups in the polydimethylsiloxane backbone. Silicone polymers with amino functionality are primarily used to adhere precursor fibers and prevent them from fusing. In this study, various silicone emulsions were prepared based on the analysis of amine silicone emulsions. One silicone emulsion was prepared using a mechanical disperser and the other was prepared using a colloid mill emulsifier capable of delivering a more powerful shear force to the emulsion. The stabilities of the fine particles in the emulsions were analyzed after heat treating the emulsions in a hot air oven at 50 and 70 ℃ for approximately one month at each temperature, which accelerated the emulsions. The emulsion method that used the colloid mill was found to be a more stable carbon fiber emulsion manufacturing method than the existing method that uses a mechanical disperser.

Biography:

Jae-Yeon Yang obtained his Ph.D. program in 2020. From 2020 to present he is working as a Senior Researcher at Korea Carbon Industry Promotion Agency.

Comparison of the Characteristics of Recycled Carbon Fibers/Polymer Composites by Different Recycling Techniques

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Abstract:

In this study, three recycling methods, namely, mechanical grinding, steam pyrolysis, and supercritical solvent process, which are used to acquire recycled carbon fibers (RCFs), were compared for their application in synthesizing polymer-matrix composites. RCF-reinforced polyethylene (PE) composites were prepared to compare the mechanical properties of the composites generated using the three recycling methods. The PE/RCF composites exhibited 1.5 times higher mechanical strength than the RCF-reinforced PE composites probably because of the surface oxidation effects during the recycling processes that consequently enhanced interfacial forces between the RCF and the matrix. Further, the steam pyrolysis process showed the highest energy efficiency and can thus, be applied on a large production scale in domestic recycled CF markets.

Biography:

Kwan-Woo Kim obtained his Ph.D. program in 2020. From 2020 to present he is working as a Senior Researcher at Korea Carbon Industry Promotion Agency.

Superporous Sodium Alginate Microbeads for Mesalazine Release Used in the Treatment of Inflammatory Bowel Diseases

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Abstract:

In order to enhance the drug entrapment efficiency and improve the swelling behaviors of drug delivery system,

Ca^{2+} crosslinking and freeze-thawing cycle techniques were used to prepare sodium alginate/polyvinyl alcohol hydrogel beads. Freezing–thawing process is the most facile method to produce physically crosslinked polyvinyl alcohol gel because it does not require the presence of crosslinking agent that may cause toxicity. The high porosity that is induced by freeze-thawing process will induce a severe burst release of an active ingredient. The presence of clays will act like a barrier and drastically reduce the burst release. In drug delivery field halloysite is intensively used because it presents a lumen where different types of active substances could be loaded and so the clay acts as a carrier[1]. The aim of this study is to obtain superporous hybrid beads of sodium alginate and halloysite using polyvinyl alcohol as a template. The alginate/ halloysite beads were prepared by electrospraying technique. Briefly in a alginate/polyvinyl alcohol were dispersed the active ingredient and different amounts of halloysite. The obtained suspensions were electrosprayed in a $CaCl_2$ solution The obtained beads were maintained for 2 h at freezing followed by 1 h of thawing. The freeze-thawing cycle was repeated 3 times and then the beads were intensively washed with water in order to remove the polyvinyl alcohol. In order to be characterized the obtained alginate/halloysite beads were freeze dried. The microparticle were characterized by FTIR, DCS, DLS, optic microscopy, *in vitro* drug release.

Acknowledgement:

Executive Agency for Higher Education and Research Funding (UEFISCDI) and National Research Council (CNCS) are gratefully acknowledged for the financial support through the PN III research project 'New technology for pH sensitive hybrid materials based on halloysite and cyclodextrin for Inflammatory Bowel Diseases treatment' no. *604PED/2022*.

Effect of the Particle Size and the Layer Thickness of GNP Filler on the Dielectric Properties and Actuated Strain of the GNP-PDMS Composites

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Abstract:

In this study, graphene nanoplatelets (GNP), a conductive carbon filler, were added to improve the low actuated strain of polydimethylsiloxane (PDMS), which is widely used in DEA. And mechanical properties, dielectric properties, and actuated strain of PDMS composite prepared by adding 0.5, 1,2, and 3 wt% of each GNP were measured. Mechanical properties were measured to be increased as the particle size was larger. In the dielectric characteristics, the higher the aspect ratio of the filler was, the easier the micro-capacitor network in the composite was formed, increasing the dielectric constant, and the higher the GNP contents also led to the increment of the dielectric constant. However, when the loss tangent is high, the performance of the actuated strain decreases because electric energy is converted to thermal energy and leakage current. As a result, the highest actuated strain was exhibited in the M25 composite, and the actuated strain value of 3.01% was measured at low electric field (< 4 kV/mm). In conclusion, it was proved that the composite with GNP with thinner layer and larger particle size, had the highest deformation.

Biography:

I am currently studying in Korea as a doctoral student in the Department of Chemical Engineering and Polymer Engineering Lab at Inha University. Her field of specialization is research on Dielectric Elastomer Actuator, which is to increase actuated strain performance with properties of low dielectric loss and high permittivity by adding a modified filler to the matrix.

Sustainable Polypropylene Light-Weight Dripline Fittings

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Abstract:

Dripline polypropylene (PP) light-weight fittings typically connect irrigation networks. Dripline is a structured pipe (rigid) and has an internally built drip emitter to give a specific amount of water. Drip irrigation is for gardening and

agriculture needs. Currently, new products are sought, pursuing a circular economy of plastics. Herein, we present a novel concept of a sustainable fitting system conceived, developed and realized via co-injection molding1 using recycled PP core material for the common part, which is the retaining nut. Mechanical properties were tested on product level. The key objective of our research is to implement a circular economy model and utilize and validate sandwich co-injection molding as a preferred process to achieve circularity on light-weight fittings. Additionally, this research work aims recycling of post-industrial PP material to develop novel sustainable light-weight fittings for low water pressure irrigation systems. Design and experimental development, mechanical recycling procedures, co-injection molding and laboratory tests are the main methodologies used in this research study. Finally, our research contributes to the declared goal of the European Commission2,3 to promote the transition to a circular economy and to boost the utilization of recycled plastics for new products, hence closing the loop in industrial products. This study is a part of a research project co-funded by the Research and Innovation Foundation (RIF) in Cyprus, the European Union and the Republic of Cyprus under the "Restart 2016-2020" programmes for Research, Technological Development and Innovation (RTDI) Support in Cyprus.

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Instrumented falling weight impact of coinjection-molded multipolypropylene sandwich plaques containing β-phase polypropylene core Journal of Macromolecular Science, Part B, 41 (4–6) (2002), pp. 881-889, https://doi.org/10.1081/MB-120013071

2 European Commission: A European Strategy for Plastics in a Circular Economy: COM(2018) 28 Final (2018)

3 European Commission: A New Circular Economy Action Plan for a Cleaner and more Competitive Europe: COM(2020) 98 Final (2020)

Fabric-elastomer Composites as a Basic Component for Protection Against CBRN Agents - Preliminary Results

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Abstract:

Recently, both in Europe and in other regions of the world, much importance is focused to increase the readiness to act in the incidents of chemical, biological, radiological and nuclear (CBRN) threats arising from terrorist attacks or other industrial accidents.

In the view of above, it is necessary to develop new CBRN-resistant materials and solutions. A prospective solution is the use of fabric-elastomer composites, consisting of reinforcement made of fibrous material covered with coatings made of specialized elastomers. Therefore, the thesis was formed that the double-sided coating of the polyamide fabric with the use of fluoro rubber improves the properties of fabric-elastomer composites in terms of resistance to sulfur mustard droplets compared to other tested polymers.

This study uses fabric-elastomer composites with specific and individual properties in the field of resistance to chemical agents and poisonous warfare agents. The aim of performed research was to presents the influence of selected rubbers (chloroprene, butyl, bromobutyl and fluorine) on the physical and mechanical parameters of the fabric-elastomer composite, such as: surface mass, abrasion resistance, water resistance, puncture resistance, resistance to inflammation and sticking and estimated time of protection against drops of sulfur mustard under static conditions, according to the NO-42-A500:2018 STD were determined.

In addition, the influence of nanoadditives, i.e. graphene, carbon nanotubes, teflon nanopowder, nanosilica and montrmorillonite on the physicomechanical properties of polymer-fabric composites and the possibility of their use in individual solutions of protection against CBRN factors, was tested and assessed.

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Biography:

Bogumiła Delczyk-Olejniczak, PhD. Eng, graduate inTextiles 2003 at Technical University Lodz, Poland; PhD degree in Chemistry in 2009, Polish Academy if Sciences, Lodz, Poland. She is a scientific worker in Moratex. In 2019-2021, Director of Technological Development in TAPS. In 2013-2018, academic teacher, Dean of the Technical Faculty of th State University of Applied Sciences in Konin. Research interest: composites, ballistic composites, natural composites, ballistic materials, siloxane polymers.

She is a co-author of: 4 patent applications and 2 utility models; 16 scientific and review publications, 21 conference oral presentations and 18 posters; Contractor or main contractor of 12 R&D and application projects.