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Keynote Presentations

Improving PVDF Piezoelectricity by Various Means

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Abstract:

Piezoelectric polymers are very useful in various electromechanical applications because of their strong piezoelectric response, flexibility, lightweight and formability. While fillers nucleate b phase in the PVDF matrix, subsequent mechanical stretching helps in aligning the dipoles to some extent. Therefore, the aim of the first part of this study is to prepare ferroelectric b-PVDF films by incorporating a hybrid filler (micro-CaCO3+ nanoclay) followed by mechanical stretching. While the tensile properties show a gradual decrease, dielectric constant increased gradually with increasing CaCO3 content in the hybrid filler. The maximum piezoelectric d33 coefficient of 30 pC/N is obtained for stretched hybrid composite films. Ferroelectrets, on the other hand, are another type of functional polymer films with heterogeneous cellular structure and internal quasi permanentdipole moments. The piezoelectricity in ferroelectrets originates from the change in dipole moments under an applied mechanical stress.Therefore, in this part of the study, a new thermally stable ferroelectret has been investigated using commercial processing technique with strong piezoelectric response. Solid PVDF/hybrid filler (micro-CaCO3 + nanoclay) films were extruded and subsequently stretched to create the initial cellular structure inside the films. While CaCO3 acts as void nucleation centers, nanoclay increases the stretchability of the highly CaCO3 filled PVDF films. Gas diffusion expansion (GDE) or controlled inflation is preformed to adjust the voids dimensions to lens-shaped voids leading to lower elastic moduli and stronger piezoelectricity. The inflated films are then subjected to corona charging at room temperature to create the dipoles inside the voids. Finally, PVDF ferroelectrets show piezoelectric d33 coefficient as high as 251 pC/N with N2 inflation and 327 pC/N for CO2 treatment. As expected, PVDF ferroelectrets exhibit better thermal stability than PP, PETP, COP and PEN and as high as Teflon. Samples charged at room temperature have their working temperature up to 120 °C

Modified Traditional Initiator Systems With Unrivaled Arrhenius-MW Behavior. Greener and More Sustainable Cationic Polymerizations

Dr. Stewart P. Lewis

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Abstract:

Current methods for the synthesis of polymers via the cationic mechanism use halide substituted Lewis acids in conjunction with adventitious moisture. This combination produces a superacid that generates the first propagating cation by protonation of the monomer. For olefins, reasonable Arrhenius plots of MW are only obtained when reaction is conducted in environmentally incorrect halogenated solvents or sulfur dioxide. They engender ionization, don't react with the propagating species, and are superior for dissolving these acids. Since water and alcohols hydrolyze these Lewis acids the next logical choice from a sustainability perspective are alkanes. To perform well in non-ionizing solvents such acids must be chemically modified to improve both their solubility and dissociation of the resultant superacid. Herein we report an easy, low-cost method for doing just that and unexpectedly we discovered that their polymerization behavior in alkanes was superior to that of the precursor acid in halogenated media.

Chitosan-Derived Smart Nanocarbons for High-Value Applications

Juan Matos Lale

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Abstract:

Advances in nanotechnology, both in relation to new synthesis methods and in the optimization of solid-state characterization techniques, have made it possible to design the properties of different materials at the molecular level. This progress is significantly important in the area of so-called nanocarbons, where scientific databases show that these types of materials have achieved nearly 700,000 publications in the last two decades. This has been due to the potential of their physicochemical properties, such as chemical inertness, quantum confinement, edge effects, high mechanical

strength, and high thermal and electrical conductivity, among others. Carbon nanomaterials, including nanotubes and fibers, graphene, foams, quantum dots (CQDs), and what are now called nanoporous carbons, have generated significant attention from scientists and industries because the properties of these materials can be designed and adapted easily and inexpensively, hence their classification as smart materials. This keynote lecture will showcase key results of our group's on innovation, scaling, design, and prototype construction, using nanocarbons prepared from chitosan and other biomass waste for specific applications including clean energy production, solar cells sensitized with carbon quantum dots, electrochemical capacitors, carbons for the remediation of pollutants in the aqueous phase using solar photoreactors and chemical sensors, among others.

Advanced Simulation of Injection Molding: Material Characterization and Main Phenomena Involved

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Abstract:

In injection molding, the final morphology distribution (and thus the properties distributions) is determined by the evolutions of temperature and flow fields within the polymer during both mold filling and subsequent cooling up to polymer solidification. Obviously, during mold filling, the shear will be intense at the mold wall and will decrease toward the mold mid-plane, being essentially symmetric with respect to the thickness mid-plane.

Once the mold has been filled, the orientation distribution, determined in the polymer by mold filling, will start relaxing; however, close to the mold wall, where the temperature is smaller, the relaxation phenomena will be very slow. In other words, a relevant molecular orientation (giving rise to fiber formation) can remain frozen at the mold surface; vice versa, close to the thickness mid-plane, a wide area is expected to solidify essentially unoriented: spherulites are, there usually found.

A software for the simulation of the whole injection molding process (filling, packing and cooling) has been developed at the University of Salerno. The software is based on an advanced characterization that describes the main phenomena taking place in the polymeric material during the process. The formation of fibers and spherulites, the role of flow intensity on alpha phase morphologies and crystallization kinetics, the interplay between crystallinity and rheology, and the effect of pressure on rheology and crystallization are accounted for. Some key results are presented and discussed in this work.

Biography:

Prof. Pantani is Full Professor at the University of Salerno. His research focuses on polymer processing, rheology, morphology evolution, dimensional accuracy and degradation kinetics of polymers. His scientific output includes ~200 papers in international journals, six book chapters, and over 250 conference presentations. His work has received ~5500 citations with an h-index of 38 (Scopus). He has been recognized with prestigious awards such as the Moran Lambla Award of PPS (2015) and the Premio dei Premi of the Italian President (2016). He serves on the editorial boards of several journals and collaborates with international research centers and industry.

Advances in Smart Polymers and Derivatives for a Sustainable Future

Daria Lebed[1], Marcelo Paolo Calagua[1], María del Puerto Morales[3], Isabel Quijada-Garrido[2] and Alberto García-Peñas[1]*

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Abstract:

The European Union's Green Deal promotes the transformation of industries through resource efficiency, cleaner technologies, and sustainable materials. Polymers play a pivotal role in this transition due to their versatility and relevance across multiple sectors. Despite ongoing challenges such as microplastic pollution, innovations in biopolymers, recycling strategies, and smart polymer systems are paving the way toward more sustainable solutions.

In this work, temperature-responsive copolymers based on *N*-isopropylacrylamide and dopamine methacrylamide were developed to create functional materials capable of interacting with magnetic nanoparticles. The resulting hybrid systems exhibit tunable solubility and strong metal-binding properties, enabling efficient removal of contaminants such as hexavalent chromium from water through magnetic separation. Moreover, these systems show potential for broader applications, including photocatalysis and biomedical technologies.

These findings highlight the potential of smart polymer, nanoparticle hybrids as adaptable and environmentally friendly materials for next-generation water purification and resource recovery technologies.

Oral Presentations

Interaction of Human Cells With Bacterial Nanocellulose

Lubica Stankova[a]*, Anna Kutova[c] , Martina Doubkova[a], Ondrej Kvitek[b], Kristyna Vejvodova[b], Barbora Vokata[d], Antonin Sedlar[a], Hazem Idriss[b], Petr Slepicka[b], Vaclav Svorcik[b], Lucie Bacakova[a]

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[d]Department of Biochemistry and Microbiology, Institute of Chemical Technology, Technická 5, 166 28 Prague 6, Czech Republic

Abstract:

Bacterial nanocellulose (BNC) is a polysaccharide (linear polymer of glucose) produced by acetic acid bacteria on the surface of a cultivation fluid. Although BNC is chemically identical to "ordinary" plant cellulose, it exhibits specific chemical and physical properties, which make it promising for a wide range of industrial and biomedical applications. These properties include high purity (i.e., absence of byproducts like lignin, pectin, hemicelluloses, etc.), high water retention capacity (important for keeping moisture in skin wounds and for removing the exudate), suitable mechanical properties mimicking those of soft tissues, mainly skin, allowing its application in regenerative medicine. The bioactivity of BNC can be enhanced by physicochemical modifications, particularly plasma treatment. In our research, BNC samples were modified in a direct current of Ar^+ plasma discharge from both sides for 240 s, which was preceded by air-drying or lyophilization of a BNC hydrogel. The BNC was seeded with normal human dermal fibroblasts (NHDFs), human keratinocytes (HaCaT) or human umbilical vein endothelial cells (HUVECs). The cells grew preferentially on the plasma-modified BNC, which was more apparent in NHDFs and HaCaTs. In general, all cell types exhibited relatively high viability on BNC. Furthermore, the scratch test confirmed the assumption of good wound healing properties of this material.

This work was supported by Project OP JAK "Excellence in Regenerative Medicine" (ExRegMed), No. CZ.02.01.01/00/22_008/0004562, of the Ministry of Education, Youth and Sports of the Czech Republic, which is co-funded by the European Union.

Biography:

I am a researcher in the Department of Biomaterials and Tissue Engineering at the Institute of Physiology of the Czech Academy of Sciences. Since 2005, I have worked in the field of nanostructured materials and tissue engineering. My research focuses on using nanostructured materials for bone, vascular, and skin tissue engineering. This work has given me the opportunity to study the interaction of various cell types with a wide range of nanostructured materials. These materials include nanocrystalline diamond, carbon-based nanoparticles, electrospun synthetic polymeric nanofibers, and bacterial nanocellulose.

From Skin to Bone: Engineering Biomimetic In Vitro Models Using Polymeric Materials

Martina Doubková[abc]*, Yu Chieh-Wu[ac], Jana Sabová[d], Marina Malić[ac], Antonín Brož[a], Věra Jenčová[e], Peter Gál[df], Lucie Bačáková[a,c]

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[e]Technical University of Liberec, Liberec, Czech Republic
[f]Prague Burn Center, Third Faculty of Medicine, Charles University and Královské Vinohrady University Hospital, Prague, Czech Republic

Abstract:

Tissue engineering is a multidisciplinary field that integrates materials science and life sciences to regulate cell behavior and tissue regeneration, as well as drug delivery and testing. Polymeric materials are increasingly employed to construct in vitro models that replicate complex tissue environments and pathological conditions. This talk highlights the development of several such models using natural and synthetic polymers for disease modeling and regenerative medicine applications. A macromolecular crowding approach was used to simulate fibrotic conditions in fibroblast cultures derived from congenital clubfoot and normal skin. Soluble macromolecules (Ficoll) added to culture media created pseudo-3D environment, which significantly enhanced extracellular matrix deposition and fibrosis-related marker expression, enabling drug screening in a physiologically relevant context. A layered 3D collagen-based skin models, supported by polycaprolactone (PCL) nanofibrous membrane and incorporating co-cultures of endothelial cells, mesenchymal stem cells, dermal fibroblasts, and keratinocytes, were developed to mimic both healthy full-thickness skin and hypertrophic scars. These models are suitable for studies on skin regeneration and anti-fibrotic drug testing. Additionally, 3D hydrogels representing the osteochondral interface were prepared using a collagen-hyaluronic acid blend or a collagen-nanohydroxyapatite scaffold on PCL membranes. These hydrogels supported co-cultures of endothelial cells and mesenchymal stem cells differentiated toward osteoblasts or chondrocytes, enabling study of mineralized tissue formation. Together, these models demonstrate the versatility of polymeric systems in recapitulating native tissue architecture and function, offering valuable platforms for preclinical research and therapeutic development.

Supported by the Ministry of Health, CR (grant NU22-06-00016) and the MEYS, CR (project CZ.02.01.01/00/22_008/0004631, co-funded by the EU).

Biography:

Martina Doubková is a researcher at the Laboratory of Biomaterials and Tissue Engineering at the Czech Academy of Sciences, Prague, Czech Republic. Her PhD project focused on improving the non-invasive fibrosis treatment of congenital clubfoot. She currently works on developing models that mimic complex tissue environments in vitro, including skin fibrosis and hypertrophic scars. Martina has co-authored over 20 scientific papers. She has received funding to conduct several student research projects during her PhD and continues to be actively involved in developing and evaluating biomaterials for bone implants, skin regeneration, and in vitro tissue models.

Hydrogel Formulation for Sustained Release of Biomimetic Nanoparticles

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[b]*The Norman Seiden Multidisciplinary Program for Nanoscience and Nanotechnology Technion – Israel Institute of Technology, Israel*
[c]*The Russell-Berrie Nanotechnology Institute, Technion – Israel Institute of Technology, Israel*

Abstract:

Hydrogels, 3D cross-linked polymeric networks, have diverse biomedical applications, particularly in drug delivery. Incorporating nanoparticles (NPs) into hydrogels can enhance therapeutic effects by enabling more targeted and sustained release. Biomimetic NPs (BNPs), which integrate leukocyte membrane proteins and were developed by Dr. Assaf Zinger's group, offer significant potential for therapeutic outcomes. However, due to their nanometric size, the controlled release of these BNPs from the hydrogel network cannot occur via a diffusion mechanism.

This study aims to develop a double network hydrogel platform for the controlled release of novel BNPs. The hydrogel dissolves at physiological conditions, allowing the BNPs to release and evaluate its therapeutic effects. We focus on creating a physically cross-linked IPN hydrogel using konjac glucomannan (KGM) and kappa-carrageenan (KCAR) polysaccharides, with embedded BNPs. The study investigates the physical, mechanical, and rheological properties of the hydrogels, including their ability to release BNPs at a controlled rate. We also assess the therapeutic effects of this release in vitro inflammation model.

The results demonstrate the successful fabrication of KGM-KCAR hydrogels incorporating BNPs. The hydrogels exhibited self-healing and shear-thinning properties, with tunable dissolution and BNP release rates, influenced by potassium chloride (KCl) as a physical cross-linker. Additionally, the formulation reduced TNF-alpha cytokine levels in an in vitro inflammation model, without significantly affecting cell viability. This research suggests that the KGM-KCAR hydrogel platform offers a promising approach for controlled release of BNPs, providing therapeutic potential in various medical applications.

Biography:

Oshrat Regev Yehishalom completed her B.Sc. in Biochemical Engineering, graduating cum laude, from the Technion – Israel Institute of Technology. She then pursued an M.Sc. in NanoScience & Nanotechnology, focusing on hydrogel formulation for the sustained release of biomimetic nanoparticles. Currently, she is working toward her Ph.D. in NanoScience & Nanotechnology through the direct track program. On May 2024, she published a paper related to her research topic.

3D Printing of Pea Protein – κ-Carrageenan Nanoparticles for Edible Pickering Emulsions

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Abstract:

Pickering emulsions (PEs) can be utilized as inks for 3D food printing owing to their extensive stability and appropriate viscoelastic properties. This research explores food-grade PEs stabilized with nanoparticles (NPs) based on modified pea protein (PP) isolate and k-carrageenan (KC). NPs are fabricated from solutions with different concentrations of protein and polysaccharide and characterized in terms of size, zeta potential, and wetting properties. The composition of the emulsion is 60% sunflower oil and 40% aqueous phase. Nine emulsion formulations with varying PP and KC concentrations are investigated. The formation of hollow NPs with a hydrodynamic diameter of 120 nm–250 nm is observed. Microscope imaging shows oil droplets surrounded by a continuous aqueous phase, forming homogenous PEs at all formulations that are stable for over 30 days. Further, the oil droplet size decreases with increasing NP concentration while the viscosity increases. Rheologic experiments portray elastic emulsion gels with thixotropic qualities ascribed to the presence of the polysaccharide. The emulsions are subjected to centrifugation in order to compare the original emulsions to concentrated PEs that show improved capabilities to serve as sustainable and printable, saturated fat alternatives due to their composition, texture and stability and rheological properties. Lastly, PEs are printed smoothly and precisely while maintaining a self-supported structure paving way for creating improved, innovative food alternatives.

Biography:

Galia Hendel, born in Israel in 1996, graduated Cum Laude from the Technion, Israel Institue of Technology completing her B.Sc in Chemical engineering. She is currently persuing a direct track Ph.D researching Pickering emulsions as fat repalcements in vegan and cultured meat products in the Laboratory of Nano-Structure and Properties of Biomedical Polymers at the Technion, Israel Institute of Technology. She received the "Irwin and Joan Jacobs excellence fellowship in research" in 2023 and published a peer-reviewed paper on the topic of Pickering emulsions in 2025.

Exploiting Self-Assembly of Block Copolymers to Control the Positioning of Lead Halide Perovskite Nanocrystals onto Conductive Supports

Anna Malafronte[a]* and Claudio De Rosa[a]

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Abstract:

The properties of devices based on perovskite nanocrystals (NCs) thin films critically depend on the size, morphology, and nanoscale arrangement of the NCs, which can influence and enhance the photophysical properties of the perovskite. We present a straightforward method based on block copolymers (BCPs) self-assembly to fabricate nanostructured thin films, onto solid conductive supports, characterized by the controlled positioning of lead halide perovskite NCs at nanoscale. In particular, spherical micelles of polystyrene-*b*-poly(4-vinylpyridine) (PS-PVP) BCPs were employed as nanoreactors for the synthesis of $CsPbBr_3$ nanocrystals and as templates to control their organization onto conductive solid supports. We used indium tin oxide (ITO), tin oxide-coated ITO (ITO/SnO_2), and nickel oxide-coated ITO (ITO/NiO) - materials largely used in optoelectronic and photovoltaic devices - as conductive supports. This strategy results in a selective infiltration of perovskite NCs into the spherical micelles of the BCP and consequent well-defined positioning of NCs onto the conductive supports. Furthermore, we demonstrate that by using two PS-PVP copolymers with different molecular masses of both PS and PVP blocks, it is possible to regulate the size of nanoclusters of perovskite NCs and their spatial distribution onto the solid supports at the nanoscale. This study highlights the high versatility of BCPs in fabricating materials with controlled nanoscale morphology and offers a promising route to finely tune the properties of perovskite-based materials.

Biography:

Anna Malafronte is Associate Professor of Industrial Chemistry at the University of Naples Federico II (Italy). She earned her Master's degree in Chemical Sciences (Summa Cum Laude) in 2011 and completed the Ph.D. in Chemical Sciences at the same university. Her main research interests include the design and fabrication of nanostructured thin films based on block copolymers (BCPs) and the study of the relationships between molecular and crystalline structures and the physical properties of semicrystalline polymers. Anna Malafronte is author of 64 scientific papers and 2 book chapters (h-index: 25; citations: 1221; source: Scopus, as of May 15, 2025).

Tuning Lamellar Nanostructure Alignment in Crystalline Block Copolymers

Rocco Di Girolamo[a]* and Claudio De Rosa[a]

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Abstract:

Phase separation of immiscible block copolymers (BCP), typically amorphous, results in formation of ordered nanostructures with self-assembly in lamellar, spherical, cylindrical, gyroid nanodomains, whose size and shape may be tuned by changing BCP molecular mass and composition. These self-assembled nanostructures having periodicity in the nanoscale, have already shown their potential for fabrication of nanomaterials.

In semicrystalline block copolymers containing crystalline blocks, microphase separation arises from incompatibility of the blocks as in amorphous BCPs, or by crystallization of one or more blocks. The final morphology is path dependent and is the result of the competition and interplay between at least two thermodynamic transitions, microphase separation and crystal-lization.

We report the structural and morphological characterization of a novel class of semicrystalline polyolefin-based block copolymers (BCPs) obtained through metallorganic catalysis. In particular we synthesized and studied cystalline-crystalline block copolymers formed by isotactic polypropylene (iPP) block linked to polyethylene (PE) or syndiotactic polypropylene (sPP) block and BCP samples where the crystalline iPP/sPP/PE block is linked to different amorphous blocks made of ethylene-based or propylene-based copolymers. The final morphology of these systems is path dependent, being affected by the competition between crystallization and phasese-paration. Finally, highly ordered lamellar nanostructures were obtained for both crystalline-crystalline and crystalline-amorphous block copolymers by using epitaxial crystallization onto selected substrates. We also coupled epitaxy with the technique of gold decoration technique such that the ordered BCP nanostructures act as template for the fabrication of long, straight, and parallel rows of gold nanoclusters that could be used in many applications.

Biography:

Rocco Di Girolamo (RDG) is Associate Professor at the University of Naples Federico II, working at the Department of Chemical Sciences. The scientific interests of RDG are focused on interdisciplinary studies concerning the synthesis and characterization of semicrystalline polymeric materials and in particular block copolymers able to form periodic nanostructures by self-assembly. RDG was awarded (2018) by American Association for the Advancement of Science (AAAS) with the Newcomb Cleveland Award for the best paper published in Science during 2017.

He is author of 138 papers published in international scientific journals and 4 Chapters of books (Scopus: h-index 30, 3441 citations).

Influence of Material Characterization Methods on Liquid Silicone Rubber Injection Moulding Simulations

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Abstract:

Accurate simulation of liquid silicone rubber (LSR) injection moulding requires reliable input data for viscosity, thermal properties, and curing kinetics. However, different experimental methodologies for material characterization can lead to significantly different datasets, raising questions about their impact on simulation outcomes. This work investigates how variations in the determination of shear viscosity, specific heat capacity, and crosslinking kinetics influence key processing outputs in commercial finite element simulation software. Simulations were performed using distinct datasets obtained through oscillatory (LAOS) and capillary (HPCR) methods for viscosity, sapphire and modulated DSC methods for specific heat capacity, and calorimetry and rheology-based approaches for curing kinetics.

The results show that viscosity datasets affect the pressure profile during the filling phase, with higher viscosity values requiring greater injection force. Specific heat capacity had a marked influence on temperature development and curing behavior during the cycle, while curing kinetics datasets led to significant differences in conversion timing, particularly in the onset and progression of crosslinking. Notably, some simulation setups predicted full cure significantly earlier depending on the dataset used.

These findings underscore the importance of critically selecting and understanding the origin of material data used in LSR injection moulding simulations. They also highlight that differences stemming from characterization methods can lead to variations in processing parameters, which may ultimately affect part quality and production efficiency. This study provides simulation engineers and material scientists with guidelines for material data selection and awareness of its implications for process simulation.

Biography:

Maurício Azevedo holds a PhD in Polymer Engineering from the Technical University of Leoben, Austria, and has over 10 years of experience in rubber technology and polymer science. He currently leads the Elastomer Technologies research group at the Polymer Competence Center Leoben (PCCL), Austria's leading research center in polymer engineering. His work focuses on material characterization, processing simulation, and the development of advanced elastomeric materials for industrial applications.

Direct Mixed-mode Partitioning Using DIC and J-Integral in Beam-like Specimens

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Abstract:

Standardised methods for testing CFRPs and measuring the fracture energy for a given type of loading are commonly used among academia and industry, e.g. Double Cantilever Beam (DCB) test for Mode I loading, End Loaded Split (ELS) for Mode II loading, and Fixed Ratio Mixed Mode (FRMM) for mixed-mode loading.

In the current work, a direct method of mode partitioning is developed, based on applying partitioned J-integral to the strain field directly measured from the fracture tests using Digital Image Correlation (DIC). In the first instance, and in order to verify the accuracy of the approach, strain fields are obtained from Finite Element Analysis (FEA) of standard symmetric fracture specimens with known mode partitioning, such as DCB, ELS and FRMM. Following the numerical work, standard fracture tests (DCB, ELS, FRMM) are conducted using DIC (Figure 1). In addition, and in order to simulate a more realistic joint, a Cracked Lap Shear (CLS) specimen has been designed and tested.

The novel partitioning approach is found to be efficient and accurate. Excellent accuracy has been achieved using well-structured numerical strain data. Very good agreement was achieved for all standards specimens. As for CLS, there is no accepted partitioning solutions and various partitioning results have been reported in literature. The findings from the current work are found to be different from the results that NASA[1] compiled in its CLS Round-Robin. The new direct mixed-mode partitioning method using either numerical or experimental data resulted in mode-I and mode-II fracture energy ratio *GI*/*GII* = 3/7.

Finally, the study has been successfully extended to asymmetric FRMM specimens with four different ratios of asymmetry ranging from 0.5 to 3.94. Results obtained have been compared to the results from Williams[2], Hutchinson[3] and SACA[4] partitioning methods (Figure 2). This further validates this new partitioning method.

References:

[1] W. S. Johnson, "Stress Analysis of the Cracked Lap Shear Specimen: An ASTM Round Robin," 1986.

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[4] M. Conroy, A. J. Kinloch, J. G. Williams, and A. Ivankovic, "Mixed mode partitioning of beam-like geometries: A damage dependent solution," Eng. Fract. Mech., vol. 149, no. 1, pp. 351–367, 2015.

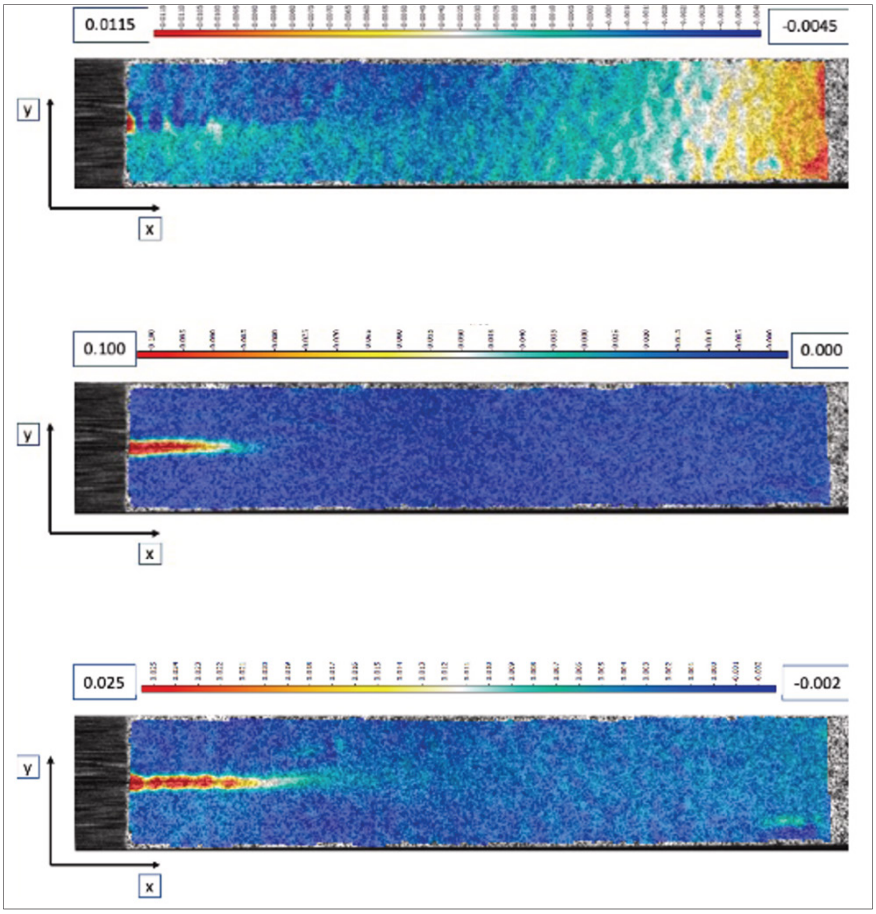

Figure 1: exx, eyy and exy strain components from DCB DIC tests.

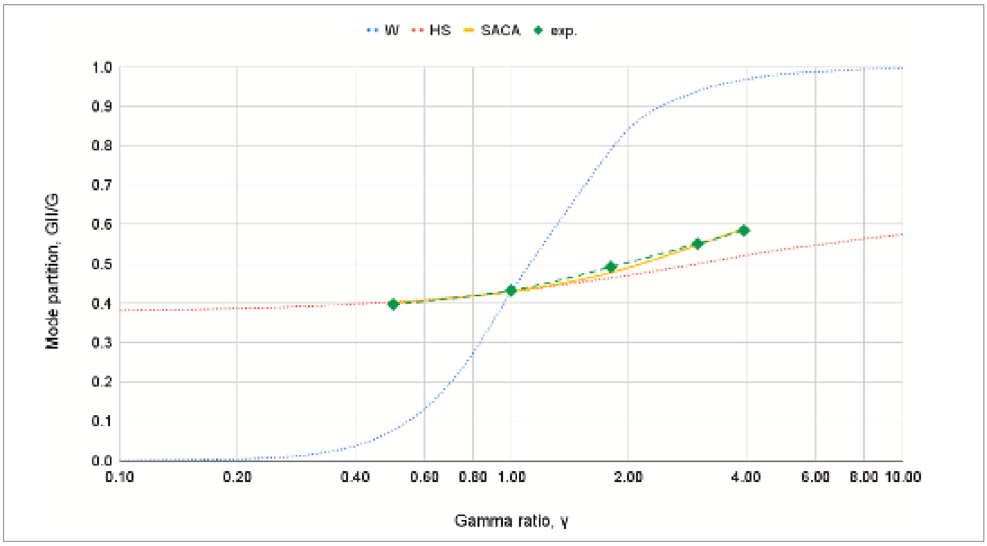

Figure 2: Comparison between experimental results and various partitioning theories (Williams' (W), Hutchinson and Suo's (HS), Conroy et al.'s SACA).

Structural Numerical Simulation in Plastic Pallets

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Abstract:

The Embalagem do Futuro REDUCE project is dedicated to designing and developing an innovative plastic pallet through computational modelling and numerical simulation. Focused on transitioning from traditional wooden pallets, it emphasizes the enhanced properties of plastic, including superior durability, resistance to moisture and pests, reduced weight, increased lifespan, and greater efficiency in transportation logistics. Moreover, their recyclability supports sustainability objectives, positioning them as an environmentally friendly option.

This study employs numerical simulation as a fundamental tool in the design phase, offering precise analysis of structural performance while eliminating the extensive costs and resources associated with physical prototyping. In accordance with ISO 8611 standards, the performance of the pallet is assessed through a Finite Element Method (FEM) model by three different simulations: two bending simulations in distinct directions and a corner drop simulation. The numerical model of the structural simulations was developed using Abaqus software.

The results of these simulations enable the measurement of displacements to meet standard requirements, as well as the identification of critical stress regions and potential structural vulnerabilities in the preliminary design. Informed by this analysis, the design is iteratively refined to meet required mechanical and safety standards, ensuring optimal functionality, reliability, and durability under practical conditions.

By integrating numerical simulation, this project demonstrates the transformative potential of computational tools in modern product development. It highlights the ability to streamline the design process, reduce resource consumption, and enhance end-product performance, setting a benchmark for innovation and sustainability in industrial logistics.

Acknowledgements:

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Biography:

Research Engineer at PIEP (Innovation in Polymer Engineering) with a master's degree in Mechanical Engineering, specializing in Manufacturing Technologies, from University of Minho (Portugal). Experience in product design and development, numerical simulation using Finite Element Methods, CAD design – analysis and correction of CAD geometries, experimental testing of materials and products and strain gauge instrumentation. Currently pursuing a master's degree in Aerospace Engineering at University of Minho.

Numerical Analysis of an Injection-Molded Composite Bicycle Frame: Influence of Fiber Orientation on Static Pedaling Loads

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Abstract:

This study presents the design and structural analysis of a polyamide-6 reinforced with 40% weight fraction of carbon fibers (PA6-40CF) bicycle frame subjected to static pedaling loads.

The research focuses on evaluating the structural performance of the frame through Finite Element Method (FEM) simulations, considering both isotropic material behavior and the anisotropic properties resulting from the fiber orientation induced by the injection molding process.

A numerical workflow was developed to incorporate fiber orientation data - obtained from injection molding simulations - into the structural model. This approach enabled a more realistic representation of the composite's behavior, allowing direct comparison with a simplified isotropic model commonly used in early design stages.

The results revealed that the fiber orientation developed during the injection molding process has impact on the mechanical properties of the frame.

The outcomes of this study highlight the importance of integrating process-induced anisotropy into structural analysis to improve the accuracy of performance predictions for injection-molded composite structures.

Moreover, this study emphasizes the growing role of polymers in advancing sustainable and efficient transportation technologies, demonstrating their capacity to meet demanding engineering requirements.

Acknowledgements:

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carbónica nas cidades” co-financed by NextGenerationEU, through the ‘Business Innovation Agendas’ investment from the Recovery and Resilience Plan (RRP).

Biography:

Research and Development Engineer at PIEP with a master's degree in Materials Engineering and a specialization in Systems Engineering, both from University of Minho (Portugal). Experience in material selection, product design and development, numerical simulation using Finite Element Methods and experimental testing of materials and products.

UV-Assisted Synthesis of Gel Polymer Electrolytes for Sustainable Li-Ion Battery Design

Ana Barrera[a*], Corinne Binet[a], Philippe Supiot[a] and Ulrich Maschke[a]

[a]*Unité des Matériaux et Transformations (UMET-UMR8207), Université de Lille, Lille, France*

Abstract:

The energy transition poses novel challenges, particularly for electrochemical energy storage. Lithium-ion batteries (LIBs) are indispensable in electronic, medical, and industrial devices, as well as in electric vehicles. These batteries offer significant advantages, including high energy density, long life, and low self-discharge. However, the use of liquid electrolytes in conventional LIBs poses significant safety concerns, including the potential for fire, explosion, and dendrite formation. This complicates the recycling process, raising environmental and safety concerns. In order to enhance the safety and recyclability of LIBs, the development of poly(ethylene glycol) diacrylate (PEGDA)-based gel polymer electrolytes (GPEs) incorporating 0-60% by weight of a commercial liquid electrolyte (1 M LiPF6 in EC/DEC 50/50 v/v) was conducted. The synthesis was executed in a single step by means of UV irradiation at room temperature. Infrared analysis and EDS mapping confirmed the efficient immobilization of the liquid electrolyte in the polymer matrix. Thermal stability of the EPGs was assessed by thermal analysis (ATG and DSC), revealing their stability over a wide temperature range from -40°C to 90°C. Temperature dielectric measurements (ranging from 20 to 100°C) conducted over a broad frequency spectrum (from 0.1 Hz to 10^6 Hz) have demonstrated that the ionic conductivity of EPGs exhibits an increase in proportion to the liquid electrolyte content. Specifically, EPGs comprising 60% by mass of liquid electrolyte attain a conductivity level that is consistent with the values reported in literature, measuring approximately 6.6×10^{-3} S/m at 30°C.

Biography:

Dr. Ana Barrera, postdoctoral researcher at UMET, University of Lille, develops advanced polymer-based materials for sustainable technologies and energy storage. Originally from Ecuador, she earned her B.Sc. in chemical engineering before completing her M.S. and Ph.D. in material chemistry in France. Her interdisciplinary work focuses on enhancing material performance and recyclability, particularly through the recovery of valuable elements from electronic waste and lithium-ion batteries. She also designs gel polymer electrolytes for all-solid-state batteries, contributing to innovative solutions in energy and environmental sustainability.

Small Biogas Plants made of Textile Materials

Prof. Dr. Josef Hofmann

University of Applied Sciences Landshut, Landshut, Germany

Abstract:

The aim of the project was to develop a cost-effective, flexible, and practical fermentation tank made from textile materials as an economical alternative to conventional fermenters made of steel or concrete.

The focus was particularly on smaller agricultural enterprises, for which traditional biogas systems are often financially unfeasible. The new concept was designed to be modular, easy to assemble, and adaptable to various farm sizes.

A central aspect of the project was the technical feasibility of a gas- and liquid-tight textile fermenter that can withstand long-term mechanical and chemical stress. The project examined suitable materials, construction methods, and operational reliability under real-life conditions. An ecological assessment was also carried out, especially regarding the reduction of concrete and steel use, and the potential to lower methane emissions through manure fermentation.

In addition, the project investigated the acceptance of the concept among farmers, their willingness to invest, and the regulatory and approval barriers that might hinder broader adoption. To test practical applicability, a pilot-scale plant was first constructed, providing valuable insights into material selection, gas tightness, chemical resistance, and process behavior. Based on these findings, a demonstration plant was developed and operated under real conditions at the Agricultural Training Center in Landshut-Schönbrunn, Germany. This plant features a double-walled construction with integrated leak detection and external heating to ensure uniform temperature distribution—crucial for a stable and productive fermentation process. It was also successfully approved according to current technical standards.

The project demonstrates that textile fermenter systems made of PE HD are technically viable and offer promising ecological and economic advantages—provided that appropriate regulatory conditions are in place.

Biography:

Since 2009 Professorship Power and Environmental Technology UAS Landshut

2004 – 2009 Technical Officer Waste Management, Government of Lower Bavaria, Landshut

2002 – 2004 Technical Officer of Landfills and Deputy of Head of Division Remediation of Contaminated Sites, Bavarian State Ministry of Environment, Munich

1990 – 2002 Technical Officer Waste Management, Government of Lower Bavaria, Landshut

1990 Research Assistant, Max-Planck-Institute of Biochemistry, Munich

1990 Ph. D., Technical University Munich

1987 – 1990 Research Assistant, University of Konstanz

1981 – 1987 Studies of Chemistry, Technical University Munich

Research: https://www.researchgate.net/profile/Josef-Hofmann-2/research

Biomimetic Reaction of Cellulose Nanofibrils via Amino Acids: A Morphological and Structural Study

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[b]Regional Centre of Advanced Technologies and Materials, Departments of Experimental Physics and Physical Chemistry, Faculty of Science, Palacky University, 17. listopadu 1192/12, 771 46, Olomouc, Czech Republic

Abstract:

As the most abundant biopolymer on Earth, cellulose has emerged as a sustainable and versatile building block for advanced materials. Its remarkable properties, including biocompatibility, low cost, and high mechanical strength, make it an ideal candidate for various applications. However, to fully unlock its potential, cellulose often requires chemical functionalization to introduce specific properties, such as enhanced surface reactivity, improved hydrophilicity, or new charge characteristics. This work presents a novel biomimetic reaction approach for the modification of cellulose nanofibrils (CNF). We demonstrate how amino acids, acting as auxiliary reagents, enable morphology tuning for CNF, offering a simple yet powerful method to modify cellulose and unlock new properties. Our innovative method is inspired by nature's efficiency to introduce specific functional groups onto the CNF surface and adjust its surface area. Transmission Electron Microscopy (TEM) revealed significant morphological changes mediated by the type of amino acid used. These distinct fibrillar topographies, driven by the chemical nature of the imidazole and guanidinium groups, create materials with tailored properties such as accessible surface area, surface chemistry, and ionic interaction potential. This work opens a new door for designing advanced cellulose-based nanomaterials for advanced applications in environmental remediation.

Biography:

Daniel José da Silva is a materials engineer whose dual bachelor's degrees in Materials Engineering and Science & Technology from the Federal University of ABC in Brazil. He earned his PhD in Materials Engineering at the University of São Paulo, Brazil. Daniel has experience working with applied surface sciences, polymer nanocomposites, including the synthesis, characterization and functionalization of polymeric materials. Currently, he works with biopolymers for water remediation at Palacký University in Olomouc (Czech Republic), at the expense of his own MSCA-OP JAK grant (n° 22_010/0008685–01, entitled Nano4Water), aiming to turn fundamental science into practical solutions for sustainability and environmental cleanup.

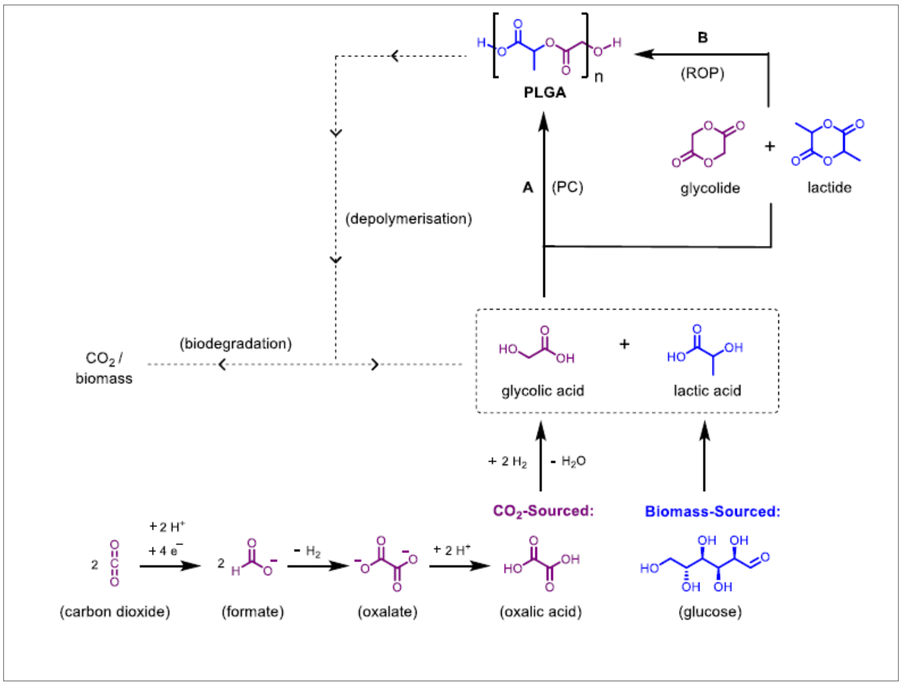
Upscaling High Glycolic Acid Polyesters: A Study into the Synthesis, Recycling and (Bio) degradation of Polylactic-co-glycolic acid (PLGA)

A. McLuskie[1], R.-J. van Putten[1,2], G.-J.M. Gruter[1,2]

[1]*Van 't Hoff Institute for Molecular Sciences, University of Amsterdam*
[2]*Avantium Support B.V.*

Abstract:

Technological developments in the synthesis, application and (re)processing of renewable polymers are critical for our transition towards a circular economy. The EU-funded HICCUPS project aims to utilise CO2 emissions from wastewater treatment processes to develop biodegradable polymers from CO2-based building blocks. Poly(lactic-co-glycolic acid) (PLGA) with a high glycolic acid content is biodegradable, home-compostable, biocompatible, and has excellent water/gas barrier properties. Furthermore, this polymer offers great potential for short-life applications such as (food) packaging and paper coating materials. PLGA can be synthesised from either (A) a Polycondensation (PC) reaction of glycolic acid and lactic acid, or (B) a Ring Opening Polymerisation (ROP) of glycolide and lactide. However, the commercial-scale feasibility of these synthetic processes is currently limited by practical and economic factors. For instance, the PC reaction results in highly coloured polymers with lower average molecular weight (Mn) values, whilst the ROP reaction is highly sensitive to the purity of the (expensive) monomers. In this work, which is a collaboration between the University of Amsterdam and Avantium B.V., we discuss efforts to optimise the upscaling of high glycolic acid polymers, and we present the recycling and (bio)degradation of high glycolic acid polyesters in different physical forms.



From Waste to Vehicles: Ageing and Durability of Post-Industrial and Post-Consumer Recycled Polypropylene

Valentina Brunella* and Matilde Arese

Department of Chemistry , NIS Interdepartmental Centre, SUSPLAS@Unito, Sustainable Plastic Scientific Hub, University of Turin, Via Pietro Giuria 7, 10125 TORINO, Italy

Abstract:

The transition toward a circular economy requires the integration of recycled polymers into demanding sectors such as automotive. This study investigates mechanically recycled polypropylene (PP) compounds containing post-industrial (PIR) and post-consumer (PCR) fractions, with the aim of assessing their suitability for automotive applications. Thermal, mechanical, spectroscopic, and morphological properties were evaluated before and after accelerated ageing.

Results on PIR-based compounds showed that, once properly stabilized, their thermal stability and tensile properties remain comparable to virgin PP, with only minor differences in impact performance. FTIR and thermal analyses confirmed structural preservation, although thermo-oxidative degradation became evident after prolonged ageing. PCR-based compounds, more affected by prior use and degradation, still exhibited stable crystallinity and tensile strength after UV exposure, though reduced low-temperature impact resistance was observed.

A comparative study of virgin, PIR, and PCR formulations highlighted a progressive decrease in oxidative stability, as demonstrated by DSC–Oxidation Induction Time (OIT) measurements. The incorporation of talc significantly improved resistance to oxidation by acting as both a diffusion barrier and a nucleating agent. Photo-ageing tests confirmed the higher susceptibility of PCR compounds to discoloration and surface degradation.

Overall, the findings support the feasibility of incorporating both PIR and PCR polypropylene into automotive components, provided that formulations are carefully optimized and appropriate stabilizing strategies are applied. Future developments will address recycled PP derived from end-of-life vehicles and investigate the use of chain extenders to further enhance the mechanical performance of recycled-based compounds.

Biography:

Valentina Brunella is Associate Professor of Industrial Chemistry (CHIM/04) at the Department of Chemistry, University of Turin, Italy, and obtained the Italian National Scientific Qualification as Full Professor in 2023. Her research focuses on polymer chemistry, with particular expertise in the effects of high-energy radiation on polymeric biomaterials, the development of controlled drug delivery systems, innovative adhesives, and the characterization of recycled and bio-based polymers for industrial applications. She has collaborated extensively with both academic and industrial partners, contributing to advances in sustainable materials and biomedical applications.

Programmable Wrinkle Morphologies on PDMS Films via Plasma-Induced Surface Oxidation

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[a] *Department of Chemical Engineering, Indian Institute of Technology Kharagpur, West Bengal, India*

Abstract:

Controlled surface morphologies on soft polymers are crucial for tailoring interfacial properties in microfluidics, optics, sensors, and flexible electronics. This study investigates the formation and tunability of plasma-induced wrinkle patterns on both uncross-linked and crosslinked polydimethylsiloxane (PDMS) thin films. Upon oxygen plasma treatment, the PDMS surface transforms into a thin, stiff silica-like (SiOx) layer over a compliant substrate, forming a mechanically heterogeneous bilayer. The resulting elastic mismatch generates compressive stresses during cooling, leading to buckling instabilities that produce well-ordered wrinkle morphologies. Wrinkle evolution was monitored by optical microscopy, and atomic force microscopy (AFM) was employed to quantify wavelength and amplitude. AFM analyses reveal a systematic reduction in wrinkle wavelength with increasing PDMS precuring time (0–30 min), attributed to enhanced bulk stiffness and reduced oxidation depth. The wrinkle dimensions are strongly dependent on plasma exposure and precuring conditions: extended plasma durations increase the oxidized layer thickness and modulus contrast, while shorter exposures and post-treatments such as thermal annealing or repeated plasma pulses yield finer and more uniform wrinkle patterns. This metal-free, scalable, and lithography-independent approach enables precise control over nanoscale surface textures through simple processing parameters. The results provide insight into stress evolution at soft interfaces and establish a pathway toward adaptive PDMS surfaces with tunable wettability, adhesion, and optical functionality.

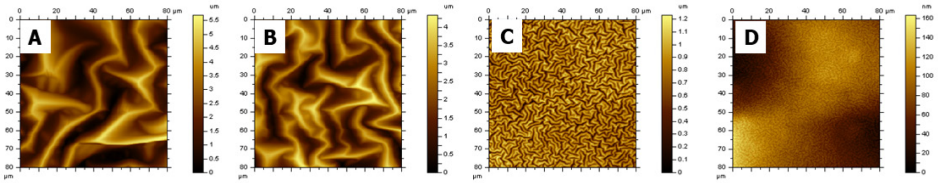

Figure 1: Evolution of wrinkle morphology observed via AFM as a function of PDMS precuring time, illustrating the decrease in wrinkle wavelength, (a) 0 min, (b) 5 min, (c) 10 min, and (d) 30 min.

Keywords: Compressive stress, Precuring time, Thermal annealing, Stress relaxation.

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Science and Applications of One-dimensional Uneven-Structured C_{60} Polymer

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Department of Energy Science and Engineering, Nagoya University, Nagoya, Japan

Abstract:

Electron-beam-irradiation of a C60 film results in formation of one-dimensional (1D) C60 polymer film with a concavo-convex (uneven) periodic curved structure, which exhibits physical properties arising from 1D metal [1]. The behavior of electrons on the curved surface is given by Hamilton operator as follows.

$$\hat{H} = -\frac{\hbar^2}{2m^*}\left[\frac{1}{\sqrt{g}}\sum_{i,j=1}^{2}\frac{\partial}{\partial q^i}\left(\sqrt{g}\,g^{ij}\frac{\partial}{\partial q^j}\right) + (h^2 - k)\right]$$

Here, g = det [gij] represents the metric tensor. The first term is an operator of the kinetic energy of electrons, and the second term consisting of the mean curvature h and the Gaussian curvature k appears like a scalar potential (the second term does not appear in the 1D plane surface). It has been a mystery whether or not this curvature term affects the behavior of electrons since 1950s. We theoretically predict the effects of the geometric curvature term on the electronic behavior of the above 1D C60 polymer and then experimentally demonstrate it. These findings will provide an insight to an interdisciplinary between modern geometry and materials science (quantum mechanics of submanifold) [2]. I will present the fundamental aspects and potential applications of the 1D C60 polymer [3].

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Biography:

Jun Onoe was graduated from Osaka University (master degree) in 1987, and worked for Panasonic Co. Ltd at the same year. He moved to RIKEN in 1990 and got Ph.D. from Kyoto University in 1997. Thereafter, he moved to Tokyo Institute of Technology as an associate professor in 2002, and has been a professor at Nagoya University since 2014. The current topics of his concern are 1) an interdisciplinary between modern geometry and materials science, 2) organic solar cells and thermoelectric devices, and 3) nano-space materials applied to recycling of precious metals from N- and E-wastes.

Developing Sustainable Plant-Based High Water Repellent Coatings Using Hydrophobic Pine and Palm Pollen

Brenda Resendiz Diaz *[a] **and Colin R. Crick** [a]

[a]*School of Engineering and Materials Sciences, Queen Mary University of London, London, E1 4NS, UK.*

Abstract:

The environmental concerns associated with plastics and fluorocarbon-based materials have driven the search for sustainable alternatives, particularly in the development of high water-repellent coatings. Plant-based materials offer a promising solution due to their biodegradability and sustainability. In this study, we developed high water-repellent coatings using modified pine and palm pollen. Superhydrophobicity was achieved by integrating a low surface energy material (plant-based wax) with a micro/nano-scale rough structure formed by the pollen. To enhance their surface chemistry, the two pollen species underwent chemical modification through an acid treatment, which effectively removed proteins and altered the wettability of the sporopollenin-based structure. The modified pollen was then combined with two different plant-based waxes: carnauba wax and soybean wax, leading to the fabrication of the final coatings. The resulting surfaces demonstrated remarkable water repellence, achieving the highest water contact angles of approximately ≈157˚ and low sliding angles of less than 6˚ with the Pine Pollen/Carnauba wax formulations. In contrast, the Palm Pollen/Carnauba wax formulations showed the highest water contact angle of ≈151˚ and the lowest sliding angle of 13˚. These findings highlight the potential of plant-based materials for environmentally friendly coating applications.

Biography:

Brenda Resendiz Diaz is a third-year PhD candidate at Queen Mary University of London (QMUL) in the School of Engineering and Materials Science (SEMS). As an integral member of Dr. Colin Crick's research group, she specialises in the design and development of superhydrophobic materials, focusing on plant-based water-repellent coatings aimed at advancing sustainable innovations in food packaging, healthcare, and agriculture.

Her research also explores the use of sulfur-based polymers for textile applications to improve durability and hydrophobic performance. She is the co-founder of *EcoBarrier*, a QMUL spin-out dedicated to the commercialisation of sustainable coatings that offer high performance with minimal environmental impact.

Synthesis of Fully-Biobased Composites from Isosorbide Monomethacrylates Reinforced with Flax by Resin Transfer Molding (RTM)

Sara Barriga Valdez[a]*, Benjamin Barraud[a], Florine Nonque[a], Théodore Vanbesien [b], Fanny Bonnet[a], and Jonathan Potier[a]

[a]Univ. Lille, CNRS, INRAE, Centrale Lille, UMR 8207 - UMET - Unité Matériaux et Transformations, F-59000 Lille, France
[b]Advanced Solution Department, Roquette Frères, 62136 Lestrem, France

Abstract:

The global production of petro-based polymers exceeds 400 million tons annually, raising serious concerns about their environmental impact and driving the search for sustainable alternatives. Bio-based materials derived from renewable resources have emerged as promising candidates. Within this context, Roquette is exploring starch-derived compounds to replace conventional petro-sourced materials. Among them, isosorbide, a bio-based platform molecule produced through the double dehydration of sorbitol, is particularly versatile for substituting petroleum-derived products. We have synthesized thermosets using isosorbide monomethacrylate (IMMA), finding that poly(isosorbide monomethacrylate) (PIMMA) exhibits a glass transition temperature (Tg) around 117 °C. With the ultimate goal of improving mechanical properties, the initial steps have focused on synthesizing and characterizing flax-reinforced PIMMA composites, as described in this study. In the present work, PIMMA thermosets were synthesized by radical polymerization under varying conditions to optimize parameters for Resin Transfer Molding (RTM). The novelty of this work lies in the one-pot, one-step synthesis of both monomers and cross-linking agents, combined with solvent-free polymerization. Flax-reinforced PIMMA plaques were successfully produced via RTM. The resulting materials displayed a Tg of approximately 145 °C.

Biography:

Sara Barriga was born in Mexico and earned her degree in chemical engineering from Universidad Autónoma de Coahuila, where she worked on Fischer-Tropsch catalysts and hydroxyapatite materials for bone scaffolds. She completed a Master's at Université de Lille in "Integrated Research for Advanced Chemistry and Materials," contributing to projects on piezochromic materials for the aeronautical industry and fully bio-based poly(isosorbide acrylates) for cosmetic applications. Currently, she is a PhD student at Université de Lille, working on the ANR project "IRRIGATE," focused on developing innovative waterborne physical gels and latexes from fully bio-based poly(isosorbide acrylates).

Study of Homogeneous and Heterogeneous Catalysts Based on Zinc (II) Complexes for the Synthesis of PLA via Ring-Opening Polymerization

Darío González[a], Jocelyn Oyarce[a], Felipe Picero[a]

[a]*Instituto de Química, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile*

Abstract:

Polylactic acid (PLA) is one of the prominent materials within the so-called biodegradable polymers, as it can achieve excellent properties comparable to those of polyolefins when synthesized via ring-opening polymerization (ROP) from the cyclic ester lactide (LA). This reaction requires a catalyst capable of initiating and controlling the polymerization [1]. In the literature, a wide range of coordination compounds used as ROP catalysts can be found, mainly in the homogeneous phase, where the factors considered responsible for the catalytic behavior are the complex architecture, types of ligands, substituent groups, and the metal center employed, with Al and Zn standing out due to their results. On the other hand, the possibility of transferring these catalytic systems to a heterogeneous phase through impregnation techniques of the catalysts onto inorganic supports has generated a growing line of research on the influence on catalytic activity and the characteristics of the obtained PLA, such as molecular weight, polydispersity, tacticity, thermal properties, among others .This work proposes the use of Zn(II) catalytic systems for ROP, with the aim of studying the influence of the catalyst structure, substituent groups, and support morphology on the properties of the obtained PLA.

Catalyst	[LA]:[Zn]	t (h)	Conv (%)	Mw (kg/mol)	Mw/Mn	Tg (°C)
(1)-OMe	800	18	86	3.82	1.48	12.1
(1)-NO2	800	18	97	4.94	1.43	26.8
(1)-H	800	18	96	1.93	1.25	22.3
(2)-Ethyl	400	4	92	5.19	1.43	24.0
(2)-Cycle	400	4	86	3.18	1.25	16.1

Table shows some trends, such as catalysts of type (2) achieving high conversions in a shorter time, and that the nitro substituent generates higher molecular weights. On the other hand, Tg increases for higher Mw and decreases significantly for lower conversions.

Biography:

Doctor of Chemistry, graduated from the University of Chile in 2015. His research focuses on polymeric materials, specializing in their synthesis, characterization, and properties. After completing his doctoral studies, he pursued a postdoctoral fellowship at the Pontifical Catholic University of Valparaíso, specializing in the synthesis of coordination compounds for use as catalysts in polymerization reactions. Currently, he is an Associate Professor and Researcher at the same university, leading a project funded by FONDECYT.

Cellulose-Derived Nanoporous Carbons for the UV-Driven Photocatalytic Remediation of Toluene Pollution

Juan Matos[1]*, Po S. Poon[2]

[1]*Iberoamerican Institute for Sustainable Development, Autonomous University of Chile Temuco, Chile.*
[2]*Unidad de Desarrollo Tecnológico (UDT), Universidad de Concepción, Chile.*

Abstract:

Among the broad variety of air pollution molecules, the volatile organic compound (VOCs) including the so-called BTX molecules (Benzene-Toluene-Xylene, BTX) are frequently found VOCs pollutants within indoor air environments. Specifically, the chronic exposure to toluene, even at very low concentration, affects respiratory and the central nervous system so, it is highly toxic for human beings. In this context, the use of efficient, low-cost, and biocompatible filters for the removal of toluene has been a challenge in the last years. In this sense, the use of natural polymers including cellulose-based biomass waste has shown to be an excellent source for the design of texture and chemical surface properties of nanoporous carbons. In the present work, the influence of the molecular adsorption density of toluene adsorbed on nanoporous carbons (AC) prepared from the sawdust of a soft-wood has been correlated with the catalytic activity of semiconductors such as TiO_2 in the UV-driven toluene photooxidation. Results showed that surface pH of carbons play a minor role while the textural and porosimetry properties strongly influence the photoactivity of the semiconductor. In conclusion, TiO_2/AC composites were highly efficient to photo oxidate toluene for two consecutive runs more efficiently than TiO_2 alone. It can be concluded that combining "adsorption on porous carbon" and "oxidative photocatalysis on semiconductors" is a promising direction for indoor air purification by removing hazardous gaseous pollutants. The present findings permit the use of the molecular density of adsorption as a parameter to predict the photocatalytic activity of photoactive semiconductors to gaseous NO_x and SO_x.

Acknowledgements:

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XAFS Analysis of Polymer-Supported Osmium Oxide Catalyst

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[1]*Department of Energy Science and Engineering, Nagoya University, Nagoya, Japan*
[2]*Institute of Materials and Systems for Sustainability, Nagoya University, Nagoya, Japan*

Abstract:

XAFS study was carried out on a phenoxyethoxymethyl-polystyrene based polymer-supported osmium oxide catalyst (PEM-MC Os catalyst) [1] that successfully proceeds asymmetric dihydroxylation of olefins, and is easily recovered by filtration and reused without loss of activity. XANES indicated that Os8+ cation in the starting material OsO4 was reduced to Os4+ cation during catalyst preparation, and EXAFS analysis revealed that the Os species in the catalyst was quite similar to OsO2. These suggest that in the preparation process the methanol reduced OsO4 to form OsO2 and the OsO2 species were encapsulated in polymer matrix. A detailed comparison of white line intensity in XANES spectra of PEM-MC Os catalyst and a OsO2 solid sample suggests that the OsO2 species in the catalyst are more cationic or more symmetric than the bulk OsO2 probably due to the interaction with the polymer matrix. It was concluded that the polymer-encapsulated Os species would be highly dispersed as very small OsO2-like particles. This species should be formed through reduction of the OsO4 by methanol in the preparation process.

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Biography:

Tomoko Yoshida was graduated from Kyoto University (Ph. D) in 1996, and moved to Nagoya University as an assistant professor at the same year. She became an associate professor of Nagoya University in 2003, and has been a professor at Osaka City University (from 2015 to 2023) and Nagoya University (since 2024). The current topics of her concern are 1) synthesis of the solid catalysts, 2) evaluation them, i.e., characterization of synthesized catalysts and elucidation of catalytic mechanisms.

Engineering Green Rubber Composites: Utilization of Devulcanized Rubber Crumb and Lignin

Michaela Džuganová[a]*, Ján Hronkovič[b], Jozef Preťo[b], Jozef Feranc[a], Ján Kruželák[a]

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[b]*VIPO a.s., Gen.Svobodu 1069/4, 958 01 Partizánske, Slovakia*

Abstract:

The growing volume of end-of-life tires poses significant environmental challenges, motivating the development of sustainable recycling methods and advanced rubber composite formulations. In this study, the mechanical devulcanization of rubber crumb (RC) sourced from truck tire treads was investigated, with the goal of reprocessing this waste material into valuable components for use in new elastomeric products. Kraft lignin, a renewable, bio-based byproduct of the paper industry, was employed as a co-processing agent during the devulcanization process to enhance both environmental sustainability and functional performance of the resulting materials.

Kraft lignin was incorporated directly into the thermo-mechanical devulcanization process (RCL), where its radical scavenging capability was leveraged to stabilize the polymer backbone and favour selective scission of sulphur cross-links. FTIR spectroscopy confirmed reduced chain scission and increased preservation of elastomer integrity in the presence of lignin. Composites prepared by blending devulcanized RCL with virgin styrene-butadiene rubber (SBR) exhibited enhanced mechanical properties -such as tensile strength and modulus - as well as higher cross-link density, compared to those in which lignin was added after devulcanization. Scanning electron microscopy revealed improved interfacial adhesion in RCL-based composites, suggesting better dispersion and compatibility of reclaimed rubber within the SBR matrix.

These results demonstrate the dual role of kraft lignin as a sustainable additive and functional devulcanization aid, supporting its use in circular rubber processing. The approach offers a promising strategy for improving the quality and performance of recycled rubber materials, contributing to the development of next-generation composites aligned with circular economy principles.

Biography:

Michaela Džuganová is a PhD student in a double degree program in polymer processing at STU in Bratislava, Slovakia and UTB in Zlín, Czechia. Currently in the fourth year of study, she focuses research on sustainable filler alternatives derived from renewable resources for use in rubber compounds. With a strong commitment to advancing eco-friendly materials, Michaela aims to contribute to greener, more sustainable polymer technologies.

Synthesis and Physical Characterization of Covalently Linked Thieno[2,3-b]thiophene-Fullerene Dimers

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[1]Chemistry Department, Faculty of Science, University of Kuwait, P.O. Box 5969, Safat 13060, Kuwait.
[2]Department of Chemistry, University of California at Davis, One Shields Avenue, Davis, California 95616, United States

Abstract:

Fullerenes have emerged as interesting building blocks in nanotechnology and polymer research due to their distinct characteristics. They act as reinforcing agents in nanocomposites, increasing mechanical strength, thermal stability, and electrical conductivity. On the other hand, thienothiophene (TT) has received great attention in the fields of electronics and optoelectronics. Here we report a synthesis and characterization of fullerene-donor-fullerene triads linked to thieno[2,3-*b*]thiophene as a donor. The photophysical and electrochemical properties of the new dumbbells were investigated using UV-vis spectroscopy, fluorescence spectroscopy, cyclic voltammetry, and square wave voltammetry. The results showed that both compounds have higher LUMO energy levels than PC61BM, indicating that they can be used in photovoltaic applications. Furthermore, the powder was structurally and morphologically characterized via X-ray diffraction (XRD) and scanning electron microscopy (SEM). The SEM revealed the morphological characterization of the two derivatives as globular and urchin-like supramolecular.

Biography:

Dr. Abdulrahman M. Alazemi, Assistant Professor, Chemistry Department, Faculty of Science, Kuwait University.

The above work won the **"Front Cover Page Award" -** RSC Organic & Biomolecular Chemistry Journal, 2024, **22**, 2978-2984. DOI: 10.1039/D4OB00027G, Feb 2024. Also, we recently filed a patent for a new detection method using polyfluorine as a tracer **Patent**: USPTO, Docket 33044.61U, Biomolecule Detection Method Using Diffusion Ordered Spectroscopy, 22nd Oct 2024.

Investigating Metal Complexes of Poly(Tartaric Acid) and Poly(Hydroxymandelic Acid) as Thermal Interface Materials

Natalia Terenti* and Alexandrina Nan

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Abstract:

Carboxylic acids are organic molecules characterised by their distinctive chemical and physical properties, attributed to the presence of two functional groups: carbonyl (-C=O) and hydroxyl (-OH). These attributes enable their application in various critical fields, such as medicine, pharmacy, organometallic, food, nanotechnology etc. Carboxylic acids are a common motif in polymers. In recent years, there has been a concentration on developing new polycarboxylic acids, attributed to their hydrophilicity, physical adsorption characteristics, and capacity to establish cross-linked structures when coordinated with various metals. Poly(tartaric acid) and poly(hydroxymandelic acid) are relatively new polymers synthesized by our group from low-cost precursors, specifically tartaric acid and hydroxymandelic acid, through a straightforward thermal process, promoting scalability and potential applications across several industrial sectors.

The physical and chemical properties of such materials can be easily modulated by adding new components by doping or complexation to different metals. This study presents novel cross-linked frameworks synthesised through the complexation reaction of poly(tartaric acid) and poly(hydroxymandelic acid) with selected 3d or 4f metals. The compounds were obtained using a solution reaction method at room temperature and by mechanochemistry. We investigated the influence of the ion radius and metal properties on the crystallinity, stability, thermal and electrical conductivity of the final organometallic polymers. The obtained materials can be easily used as thermal interface materials for future applications.

Biography:

Natalia Terenti received her doctoral degree in 2022 under the supervision of Prof. Ion Grosu at the Faculty of Chemistry. Her doctoral degree work focused on developing new molecular designs to access efficient organic solar cells and heterogenous catalysts. In 2023, Natalia joined Romania's National Institute for Research and Development of Isotopic and Molecular Technologies (INCDTIM) as a Scientific Researcher. Since 2024, Natalia is a post-doctoral research associate working with Prof. Mihaiela Stuparu in developing functional molecular materials based on corannulene and leading her own project for Young Research Team on Synthesis and characterization of new metal complexes of polymeric polycarboxylates.

Synthesis and Characterization of a New Ionic Poly(IMIDE) With Potential Application as a Membrane for Gas Separation

María V. Velázquez-Tundidor[1], Yennier Cruz[1], Ary Rodríguez[1], Fidel E. Rodríguez González[1], Vladimir Niebla[1], Alain Tundidor-Camba[2], Claudio A. Terraza[1]

[1]*Research Laboratory of Organic Polymers (RLOP), Department of Organic Chemistry, School of Chemistry, Faculty of Chemistry and Pharmacy, Pontifical Catholic University of Chile, Santiago, Chile.*
[2]*Department of Chemical and Biological Engineering, University of Alabama, Tuscaloosa, Alabama 35487-0203, United States.*

Abstract:

Polymeric membranes have garnered increasing interest for industrial gas separation applications due to their effectiveness in enhancing energy efficiency in processes such as CO_2 capture and natural gas purification (CO_2/CH_4 separation). Their high performance, scalability, and compatibility with sustainable energy sources position them as a key solution to current challenges related to energy consumption and the mitigation of greenhouse gas emissions.

In this work, we report the synthesis of a novel ionic poly(imide) via the Menshutkin reaction, employing diimidazolimide and α,α-dibromo-p-xylene as monomers. The precursors, monomer, and resulting polymer were characterized by ^{1}H-NMR, ^{13}C-NMR, DEPT, and FT-IR spectroscopy. The solubility of the material in common organic solvents and the thermal stability were evaluated through thermogravimetric analysis (TGA). Furthermore, dense films were fabricated by solvent evaporation to assess the membrane-forming ability, which will subsequently be evaluated for gas permeability performance.

Biography:

María Victoria Velázquez is a Ph.D. student in Chemistry at the Pontificia Universidad Católica de Chile, where she also earned her undergraduate degree in Chemistry. During her undergraduate studies, she joined the polymer membranes research group, which marked the beginning of her research career. Her current work focuses on the synthesis of novel polymeric materials for the development of membranes aimed at gas separation applications.

Design BioCP-Doped Films Based on Chia Seed Mucilage

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[b]*Department of Pathology, Wroclaw University of Environmental and Life Sciences, Norwida 31, 50 -375 Wrocław, Poland*

Abstract:

The treatment and prevention of infections, coupled with robust strategies for pain management, are essential pillars that influence global health and well-being. Recently, considerable attention has been devoted to the development of advanced therapeutic materials for wound care, including the use of metal-organic frameworks (MOFs) and coordination polymers (CPs).

Here, we present novel antimicrobial composite materials based on chia seed mucilage (CSM) or its modified form, CSM/ST (ST - starch). These formulations are enhanced with a therapeutic silver(I) coordination polymer (referred here as Ag@CSM or Ag@CSM/ST) to improve its antimicrobial properties. These materials exhibit excellent ability to absorb water and demonstrate significant antimicrobial activity against both Gram-positive and Gram-negative bacteria and a yeast. This characteristic suggests the promising potential of Ag@CSM and Ag@CSM/ST for the development of new novel? antimicrobial patches to manage complex wounds.

Funding acknowledgment: SWJ gratefully acknowledges the financial support from the National Science Center, Poland (Grant No. 2019/35/D/ST5/01155).

References:

Jaros, S. W.; Komarnicka, U. K.; Kyzioł, A., Pucelik, B.; Nesterov, D. S.; Kirillov, A. M.; Smoleński, P. J. Med. Chem., **2022**, 65, 11100-11110

Biography:

Sabina W. Jaros is an assistant professor at the Faculty of Chemistry, University of Wrocław, Poland. Upon completing her degree in Environmental Chemistry in 2011, she completed a PhD in Chemistry (2016) from the University of Lisbon. She conducts research on designing and synthesizing new coordination polymers, metal-organic networks, and biomaterials, focusing on potential applications as metal-based antimicrobial and anticancer therapeutic, as well as innovative antimicrobial and luminescent materials.

Technologies for Obtaining Biocomposites With Improved Durability Against Environmental Factors

Natalia Kubiak[a]*, Robert E. Przekop[b], Bogna Sztorch[b]

[a] *Faculty of Chemistry, Adam Mickiewicz University, Poznan, Poland*
[b] *Center for Advanced Technologies, Adam Mickiewicz University, Poznan, Poland*

Abstract:

The growing demand for environmentally friendly materials has intensified research into bio-based polymer composites incorporating natural fillers. In this study, polylactic acid (PLA) was reinforced with a lignocellulosic filler derived from grass biomass, subjected to surface modification prior to compounding. The main objective was to assess how different pre-treatment methods of the natural filler influence the processability and mechanical performance of PLA-based composites.

The grass material was first ground and then modified via two environmentally relevant routes: hot water extraction and alkaline treatment with sodium hydroxide. After neutralization and drying, the modified fillers were melt-blended with PLA to prepare 20 wt% masterbatches, which were subsequently diluted to yield composites containing 5, 10, and 20 wt% of filler. Test specimens were fabricated using injection moulding.

Rheological behavior was investigated using melt flow index (MFI) analysis, and mechanical performance was characterized through tensile, flexural, and impact testing. The effect of both filler loading and modification route on the composites' flow properties and mechanical responses was systematically analyzed.

The results revealed that surface treatment influences the filler–matrix interactions, affecting both processability and strength-related properties. Increasing filler content impacted

flowability and mechanical behavior, underlining the relevance of formulation and interface control in composite design.

This study highlights the feasibility of using modified plant-derived waste as functional fillers in biodegradable polymer matrices. The findings contribute to the design of sustainable composite systems and support the development of eco-efficient processing strategies for future circular materials.

Biography:

Natalia Kubiak is a second year PhD student at Faculty of Chemistry, Adam Mickiewicz University in Poznań, Poland, focusing on sustainable polymer composites. Her research explores the impact of natural filler modification on the structure and properties of PLA-based materials, particularly in the context of circular economy and green processing. She holds an MSc in Chemical Technology (Technology of Polymers) and has experience in polymer processing, testing, and material characterization. She has participated in several national research initiatives and is actively involved in promoting eco-friendly materials development at the interface of science and industry.

Sustainable PLA Composites Reinforced With Agricultural Waste for FDM 3D Printing

Magdalena Kustosz[a]*, Robert Przekop[b], Bogna Sztorch[b]

[a] *Faculty of Chemistry, Adam Mickiewicz University, Poznań, Poland*
[b] *Center for Advanced Technologies, Adam Mickiewicz University, Poznań, Poland*

Abstract:

This study focuses on developing sustainable composite filaments for Fused Deposition Modeling (FDM) 3D printing by modifying bio-based polylactic acid (PLA) with natural fibers derived from agricultural and food industry waste. PLA is among the most commonly used materials in FDM due to its ease of printing, glossy finish, and low shrinkage. Its renewable origin from sources like corn starch or sugarcane makes it a more eco-friendly alternative to petroleum-based polymers. However, PLA has relatively low impact resistance and limited durability, which motivates the search for composite solutions supporting sustainable production. In this research, waste-derived natural fillers are added to the PLA matrix to improve mechanical and thermal properties while reducing material costs and environmental impact. This approach addresses concerns about CO_2 emissions from conventional polymers and utilizes the low cost and wide availability of agricultural byproducts. The biocomposite filaments are produced via extrusion and are formulated to maintain printability while enhancing the performance of printed parts. The study includes optimizing filler content and dispersion, evaluating thermomechanical properties, print quality, and dimensional stability, and benchmarking against commercial petroleum-based filaments. Results show that PLA composites reinforced with natural waste fillers offer a viable and environmentally responsible alternative for additive manufacturing. These materials combine improved technical performance with a reduced ecological footprint, contributing to the advancement of sustainable solutions in 3D printing.

Biography:

Magdalena Kustosz, M.Sc. Eng. is a second-year PhD student at the Doctoral School of Exact Sciences, Adam Mickiewicz University in Poznań, Poland. Her research focuses on the development of polylactic acid (PLA)-based composites for 3D printing using Fused Deposition Modeling (FDM) technology. She is particularly interested in sustainable materials and the use of natural waste-derived fillers to enhance the mechanical and thermal properties of PLA while promoting environmentally responsible additive manufacturing.

Breaking the Limits of PLA Toughness: The Role of Dual-Functional Organosilicon Additives in Structure–Property Optimization

Julia Głowacka[a,b]*, Bogna Sztorch[a] and Robert Przekop[a]

[a]Adam Mickiewicz University, Centre for Advanced Technologies, Poznan, Greater Poland, Poland
[b]Adam Mickiewicz University, Faculty of Chemistry, Poznan, Greater Poland, Poland

Abstract:

The growing emphasis on sustainable materials demands bio-based polymers that deliver not only environmental benefits but also mechanical performance suited to advanced applications. Polylactide (PLA) is a leading candidate in this domain, yet its inherent brittleness continues to limit its use in sectors such as automotive, sports equipment, and electronic housings—where durability is non-negotiable. This study investigates a strategy to address these limitations through the use of dual-functional hybrid organosilicon modifiers. A series of methacrylate-functionalized spherosilicates and cyclosiloxanes were synthesized via catalytic hydrosilylation and subsequently integrated into PLA. These macromolecular additives feature tunable core architectures and reactive functional groups designed to enhance the structure–property relationships within the PLA matrix. Mechanical testing demonstrated significant enhancements: impact strength improved by approximately 45% with just 1 wt% of the additive, while a 5 wt% loading of CS-2MA-2TMOS resulted in an impressive 104% increase. Additional improvements in tensile and flexural properties were observed, indicating efficient stress transfer and energy dissipation through micro- and nanoscale interactions. Fractographic analysis confirmed the presence of ductile fracture behavior, with dispersed modifiers acting as crack-arresting domains. Rheological studies indicated a predominant lubricating effect—rather than plasticization—evidenced by reduced viscosity and increased melt flow rate, all while maintaining structural integrity. These findings illustrate that dual-functional organosilicon additives can effectively enhance the mechanical performance of PLA, making it a more viable option for high-performance, durable applications in demanding industries. The research was funded under IDUB research project no. 054/13/SNŚ/0036.

Biography:

Julia Głowacka is a PhD student at Adam Mickiewicz University in Poznan and a junior researcher at the Laboratory of Technological Processes, Center for Advanced Technologies UAM. Her work bridges the fields of chemistry and materials science, with a focus on enhancing the toughness and lifespan of polylactide-based composites. She has co-authored over 20 scientific publications and contributed to numerous R&D projects with industry. Her expertise encompasses polymer processing, composite formulation development, and the synthesis of organosilicon compounds. She is actively involved in science outreach and workshop organization. Her research interests also include circular economy and automation in materials research.

Breaking the Limits of PLA Toughness: The Role of Dual-Functional Organosilicon Additives in Structure–Property Optimization

Roksana Konieczna[a]*, Bogna Sztorch[b] and Robert E. Przekop[b]

[a]Faculty of Chemistry, Adam Mickiewicz University, Poznan, Poland
[b]Center for Advanced Technologies, Poznan, Poland

Abstract :

Additive manufacturing technologies, especially Fused Deposition Modeling (FDM), have transformed sectors such as construction, automotive, and medicine by enabling the rapid prototyping and production of complex components. However, the potential of these technologies in the development of advanced composite materials remains underexplored. This study focuses on an innovative adaptation of the FDM technique, Liquid for Fused Deposition Modeling (L-FDM), which allows for the direct introduction of chemicals and polymer filament modifications during the printing process. These methods can be utilized in any laboratory by users without access to specialized devices. Literature reports indicate improvements in the mechanical and thermal properties of polymer composites through the addition of organosilicon compounds by conventional methods. The research investigates the effect of (3-thiopropyl)silsesquioxane on the properties of polylactide composites reinforced with natural fibers. By leveraging the L-FDM method, organosilicon compounds were integrated into the polymer matrix, aiming to enhance the mechanical, thermal, and surface properties of the composites. Comprehensive testing was conducted to evaluate the composites' structural and thermal performance and hydrophilic-hydrophobic properties. The results highlight the potential of L-FDM as a versatile and accessible method for fabricating functionalized polymer composites with improved utility properties. This work demonstrates the feasibility of using L-FDM to tailor the characteristics of bio-based polymer composites, contributing to the advancement of sustainable materials and chemical engineering.

Biography:

Roksana Konieczna is a second-year PhD student at the Faculty of Chemistry, Adam Mickiewicz University in Poznan, Poland. Her research is conducted at the Adam Mickiewicz University Center for Advanced Technologies, in the Laboratory of Technological Processes, under the supervision of Professor Robert Przekop. She is actively involved in studies focusing on polymer processing, 3D printing, polymer composites, and other related fields. Beyond her scientific work, she is an active member of the Association of Chemical Industry Engineers and Technicians (SITPChem).

Pilot Study on the Application of L-FDM Technology for Printing Controlled-Release Tablets Containing Active Pharmaceutical Ingredients

Ewa Gabrielab*, Anna Olejnik, Robert Pietrzak

[a]*Faculty of Chemistry, Adam Mickiewicz University*
[b]*Center for Advanced Technologies*
[c]*Sygnis S.A., Gdansk*

Abstract:

3D printing technologies enable the creation of complex and precise structures, making them attractive for applications in medicine and pharmacy, particularly in the production of personalized medicines. Their main advantages include the ability to tailor drugs to individual patient needs, control over the structure and shape of tablets, and regulation of the active substance release rate.

This preliminary study investigates the feasibility of using L-FDM (Liquid for Fused Deposition Modeling) technology for fabricating tablets with personalized release profiles of active substances. L-FDM technology involves passing the filament through a reservoir containing a modifier, which can be a chemical substance in liquid form or a solution.

The material coated with the modifier is then fed into the 3D printer's head, where it is melted and extruded through the nozzle. This method enables the incorporation of chemical compounds into thermoplastics without the need for conventional processing equipment.

A composite polylactide (PLA) filament filled with activated carbon was used to print tablets containing a dye for visual assessment of adsorption and release, as well as antipyrine model Active Pharmaceutical Ingredient (API). The study examined the influence of filament composition and printing parameters on the amount of API released from the tablets. The results indicate that the release rate is strongly affected by the printing speed , the filament material, and the nature of the incorporated compounds.

Biography:

Ewa Gabriel is a doctoral candidate at the doctoral school of Exact Sciences at Adam Mickiewicz University, Poznan, where she also earned her Masters degree in chemistry with a specialization in Cosmetic Chemistry. Since 2018, she has worked as a senior technician at the Center for Advanced Technologies AMU, contributing to interdisciplinary research in materials chemistry, polymer modification and additive manufacturing. Her PhD research, supervised by University Professor Robert Przekop, Ph.D., D.Sc. (habilitation), focuses on innovative methods for incorporating chemical substances into polymer matrices using L-FDM technology.

Thermal Characterization of FFKM: A DOE-Based Optimization of DSC and TG Parameters

Caio R. F. Nascimento[a]* and Gabriela M. dos Santos[a]

[a]*National Institute of Technology - INT, Rio de Janeiro, RJ, Brazil*

Abstract:

The optimization of analysis parameters in the thermal characterization of polymeric materials is essential to determine the best analysis conditions, aiming to make the characterization process as fast and accurate as possible. In this study, DSC and TG techniques were employed, and parameters such as atmosphere flow rate, presence and duration of isothermal steps at the beginning of the analysis, sample mass, heating rate, and cooling rate were tested for DSC analysis in order to observe the effects of each parameter on the thermal properties of the FFKM polymer. The polymer selected as a reference for this characterization was the perfluoroelastomer, an engineering elastomer used as a high-performance sealing material for applications requiring extreme chemical resistance, such as oil and gas extraction in the Brazilian Pre-Salt layer, for example. FFKM can operate within a temperature range of -20 to 330 °C. The Design of Experiments (DOE)

methodology was applied to evaluate all the parameters in this study, and the number of experiments was determined based on the Taguchi method.

Biography:

Chemical Engineer graduated from the Federal University of Rio de Janeiro (UFRJ), with a Master's degree in Science and Technology of Polymers and a Postgraduate degree in Polymer Engineering. Manager of the Polymer Materials Technology Laboratory at the National Institute of Technology (INT) in Rio de Janeiro, Brazil. Involved in research and technological development projects in the fields of automotive parts recycling, degradation resistance of polymers used in the oil and gas industry, structural adhesives, and additive manufacturing of photocurable resins using Brazilian biomass.

Residual Tensions in Multilayers for Clear Aligners With Tunable Thermomechanical Properties

José Ignacio

IMDEA Materials, Spain

Abstract:

Clear aligners are a new dentistry technique involving moving teeth using a dental appliance made from transparent thermoplastic material based on standardized movements programmed by software. Conventionally, the thermoplastics used were copolyesters and polyurethanes, but the need for more precise and comfortable treatments has pushed the industry into using combinations of thermoplastics.

Our project aims to manufacture multilayers from widely available materials with comparable properties to commercial multilayers, while controlling the thermomechanical properties for adapting multilayers to different treatment situations.

First, we evaluated the thermomechanical properties of different materials that could be used in multilayered clear aligners. We manufactured monolayers in a hot-plate hydraulic press and cut dog-bone samples for tensile testing, DMTA, DSC, and stress relaxation. We also manufactured monolayers to assess the thermoforming.

To manufacture multilayers, we manufactured thin monolayers of selected materials and stacked them together using a hot-plate press. Finally, the tensile test, DMTA, DSC, and thermoforming were also evaluated in the multilayers along with the layer thickness by optical microscopy.

We were able to obtain materials with very similar properties to commercial multilayers in DMTA, DSC, and stress relaxation, from which we infer that our multilayers were susceptible to being used as clear aligners, and that the combinations followed a mixing rule, from which some properties can be tailored. We also found that multilayers show an enlarged elastic regime in comparison with monolayers, which cannot be explained by mixing rules.

Our results show that multilayers can be one of the more promising ideas for personalised clear aligners, and that this possibility is currently achievable.

Work supported by a grant for industrial PhD of the Community of Madrid regional Government (IND2022/IND-23679), in collaboration with Secret Aligner S.L.

Hydrophobic/Hydrophilic Bifunctional Cryogel for the SPE-LC-MS Analysis of PFAS in Water

Gabriel C. da Fonseca[a*], Marcela Konjevod[b], Ameer Y. Tahac[d,e], Senentxu Lanceros[a], Roberto Fernandez de Luis[a], Maibelin Rosales[a], Antonio Veloso-Fernández[g], Erlantz Lizundia[a,h], Jorge Sáiz[a,d,*]

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Abstract:

The contamination of water bodies is a global challenge due to the discharge of industrial and urban products without

pretreatment. Pharmaceuticals and personal care products, and per- and PFAS, for instance, are contaminants of emergent concern due to their adverse environmental and human health effects. However, today's water treatment systems fail in removing these substances from water, mainly because of the high costs. Herein, we produced adsorbent cryogels using biopolymers (cellulose, chitosan, and pectin) as sustainable and low-cost sources for an environmentally friendly adsorbent. Solid-phase extraction (SPE) cartridges were fabricated using the cryogels and tested for 27 PFAS compounds. Compared to commercial SPE cartridges, the cryogel-based SPEs showed superior recovery for long-chain PFAS, while maintaining fair recovery for short-chain species, highlighting their bifunctional adsorption capacity. The cartridges were used in the LC-MS analysis of river samples, which showed the presence of perfluoroalkyl carboxylic acids, perfluorohexanoic acid, 4:2 fluorotelomer sulfonic acid, and 6:2 chlorinated polyfluorinated ether sulfonate. Finally, we quantified the environmental impacts of the fabricated polysaccharide foams through life cycle assessment. Cradle-to-gate climate change potential values of 53.2 kg CO2-eq. per kilogram of produced cryogel, which is lower than the carbon footprint of benchmark porous materials, demonstrating that cryogels are suitable enablers for low-environmental-impact water remediation applications.

Biography:

As an undergraduate research student (Brazil), he worked with lignocellulosic biomass for biochar production to absorb contaminants, like dyes and pesticides, and on the cellulose extraction from the biomass to synthesize cellulose acetate and produce hydrogels for pesticide-controlled release applications. In his master, he presented the thesis "Boosting light-driven photoelectrocatalytic water oxidation by using green source-based carbon quantum dots", showing that carbon quantum dot from biomass is a promising nanomaterial for photoelectrocatalytic reactions. Now, he is a PhD student at BCMaterials, Spain, working on biopolymers for water treatment and with carbon dots synthesis from biomass.

In vitro biological behavior of self-assembled nanoparticles with perfluorinated core: Crosstalk between surface charge and fluorophilicity

Leana Vratović[1*]; Martina Kabešova[2], Vit Guiglielmo Mišurec[1], Ewa Pavlova[1], Jan Kučka[1], Jan Pankrac[3], Ludek Sefc[3], Martin Hruby[1], Miroslav Vetrik[1]

[1]Institute of Macromolecular Chemistry of the Czech Academy of Sciences, Prague 6, Czech Republic;
[2]First Faculty of Medicine, Charles University, Prague 2, Czech Republic
[3]Center for Advanced Preclinical Imaging, First Faculty of Medicine, Charles University, Prague 2, Czech Republic

Abstract:

Fluorinated materials, ranging from micelles and nanoparticles to the emerging class of nanoplastics, are rapidly gaining traction in biomedical research. At the same time, they raise important questions about toxicity and persistence in living systems and the environment. In this study, we aimed to explore "fluorosomes" - nanoparticles that self-assemble from amphiphilic chains with a perfluorinated core. Our goal was to understand how their surface charge and strong fluorophilicity influence interactions with cells. Across several cell lines, we tracked how fluorosomes were taken up, where they localized in cellular compartments, and whether they caused toxicity based on their functionality. Interestingly, even though longer fluorinated chains are extremely hydrophobic and not classically lipophilic, the overall surface charge turned out to be the key factor shaping how cells responded. All types of fluorosomes showed a preferred site of accumulation in the endoplasmic reticulum. Evidence suggests caveolae-mediated endocytosis as the main entry route - a pathway often used by viruses and known to avoid lysosomal degradation. That behavior opens up exciting possibilities for drug delivery, particularly when targeting pathways connected to the endoplasmic reticulum. On the other hand, it mirrors the mechanisms that make fluorinated materials persistent, both inside organisms and in the environment. Our findings highlight this tension clearly: fluorosomes and related nanosystems hold promise as possible next-generation biomedical tools, but the very same traits that make them effective also make them difficult to eliminate. Careful design and assessment will be essential as their use expands.

Biography:

Leana Vratović is a PhD student in Macromolecular Chemistry at the Institute of Macromolecular Chemistry, Czech Academy of Sciences, Prague. She obtained her master's degree in Environmental and Public Health from the Faculty of Medicine, University of Rijeka, Croatia. Her research focuses on the synthesis and characterization of polymer-based nanoparticles with potential applications in biomedicine. She has gained international experience as a visiting scholar at Stanford Medicine School, where she worked with spheroids as biological models, and at the University of Minnesota, where she applied advanced techniques such as DLS, SAXS, and TEM. Beyond her academic work, she has presented at international conferences and maintains a strong interest in interdisciplinary approaches to polymer innovations.

Virtual Presentations:

Polymer Engineering for Biomedical Applications - Material development for Implants

Ines Kuehnert* and Hester Oosthuizen*, Erik Schoene*, Andreas Leuteritz*

**Leibniz-Institut fuer Polymerforschung Dresden e.V., Dresden, Saxony, Germany*

Abstract:

Polymer engineering plays a crucial role in the development of advanced solutions for biomedical applications. Biocompatible and biodegradable polymers are of interest or even already used in fields such as tissue engineering, controlled drug delivery, implant technology, and medical diagnostics. By tailoring polymer structures, mechanical, chemical, and biological properties can be precisely adapted to meet specific medical requirements.

In the presentation our recent results of the BioIMplant project, funded by M-ERA.NET, will be discussed. The project focuses on the design of advanced bioresorbable polymer composites reinforced with bioactive glass (BG) for osteosynthesis. These composites are engineered to degrade safely in the body, eliminating the need for secondary surgeries after bone healing, and to actively promote bone regeneration. BG is a well-known osteoconductive material that enhances bioactivity and mechanical strength. However, poor dispersion of BG within polymer matrices often leads to inhomogeneities that compromise performance. To overcome this, BioIMplant employs polymer interface engineering strategies—specifically, surface modification of BG using bifunctional compatibilisers. These modifiers enhance BG–polymer compatibility, improve dispersion, and enables the provision of bone growth-promoting bioactive glass at the site of regeneration. By engineering the polymer matrix and filler interface, the project targets composites with tunable degradation, mechanical performance, and biological functionality.

Results on the processability of the new composites using precision micro-injection molding and additive manufacturing will also be presented. These polymer processing methods can be used to produce complex, patient-specific implant geometries with controlled resorption rates and customized mechanical properties.

Biography:

Ines Kuehnert received her doctoral degree in Plastics Technology (TU Chemnitz, Germany). Research interests: plastics processing and process simulation, esp. multi-material combination (injection molding, additive manufacturing), process-controlled morphology. Postdoc time: University of Erlangen-Nuremberg, Institute of Polymer Technology. Current position: Head of department Polymer Processing, Leibniz-IPF Dresden; responsible for around 50 employees, coordination of funding programs and research cooperation with industry). Lecturer: national (TU Dresden) and international (e.g. in South

Africa; Colombia, India). Dr. Kuehnert is an international representative in the Polymer Processing Society and a spokesperson of the industrial expert network on thermoplastic elastomers. Publications: ORCID-ID: https://orcid.org/0000-0002-3795-3265

Environmental 100% Biobased Poly(Trimethylene Furanoate (PTF) Modified With Sebacic Acid and Suberic Acid

Valentina Siracusa[a*], Agata Zubkiewicz[b], Anna Szymczyk[b], Nadia Lotti[c], Michelina Soccio[c], Giulia Guidotti[c]

[a*]*Department of Chemical Science, University of Catania, Catania (CT), Italy*
[b]*Department of Mechanical Engineering and Mechatronics, West Pomeranian University of Technology, Szczecin, Poland*
[c] *Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Bologna, Italy*

Abstract:

Highly promising fully biobased random copolyesters, poly(trimethylene 2,5-furandicarboxylate-*co*- trimethylene sebacate) (PTFcoPTSeb) and poly(trimethylene 2,5-furandicarboxylate-*co*-trimethylene suberate) (PTFcoPTSub) were synthesized by using bio derived 1,3-propanediol, dimethyl ester of 2,5- furandicarboxylic acid (FDCA-DM), and sebacic acid/subaric acid (5, 15 and 25 mol%), through eco-friendly polycondensation in the melt. The all used co-monomers were derived from fast-renewable resources, such as castor oil and sugars. The prepared copolymers were processed into free-standing thin films and subject to structural, thermal, mechanical and barrier properties characterization. Composting experiments at lab scale were also carried out. The results indicated that the tuning of aliphatic co-unit content is an effective tool to modulate the chain mobility and the crystalline phase developed in the samples, responsible for the different mechanical and barrier performance and biodegradation kinetics. Life Cycle Assessment analysis (LCA), in lab scale dimension, from cradle-to-laboratory gate, are still in progress. Impacts are studied from an environmental perspective to highlight the best performing polymer. LCA study will allow us to understand that, despite in the phase of lab-scale design, testing and assessment, it is possible to find and use materials with the potentiality to implement the sustainable circular economy (Project "TECH4PATH founded by MUR - Ministero dell'Università e della Ricerca – PRIN2022, cod.

2022YB8ABM; CUP E53D23011070006 - D.D. 104 del 02/02/2022 - PNRR per la Missione 4, Componente 2, Investimento 1.1).

Biography:

Siracusa Valentina took her degree in Industrial Chemistry at the University of Catania (Italy). She completed her PhD and post-PhD study working on the synthesis and characterization of innovative engineering polyesters. From 2006 she is Associate Professor for Chemistry for Engineering at Catania and Bologna Universities. She collaborates to several research projects, both for academic than industrial interest, on topic such as recycle, ambient, food packaging, graphene for innovative application. She collaborates with national and international research groups on the synthesis of biopolymers used as packaging, with also Life Cycle Assessment studies (with SimaPro software). She is author of more than 125 papers in high impact factor scientific journals, author of several book chapters and guest editor and Editorial member of several International Journals.

Nanogels for Pulmonary Drug Delivery

Nikolaos Politakos[a]* and Christos Chochos[a]

[a]*Institute of Chemical Biology, National Hellenic Research Foundation, Athens, Greece*

Abstract:

Research on cancer and anticancer strategies has been widely conducted over the last two decades, presenting novel vehicles for effective targeted systems. Lungs are considered an ideal passage for therapeutics into the body, by which local concentrations of active pharmaceuticals can be delivered with a lower burden for the rest of the body. The delivery of the therapeutic via the lungs is promising, but several things should be considered. This project's scope is the synthesis-preparation of microgels by incorporating smart nanogels for the pulmonary delivery of an anticancer drug to the lungs. The system will have a targeting moiety for cancer cells and a stealth ability to incorporate the nanogel into the deep lung. These formulations can be a solution in delivering drugs by increasing their size due to hydrophilicity to avoid macrophages and deal with the lung microenvironment. These nanogels can deliver the active compound, be biocompatible, and have good physicochemical properties. Adding responsiveness, such as pH, can give an extra property and transform the formulations from passive materials to active ones.

Biography:

Dr. Politakos obtained his Ph.D. (2010) in Materials Engineering (University of Ioannina) in polymer synthesis. 2010 he moved to the University of the Basque Country, working with chemical modifications and composites. 2014, he worked in CICbiomaGUNE, preparing responsive copolymer brushes for biomedical applications. 2017, he started working on graphene oxide for CO_2 capture in POLYMAT. 2020, he joined the Responsive Polymer Therapeutics Group, preparing hydrogels for wound healing. 2024, he started at the NHRF as Fellow of HORIZON-WIDERA-2022-TALENTS, working with inhaled formulations to target lung cancer. His research interests include the synthesis of materials for biomedical and environmental applications.

Optimizing Pore Environment in a Cationic Polymetric Nanotrap for Highly Efficient Remediation of Short-Chain Per- and Polyfluoroalkyl Substances from Water

Bin Wang*

State Key Laboratory of Radiation Medicine and Protection, School for Radiological and Interdisciplinary Sciences (RAD-X), and Collaborative Innovation Center of Radiation Medicine of Jiangsu Higher Education Institutions, Soochow University, Suzhou 215123, China

Abstract:

The rising production and utilization of short-chain per- and polyfluoroalkyl substances (PFAS) has resulted in their extensive release into aquatic ecosystems, posing significant risks to both human health and environmental integrity. There is an urgent demand for sorbents that can effectively eliminate short-chain PFAS from drinking water, presenting a considerable challenge. This study introduces CPN-1, an innovative adsorbent engineered with aminoguanidine centers within its polymeric structure, which demonstrates superior performance in the removal of short-chain PFAS from aqueous environments. CPN-1 sets unprecedented benchmarks in adsorption capacities for five selected short-chain PFAS, achieving exceptional removal efficiencies of up to 92% for perfluorobutanesulfonic acid (PFBS) and 100% for Hexafluoropropylene oxide dimer acid (GenX). Furthermore, it successfully eliminates over 99% of PFAS from actual groundwater samples within 30 minutes. For the first time, this study provides real-time monitoring of the sorption process of perfluorobutanoic acid (PFBA) and PFBS into the pores of CPN-1, employing time-dependent *in-situ* attenuated total reflection (ATR) infrared spectroscopy. This research pioneers a novel approach to the design of functional materials, contributing to the advancement of strategies for managing contaminated drinking water.

Biography:

Dr. Bin Wang earned his B.S. degree from Qingdao University of Science and Technology, China, in 2011, followed by a Ph.D. from Beijing University of Technology in 2018 under the supervision of Professor Jian-Rong Li. After completing five years of postdoctoral research at the University of Texas at San Antonio and the University of North Texas, he joined Soochow University as a Full Professor in the College of Radiation Medicine and Protection in January 2024. His research focuses on designing functional porous materials—including porous organic polymers (POPs), metal-organic frameworks (MOFs), and hydrogen-bonded organic frameworks (HOFs)—for environmental applications. He has published more than 60 papers with the total citations over 9600 and the H-index of 34.

Designing and Synthesis Routs for Conductive Ionomers for Durable Anion Exchange Membrane-Based Water Electrolyzers and Fuel Cells

Mehdihasan Shekh[*a]

[a] *Shenzhen Wenshi Hydrogen Energy Technology Co. Ltd, Shenzhen, Guangdong, P.R. China*

Abstract:

To mitigate climate change, advancing renewable energy technologies is imperative for reducing carbon footprints. Over decades, integrating renewable energy systems with water-splitting devices, such as water electrolyzers (WEs), has emerged as a viable pathway to produce green hydrogen—a clean, storable energy carrier. This hydrogen can be efficiently converted back to electricity via redox-based fuel cells (FCs), closing the renewable energy cycle. Among WEs/FCs, anion exchange membrane (AEM)-based systems offer cost-effective operation at lower temperatures compared to their proton exchange membrane counterparts. However, the longevity of AEM-based WEs/FCs remains a critical challenge, primarily attributed to degradation of the core component: the anion exchange membrane (AEM). To address this, the development of robust ionomer structures with enhanced mechanical strength, ionic conductivity, chemical stability, and durability under humid alkaline conditions is essential.While ether-containing and ether-free AEMs have been extensively studied, ether-based systems exhibit limited performance due to hydrolytic instability in alkaline environments, whereas ether-free AEMs demonstrate superior stability (>2000 hours). Nevertheless, optimizing membrane design requires meticulous consideration of parameters such as repeating monomer units, quaternary ammonium ion types and spatial distribution, and balancing hydrophobic/hydrophilic units. This review systematically examines emerging design strategies and synthesis approaches for AEM ionomers, critically evaluating their advantages and limitations. Particular emphasis is placed on structure-property relationships and their impact on membrane performance under operational conditions. By synthesizing existing knowledge and identifying unresolved challenges, this work provides a roadmap for advancing durable, high-performance AEMs, pivotal to realizing scalable, sustainable hydrogen energy technologies.

Biography:

Dr. Mehdihasan Shekh earned his Ph.D. in Polymer Chemistry from Charotar University of Science and Technology (Gujarat, India) in 2016. With 1.5 years of teaching and 7 years of research experience, he became Research Director of the Membrane Department at Shenzhen Wenshi Hydrogen Energy Technology Co., Ltd. in December 2023. His work focuses on bio/synthetic polymer composites—including electrospun nanofibers, hydrogels, nanocomposites, nanoparticles, and functional membranes—applied to drug delivery, biosensors, supercapacitors, and electrolyzers. He has authored over 30 peer-reviewed articles and holds an H-index of 15 (Scopus).

From Limonene to Functional Polymers: Monomer Design and Miniemulsion Polymerization for Targeted Sorption of Caffeine and Rhodamine B

Thainá Araruna[*a,b], **Angelo H. L. Machado**[a] **and Fabricio Machado**[a,b]

[a] *Institute of Chemistry, University of Brasília (UnB), Darcy Ribeiro University Campus, Brasília, DF, Brazil*
[b] *Graduate Program in Chemical Engineering, Federal University of Goiás, Goiânia, GO, Brazil*

Abstract:

Biobased polymers were synthesized from multifunctional monomers derived from limonene dioxide, obtained via catalyst-free two-phase epoxidation at room temperature. These monomers—two tetrafunctional diesters and one trifunctional acrylamide—were selectively functionalized via catalyst-free (meth)acrylation or acrylamidation, with reactions monitored *in situ* by IR spectroscopy to ensure selective conversion of functional groups. Subsequent polymerizations were carried out via miniemulsion using AIBN as initiator and Crodamol GTCC, a renewable co-stabilizer. This process yielded densely cross-linked poly(meth)acrylates and a polyacrylamide hydrogel, respectively named poly(limonene 2,8-dihydroxy diacrylate), poly(limonene 2,8-dihydroxy dimethacrylate), and poly(limonene 2-hydroxy acrylamide). Structural characterization was confirmed by ^{1}H and ^{13}C NMR; morphology and surface area were assessed by SEM and BET. Thermal behaviour was evaluated by DSC ($Tg \approx 112–113$ °C) and TGA (decomposition up to ≈ 400 °C). The poly(meth)acrylates showed high gel content (73–87%), while the hydrogel exhibited notable swelling (75%) and a soft morphology.

Adsorption/desorption assays with caffeine and rhodamine B revealed molecule-specific and reversible sorption: the polyesters retained and released both solutes with moderate to high efficiency (adsorption 46–41%, desorption 96–75% for caffeine; adsorption 55–56%, desorption 57–40% for rhodamine B), whereas the hydrogel promoted rapid release of rhodamine B but effectively trapped caffeine (adsorption 17%, desorption 94% for rhodamine B; adsorption 26%, desorption 25% for caffeine). Altogether, these findings highlight the potential of terpene-derived building blocks and heterogenous polymerization strategies for designing biobased polymers with tailored properties for environmental remediation or controlled delivery.

Biography:

Thainá Araruna is a Ph.D. candidate in Chemistry at the University of Brasília, Brazil. Her research focuses on renewable polymers derived from terpene-based and other biobased monomers, exploring polymerization strategies and structure–property relationships. She has experience in polymer synthesis, nanostructuring, and techniques (NMR, FTIR, DSC, TGA, SEM, BET, DLS, GPC, MS). Her work explores the development of sustainable materials with potential applications in adsorption, controlled release, and environmental remediation. She has contributed to the development of polymeric supports, coatings, biodegradable polymers, nanocomposites, zeolites, hybrid composites, and biogas production, reflecting her broad interdisciplinary approach to sustainable materials and green chemistry.

Experimental Design Applied to the Bulk Ring-opening Polymeriztion of ε-Caprolactone Using the Ionic Liquid Catalyst [C4C1Im][In_2Cl7]

Giovanna M. R. Otero[1]*, Gabriel F. S. Brito[1], Brenno A. D. Neto1, Fabricio Machado[1]*

[a]Institute of Chemistry, University of Brasília (UnB)/Brasília, DF, Brazil

Abstract:

The bulk ring-opening polymerization of ε-caprolactone (ε-CL) was investigated using the ionic liquid BMI·In_2Cl_7 as catalyst, applying a 3^2 full factorial experimental design. Temperature (70–110 °C) and catalyst-to-monomer molar ratio (1:500 to 1:1500) were selected as independent variables, with weight-average molecular weight (Mw) as the response. The resulting quadratic model demonstrated strong predictive power ($R^2 \approx 0.98$; $p < 0.001$), and canonical analysis revealed a local minimum Mw at 77.8 °C and 1:1618 molar ratio. Temperature exhibited the most significant influence on Mw, with a marked quadratic effect. In contrast, the catalyst-tomonomer molar ratio showed a less pronounced effect, suggesting a primarily linear influence with lower sensitivity. The agreement between experimental and predicted Mw values, as well as the randomness of residuals, confirmed the robustness and adequacy of the statistical model. These findings demonstrate the effectiveness of [C4C1Im][In_2Cl_7] as a metal-containing ionic liquid catalyst under mild conditions and validate the application of response surface methodology in optimizing polymerization processes.

Biography:

Giovanna M. R. Otero is a chemical engineer graduated from the University of Brasília in 2018 and currently a master's student in Chemistry at the same institution. Her research focuses on cationic ring-opening polymerization catalyzed by ionic liquids, with emphasis on experimental design and the implementation of machine learning strategies for process optimization and polymer characterization.

Numerical Analysis of Seal Seam Geometry and Its Impact on Opening Forces in Flexible Packaging

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Fraunhofer Institute for Process Engineering and Packaging IVV /Division Processing Technology, 01189 Dresden, Saxony, Germany

Abstract:

The heat contact sealing process significantly influences the formation of seal seams, which in turn impacts the opening behavior of the flexible packaging. This study systematically investigates how the geometry of seal seams, shaped by the heat contact sealing process, affects the mechanical opening behavior. A detailed numerical model was developed to simulate the seam opening process, accounting for the composite structure, seam geometry, and separation process. The results demonstrate why pronounced seal beads, influenced by sealing parameters such as sealing time, pressure, and temperature, affect the opening behavior. This highlights the importance of considering these effects during the processing of packaging materials to ensure that the packaging is both securely sealed and easy to open. The simulation results reveal that pronounced seal seams require higher opening forces, while less pronounced seams result in lower forces. These findings provide valuable insights into the mechanical behavior of seal seams and can be applied to optimize sealing processes for a balance between seal strength and user-friendliness.

Biography:

My name is Marc Götz and I'm research associate at the Fraunhofer Institute for Process Engineering and Packaging in Dresden. I'm focusing on the processing of flexible packaging materials mainly for pharmaceutical and food applications, including thermoforming, sealing and web handling. After my Master's degree in Applied Mechanics at TU Darmstadt, where I specialized in numerical simulation, I have spent the past six years researching the numerical modeling of processing technologies, with a particular emphasis on sealing and forming processes.

Sustainable Polypropylene Light-Weight Skateboards

Andreas Charalambous[a]*, Demetris Constantinou[a], Georgia Papaparaskeva[b], Varnis Charalambous[b], Stavros Hadjiyiannis[b] and Panayiotis Philimis[b]

[a]*Capsule Skateboards Ltd, Nicosia, Cyprus*
[b]*Cyprus Research and Innovation Center Ltd, Nicosia, Cyprus*

Abstract:

Conventional plywood has been the main source of the upstream supply chain for feeding skateboard manufacturers. Not only this, but the market has "enforced" the global skateboarding communities to believe that nothing beats a classic 7-ply maple deck in terms of pop and durability. During the last few years Capsule Skateboards has managed to debunk this by introducing a new generation skateboard made from advanced polymer and composite materials and thermoforming processes, incorporating unique and advanced performance features including durability, zero delamination, impact absorbing, and customizable according to user requirements.

However, the current production process creates increased raw fabric material waste that is left behind after the fabric material is cut to shape. Capsule Skateboards set the goal to develop, test, and validate a new prototype deck made from 100% recyclable fabric material waste, and its process for production, that could be used to manufacture cruisers and kid skateboards. To date, our team has examined, via extensive parametric studies, the ideal thermo-mechanical method to effectively recycle Capsule's fabric waste, without losses. As a result, a specific material assortment that combines 100% fabric recyclate material with PP virgin has been achieved, that provides unique mechanical properties close to a fully virgin deck and can also be produced in large-scale. These will allow Capsule to move closer to becoming the first circular-economy compliant skateboard deck manufacturer. The Project is funded by the European Union Recovery and Resilience Facility of the NextGenerationEU instrument, through the Research and Innovation Foundation.

Biography:

Mr. Andreas Charalambous is the co-founder and CEO of Capsule Skateboards and is who envisioned Capsule's innovative skateboard offering. Since 2015, Andreas has led the company to a successful path reaching critical milestones such as the cooperation with Gravity Incubator, the acquisition of Public Funding for Industrial Development from the Ministry of Commerce, Industry and Energy, the establishment of Capsule Skateboard's manufacturing facility, the successful participation in industries leading tradeshows (AGENDA, ISPO Munich), where he managed to gain interest for distribution both from large Skateboard resellers in the US and distributors from 6 countries and the accreditation of several awards.

Photopolymerization of Acrylated and Methacrylated Soyabean Oil

Laura Ciciliano[a*], Fabrício Machado[a]

[a]*Institute of Chemistry, University of Brasília (UnB)/Brasília, DF, Brazil*

Abstract:

This work explores the photopolymerization of acrylated and methacrylated from soybean oil using 2-Hydroxy-4'-(2-hydroxyethoxy)-2-methylpropiophenone (Irgacure2959) as a photoinitiator. The goal was to evaluate how efficient is Irgacure2959 in triggering free-radical polymerization under ultraviolet (UV) irradiation, aiming to produce renewable-based polymeric coatings. For that, two different monomers were used: acrylated soybean oil (ASO), methacrylated soybean oil (MSO). These compounds were obtained by functionalizing epoxidized oils through reactions with acrylic or methacrylic acid. Their chemical structures were confirmed by ^{1}H and 13C NMR and FTIR, especially by identifying signals related to vinyl groups. Then, photopolymerization assays were carried out under UV light (365 nm), using 5% concentration of Irgacure2959. Since this photoinitiator undergoes a Norrish Type I α-cleavage upon UV exposure, it efficiently generates initiating radicals capable of adding to the double bonds of acrylates and methacrylates. These monomers are highly reactive due to the conjugation between the vinyl group and the carbonyl, which facilitates rapid polymerization even under low-intensity light. All tested systems formed cohesive films. The resulting materials showed good film integrity, homogeneity, and notable surface adhesion. This strategy confirms the potential of combining safe photoinitiators with renewable monomers for developing biobased adhesives and protective coatings, especially for agriculture and packaging uses.

Biography:

Laura Ciciliano holds a degree in Industrial Chemistry from the University of Brasília (2023) and is currently pursuing a master's in Chemistry at the same institution. Her research focuses on the photopolymerization of bio-based monomers derived from soybean oil, with emphasis on their structural modification and application in the development of functional polymeric coatings. These materials are designed to address agronomic challenges, such as reducing pod shattering in oilseed crops.

The Effect of the Frequency of the Ultrasonic Field on the Swelling Kinetics of PMAA Xerogel and PMAA-LTA Zeolite Composite Xerogel

Jelena Jovanović*[a] , Vesna Panic[b], Nebojša Begović[a], Borivoj Adnadjevic[c]

[a] *Institute of General and Physical Chemistry, Studentski Trg 12-16, Belgrade, Serbia*
[b] *Innovation Center of Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, Serbia*
[c] *University of Belgrade, Faculty of Physical Chemistry, Studentski Trg 12-16, Belgrade, Serbia*

Abstract:

We investigated the effect of the frequency (ω) of ultrasonic field (USF) on the equilibrium swelling degree (SDeq) and the swelling kinetics of poly(methacrylic acid) (PMAA) xerogels and PMAA-LTA zeolite composite xerogels (PMAA-LTA) under the conditions of simultaneous cooling and ultrasonic field action (SC-USF). Isothermal swelling of PMMA and PMAA-LTA in distilled water were monitored under SC-USF conditions at temperatures T= 298 – 313 K. The effect of ω and T on the shape of the isothermal kinetic swelling curves was analysed applying mathematical models. The power law equation showed dominant physical mechanism of swelling. By using the model-fitting method, mathematical model of swelling kinetics was determined revealing that the investigated isothermal kinetics of swelling can be fully described by the surface shrinkage model of the glassy part of the hydrogel. The effects of ω and T on the swelling rate constant were also analyzed. The values of kinetic parameters (Ea and lnA) of the swelling were calculated. The selective energy transfer (SET) model described thermal activation of the swelling processes. The possible mechanism of the influence of ω on the SDeq and swelling kinetics of PMAA and PMAA-LTA was discussed. We concluded that the interaction of USF with the solvent and xerogel/hydrogel led to structural changes in the glassy part of the hydrogel. The dominant influence of USF on the SDeq and kinetics of xerogel swelling was related to the formation of solvent micro-jets in the vicinity of the xerogel/hydrogel particles. caused by collapse of cavitation solvent bubbles.

Biography:

Dr Jelena Jovanovic, research professor, is R&D Director at Institute of General and, drug-release) both under conventional and non-conventional conditions (Physical Chemistry, Belgrade, Serbia. Dr J. Jovanovic has extensive career which covers numerous areas: advanced and smart materials, polymers, composites, hydrogels,, synthesis and polymerizations, and physicochemical processes (adsorption, extraction, swelling, ultrasonic, cavitation). Hydrogels are within the topic of her interest along with the effects of external fields on the reaction kinetics. She worked on development of novel methods of kinetics analyzes. Dr J. Jovanovic has approved international and leadership experience.

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