Spectrum Conferences & Expos

ISBPS2025 ABSTRACT BOOK

3rd International Summit on

BIOPOLYMERS and Polymer Science

July 21-22, 2025 | Frankfurt, Germany

FOREWORD

Dear Colleagues,

It is our pleasure to invite all scientists, academicians, young researchers, business delegates and students from all over the world to attend the 3rd International Summit on Biopolymers and Polymer Science (ISBPS2025) to be held in Frankfurt, Germany during July 21–22, 2025.

ISBPS2025 shares an insight into the recent research and cutting-edge technologies, which gains immense interest with the colossal and exuberant presence of young and brilliant researchers, business delegates, and talented student communities.

ISBPS2025's goal is to bring together a multi-disciplinary group of scientists and engineers from all over the world to present and exchange breakthrough ideas relating to Biopolymers and Polymer Science. It promotes top-level research and globalizes quality research in general, thus making discussions and presentations more internationally competitive and focusing attention on the recent outstanding achievements in the field of Biopolymers and Polymer Science.

We're looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Biopolymers and Polymer Science.

Organizing Committee Members

Feng-Huei Lin	President-Formosa Associate of Regeneration Medicine, Dept Biomed. Eng., National Taiwan University, Taiwan
Magnus Magnusson	University of Iceland, Iceland
Elke Metzsch-Zilligen	Head of the Division Plastics Fraunhofer Institute for Structural Durability & System Reliability LBF, Germany
Geoffrey Robert Mitchell	Vice Director - Centre for Rapid & Sustainable Product Development IPL, Portugal
Mariyam Jameelah Ghazali	National University of Malaysia, Malaysia
Febi Varghese	Director & CEO - Kerala State Nirmithi Kendra, India

Operando X-ray Scattering During Injection Moulding Towards a Circular Economy

Geoffrey R Mitchell1,2

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Abstract

Injection moulding is the most common technology for shaping plastics products in use today. It is a deceptively simple technique in which molten polymer is injected in to a metal mould at high pressure. The polymer cools and form a solid to retain the shape of the mould, it is then ejected and the next cycle continues. The technology transforms thermoplastic polymers in to high quality parts with a good surface finish. The quality control on such technology is largely restricted to a visual inspection of the part after it is produced. Defects such as weld lines and porosity are only detectable by optical inspection if the defect manifests itself on the surface of the part. Some attempts have been reported on the use of pressure and temperature versus time curves in conjunction with machine learning techniques to identify defective moulded parts during the injection mould cycle. At CDRSP we have launched a major project to provide multiscale feedback during the injection moulding cycle to drive digital twin type technology as well as a dynamic quality control process. We described an industrially relevant injection moulding system which can be mounted on the NCD-SWEET Beamline at the ALBA Synchrotron Light Source in Barcelona to take account of the intense X-ray beam available. This allows us to record in real-time quantitative small-angle X-ray scattering to evaluate the process of transformation of a polymer melt after injection in to the mould cavity in to a semi-crystalline solid. We have been able to follow this transformation with a time step of 50ms and thus provide critical data on the injection moulding cycle which hitherto was unavailable. We give examples of the data available and describe how we can extract quantitative parameters such as preferred orientation, crystallinity and details of the temperature of crystallisation. We show how we will use these data to move towards 100% circularity with plastic parts below.

This work was supported by the Fundação para a Ciência e Tecnologia (Portugal) through the Project references: https://doi.org/10.54499/UIDB/04044/2023

Keywords: Injection Moulding, polypropylene; digital twins; Circularity

Biography:

Geoffrey Mitchell is a researcher at the Centre for Rapid and Sustainable Product Development at the Polytechnic Institute Leiria in Portugal, the Institute for Sustainability and Innovation in Engineering Structures, University of Coimbra and Chief Scientific Officer of Visionary Equation lda, a high tech startup company in Marinha Grande. Geoffrey

Mitchell carried out his doctoral work at the University of Cambridge in the UK and subsequently held post-doctoral fellowships at Cambridge and at Hokkaido University in Japan. Prior to his current position he was Professor of Polymer Physics at the University of Reading, UK and the founding Director of the Centre for Advanced Microscopy at Reading. His research work bridges physics, engineering, biology, chemistry and technology and he is a Fellow of both the Institute of Physics and the Royal Society of Chemistry as well as the Royal Society for the Encouragement of Arts, Manufactures and Commerce and a Member of the Institute for Physics and Engineering of Medicine. He is a Visiting Medical Physicist at the Oxford University Hospitals NHS Foundation Trust, Oxford UK.

Geoffrey Mitchell is passionate about direct digital manufacturing (DDM) which enables products to be manufactured directly from a digital design without the need for specialist tooling or moulds and the development of novel materials to support these emerging technologies. He is particularly interested in the scales of structure present in all materials and especially biopolymers. He has pioneered and made extensive use of x-ray and neutron scattering methods coupled to computational molecular modelling and electron microscopy techniques. He is a member of the editorial boards of a number of international journals, He is the editor of a book “Controlling the Morphology of Polymers Multiple Scales ” published by Springer in 2016 and a book “Electrospinning: principles, practice and possibilities” published by the Royal Society of Chemistry in 2015.

Iron-doped Calcium Sulfide Magnetic Nanoparticles Surface Modified with PVP and SiO2 as Thermoseeds for Hyperthermia

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Abstract

In this study, a magnetic iron-doped calcium sulfide (Fe-CaS) nanoparticle was newly developed and studied for the purpose of hyperthermia due to its promising magnetic property, adequate biodegradation rate and relatively good biocompatibility. Fe-CaS nanoparticles were synthesized by a wet chemical co-precipitation process with heat treatment in an N2 atmosphere, and were subsequently cooled in N2 and exposured to air at a low temperature. The crystal structure of the Fe-CaS nanoparticles was similar to that of the CaS, which was identified by an X-ray diffractometer (XRD). The particle size was less than 40 nm based on a Debye-Scherrer equation and transmission electron microscope (TEM) examination.Magnetic properties obtained from the SQUID magnetometer demonstrated that the synthesized CaS was a diamagnetic property. The area of the hysteresis loop increased with the increasing of the treated temperature, especially at 800oC for 1 hour. This is because more Fe ions replaced Ca ions in the lattice at the higher heat treatment temperature. The heat production was also increasing with the increasing of heat treatment temperature, which resulted in an adequate specific absorption ratio (SAR) value, which was found to be 45.47 W/g at 37oC under an alternative magnetic field of f = 750 KHz, H = 10 Oe.

The in vitro biocompatibility test of the synthesized Fe-CaS nanoparticles examined by the LDH assay showed no cytotoxicity to 3T3 fibroblast. The result of in vitro cell hyperthermia shows that under magnetic field the Fe-CaS nanoparticles were able to generate heat and kill the CT-26 cancer cells significantly. Furthermore, the sulfide-based magnetic Fe-doped CaS nanoparticles modified with a silica layer were then investigated. A polyvinyl pyrrolidone polymer was used as the coupling agent. The developed nanoparticles contained 11.6 wt% iron concentration, and their x-ray diffraction pattern was similar to those of CaS and Fe-CaS nanoparticles. In the animal study, tumor-bearing Balb/c mice were subcutaneously injected with nanoparticles and exposed to an AC magnetic field manifested a reduction in tumor volume. The newly developed Fe-CaS nanoparticles and silica-modified Fe-CaS nanoparticles can thus be considered a promising and attractive hyperthermia thermoseed.

Keywords: Hyperthermia Iron-doped Calcium Sulfide Nanomedicine Magnetic nanoparticles

Biography:

Prof. Feng-Huei Lin is a distinguished researcher in the field of biomedical engineering with an extensive background in biomaterials and regenerative medicine. He completed his Ph.D. in Materials Science from the National Cheng-Kung University, Taiwan, in 1989, following his Master's in the same discipline and institution in 1985. He earned his Bachelor's degree in Earth Science from the National Cheng-Kung University in 1980. Prof. Lin has been a leading figure in various prestigious institutions, holding key positions such as Tenure Distinguished Professor at the Institute of Biomedical Engineering, National Taiwan University (since 2012), and Director at the National Health Research Institute's Institute of Biomedical Engineering from 2014 to 2022. He has also served as Director of the Biomedical Engineering Division at the NHRI, and the Institute of Biomedical Engineering at NTU. An influential voice in the scientific community, Prof. Lin is a member of the editorial boards of top-tier journals, including the International Journal of Molecular Sciences and Frontiers in Bioengineering and Biotechnology. He was the Editor-in-Chief of the Journal of Biomedical Engineering from 2007 to 2011. Prof. Lin's research has significantly contributed to the advancement of biomaterials and regenerative medicine, with over 500 SCI-indexed publications since 1990, an H-index of 72, and more than 19,000 citations. He has been recognized as one of the world's top 2% scientists for four consecutive years by Stanford University and is ranked 32nd in Materials Science globally.

Shaping the Future of Polymer Processing and Durability by Using Biobased Stabilizers

Elke Metzsch-Zilligen

Naturally Sourced Alternatives for Phenol-Based Primary Antioxidants

Abstract

The concepts of a circular economy have been influencing the plastics industry significantly in recent years. The demand for more sustainable plastics by regulators and consumers alike has prompted producers to consider alternatives to petrochemical-based feed stocks. Not only worldwide production capacities of recycling plastics, but also those of the so-called bioplastics are increasing. As of today, biobased plastics, i.e., plastics consisting partly or completely of polymers which are produced from natural resources, however, for additivation largely have to rely on commercial products which have not yet been based on renewable raw materials. Plant oils, fats, fibres, woods and cellulose, chitin and chitosan or starch and sugar derivatives offer lots of possibilities for additivation. A potential often overlooked are phenolic structures with antioxidant potential. Commercially available antioxidants are often based on sterically hindered phenol structures, which are ubiquitous in nature. We will demonstrate how their potential can be unlocked by comparing different phenols in additive combinations in different use cases. Emphasis will be placed on their application in polyolefins.

Biography:

Dr. Metzsch-Zilligen is a distinguished chemist specializing in physical chemistry, having earned her PhD from the University of Cologne in 2006. With extensive experience in the food industry, she transitioned to the German Plastics Institute (DKI) in 2011, which later integrated into Fraunhofer LBF in 2012. She led the “Additivation and Durability” department and, as of April 1, 2024, heads the “Plastics” division at Fraunhofer LBF. Her research focuses on developing new additives and optimizing additive systems for thermoplastics. A strong advocate for sustainability, she has significantly advanced the quality of recyclates, enhancing their mechanical, sensory, and optical properties to promote the use of recycled materials over virgin plastics.

Plant-Based Protein Adhesives and Plant-Based Protein Hydrophobes the Conundrum of Water in Bio-Based Composites

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Abstract

Bio-based composites made from wood or agricultural fiber are sustainable construction materials. Human awareness, corporate initiatives emphasizing sustainability, and government legislation are driving the research and product development of bio-based construction materials for structural and non-structural applications. Having adhesives derived from plant-based proteins adds to the sustainability of these construction materials. Plant-based proteins, like soy proteins, have gained much interest in recent years as aqueous based composite adhesives because of their safe handling and low environmental and worker impact. Wood, agricultural fiber, and plant proteins are hygroscopic. This creates challenges when designing a bio-based composite for structural and non- structural applications. Our research investigates how we can take advantage of the hygroscopic nature of wood and soy proteins and use the water to our advantage for developing strong adhesive bonds. In addition, we are investigating how to make the hygroscopic soy proteins hydrophobic by utilizing their unique ability to like both water loving and hydrophobic materials. Our goal is to understand and modify plant proteins for use in biobased structural and non-structural composites.

Keywords: Bio-based Composites; Plant-Based Protein Adhesives

Biography:

Dr. Marcinko boasts over 40 years of experience in industrial R&D, research management, and academia. His expertise spans biopolymers, polyurethane chemistry, adhesion science, wood and agricultural fiber composites, polymer characterization, and polymer structure-property relationships. An adjunct professor, he has developed industrial short courses on biopolymer adhesives and coatings, polyurethane and polymer chemistry, and adhesion science. Dr. Marcinko has authored over 60 peer-reviewed publications and holds 22 patents, with 2 patents pending. Educationally, Dr. Marcinko earned his Ph.D. in Chemistry from The University of Akron in 1992, an M.S. in Chemistry from Case Western Reserve University in 1990, and dual B.S. degrees in Chemistry and Biology from King's College in 1983.

Latest Market Trends for Renewable Polymers from Biomass, CO2 and Recycling

Michael Carus

Founder & CEO - nova-Institute, & Executive Manager of the Renewable Carbon Initiative (RCI

Abstract

Renewable polymers are partly or wholly made from renewable carbon. Renewable carbon includes all carbon sources that avoid or replace the use of additional fossil carbon from the ground, from the geosphere. Renewable carbon can come from the atmosphere, biosphere or techno sphere - but not from the geosphere. Renewable carbon circulates between the biosphere, atmosphere or techno sphere, creating a circular carbon economy.

The largest group today is bio-based polymers: 17 different bio-based polymers are commercially available worldwide. The CAGR of capacity between 2024 and 2029 is expected to be an impressive 13%, with most investment taking place in Asia.

CO2-based polymers have a bright future, but are still at an early stage due to high production costs, dominated by the price of green hydrogen. The most promising routes are biotech, methanol and electrochemistry.

The policy framework is driving demand for recycled polymers and plastics in packaging and automotive. For mixed plastic waste, virgin quality or food contact, a wide range of advanced chemical recycling is promising.

The presentation will include the latest market data and trends.

Biography:

Michael Carus, Founder and Managing Director nova-Institute. Michael Carus is one of Europe's leading experts, market researchers and policy advisors on the renewable carbon economy - including bio-based, CO2-based and recycling. In late 1994, together with five other scientists, he founded the private and independent nova-Institute for Ecology and Innovation. From the beginning, Carus has been involved in the company as an owner and one of the managing directors. Today, the nova-Institute employs nearly 50 scientists from a wide range of disciplines, covering markets, technologies, sustainability, communication and policy. In 2020, Carus founded the Renewable Carbon Initiative (RCI), which by 2024 will have more than 60 members from the chemical and other industries. Carus is one of the two executive managers of the RCI.

From the T-string World of RNA to Genes and Curricula: T-society Self-similarity as a Turning Point in Earth's Natural History

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Abstract

Since the 1970s, this research project comparing human and animal behavior has added neuronal and nanoscale interactions. It has resulted in algorithms and pattern types, such as the T-pattern, T-string, and the T-society concept (Magnusson, 2023. 2024a, 2024b). It has been greatly inspired by the work of behavioral biologists, such as Desmond Morris' "The Naked Ape" and of N. Tinbergen, K. von Frisch, and K. Lorenz, whose research on animal and human behavior earned them the Nobel Prize in Physiology or Medicine in 1973. E.O. Wilson's Sociobiology followed in 1975, focusing on insect mass societies.

In the late 1970s, data was collected on the real-time occurrence times of behavior categories, i.e., discrete point series within the same observation intervals. However, multivariate statistical methods and artificial neuronal network analysis techniques were inadequate for pattern detection in this real-time data. This led to the development of new pattern types, most notably the T-pattern with corresponding detection algorithms and specialized software (Theme). (See Magnusson, 1981, 1983, 1996, 2000). The T-pattern, initially defined by an algorithm, is a repeated self-similar statistical (pseudo-fractal) binary tree of a relationship called a critical interval between the point series of the two branches of each non-terminal node; thus, T-patterns recur with statistically significant translation symmetry. Real-time T-pattern detection and analysis (TPA) with the dedicated Theme software led to the discovery of far more complex patterns than expected in human and animal interactions and eventually also in neuronal brain networks, discovering a multitude of unexpectedly complex and highly significant T-patterns (Magnusson et al., 2016).

Attention then turned to patterns in physical strings of letters or molecules, called T-strings, detected in texts and proteins and thus in RNA and DNA (Magnusson, 2004, 2020a, 2023, 2024a, 2024b).
In protein societies, the behavioral potentials and tendencies of the individual proteins are initially set in ribosomes using segments of DNA T-strings, that is, genes external to the proteins. This kind of society of multiple kinds of specialized individuals, defined by a Giant Extra-Individual Purely Informational T-string, or GEIPIT, is here called a T-society, distinguishing it from Interactive Emergence Societies, or IES, which do not involve specialization through GEIPITs and were universal in the RNA world, animals, and even most literate humans until recently.

This only changed with the development of human extra-individual infinitely extendable memory, i.e., texts, beginning around 3000 BCE and mostly from around 1800 CE with mass literacy, education, and specialization in schools using curricula, that is, segments of a society's texts (textome), coinciding with unprecedented advances in a biological split second, a turning point in human and Earth's natural history.

Keywords: T-society, Self-similarity, T-string, T-pattern-detection

Biography:

Magnus S. Magnusson, Ph.D., Emeritus Research Professor, in 1991, founder of the Human Behavior Laboratory, School of Health Sciences, University of Iceland. The author of the T-system includes T-pattern, T-string, and T-society. Author of the dedicated THEMETM T-pattern Detection and Analysis, TPA, software (PatternVision Ltd.). Co-directed project "DNA analysis with Theme." Publications and keynote talks in biology, neuroscience, mathematics, the science of religion, proteomics, A.I., and nanoscience. Deputy Director, Anthropology Laboratory, 1983-1988 in the Museum of Mankind of the National Museum of Natural History, Paris. Since then repeatedly, invited Professor at the University of Paris V, VIII & XIII. A formal collaboration between 40 European and American universities was initiated in 1995 at the University of Paris V, Sorbonne, based on "Magnusson's analytical model." See Magnus-Magnusson.pdf (researchoutreach.org)

Methodology for the Development of Essential Oil Microcapsules using Complex Coacervation with Biopolymers

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Abstract

Due to the complexity of their chemical composition, the Essential Oils (EO), which can offer antioxidant, or antibacterial activity, among other properties, are very difficult to microencapsulated. To solve the problem, we have developed a systematic approach using clear steps where every component can be assessed and therefore, the application of Complex Coacervation using biopolymers is possible with high yielding percentages on microencapsulation.

There is a previous step where the surface tension measurements, are used to establish the most appropriate mass ratio between EO/Type of surfactant. Profiting from the self-assembly characteristic behavior, there is the formation of an intermediate complex (CAC). After, the use of the same properties, can help us to understand the mass ratio with the next component of the system, that is the first layer of biopolymer, chitosan.

Therefore, for each EO and every type of surfactant, it is possible to characterize the first, and second aggregation complexes formed, which can be finished just with the addition of the required second biopolymer and the desired amount of cross-linking agent. All this process would allow us to control the final drug-delivery mechanism of the formed microcapsules.

Each step can be characterized using FT-IR, Thermogravimetric Analysis, and Laser Scattering instruments. Some chosen results will demonstrate how the different drug-delivery profiles, correspond to different mass ratio combinations, altering the diffusion mechanisms.

Biography:

Since 1984, teaching Chemical Engineering at the Engineering School of Terrassa (ESEIAAT), BSc ChemEng, MSc Engineering, PhD in Industrial Engineering. Has authored more than 100 research articles and has coordinated several PhD Thesis and more than 200 BSc and MSc Thesis. A lot of different projects in agreement with private and public companies in microencapsulation systems to be applied to solve industrial problems.

Novel Polymer-based Approaches for Self-Assembly of mRNA-based Pharmaceuticals

Heinrich Haas

Abstract

Successful application of messenger RNA (mRNA) in COVID-19 vaccines has underlined the potential of using mRNA in pharmaceutical products.

While in the currently licensed lipid-based nanoparticles, so-called LNPs, are being applied, polymers constitute a valuable extension to the nanoparticle engineering space, complementing lipid-based system. Parameters like charge density, water solubility, internal organization and intrinsic immunogenicity can be modulated according to the intended form of intervention.

Here we describe a format of polymer-complexed self-amplifying RNA (saRNA) molecules designed for vaccination against infectious diseases. The formation of PEI-complexed saRNA is based on general principles of self-assembly between oppositely charged polyelectrolytes and highlight potential applications of this novel format.

These polymer-complexed RNA molecules are promising for systemic delivery of genetic material to compartments that are difficult to reach with larger particles, which makes them attractive for a variety of different prophylactic and therapeutic applications.

Biogrpahy:

Dr. Heinrich Haas earned his Ph.D. under Prof. Dr. Helmuth Möhwald at Johannes-Gutenberg Universität Mainz, researching lipid membranes and bio-molecular systems. With extensive experience in the pharmaceutical industry (Munich Biotech, Medigene, BioNTech), he has advanced various nanoparticle products to clinical stages, focusing on innovative approaches to nanoparticle development and control.

Process Development of Remote Atmospheric Pressure Plasma-Assisted Functionalization on Biodegradable Polymeric Textiles for Bone Tissue Engineering

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Abstract

The porous textile structure of biodegradable polymeric nonwoven possesses the potential of being applied to tissue engineering scaffolds and wound dressings. However, the inert and hydrophobic surface properties of these materials not only lead to poor osteo conductivity and antibacterial performance but also limit the efficiency of surface modification treatments, including hydroxyapatite deposition, biomolecule immobilisation and the introduction of nanoparticles. To address these concerns, customized remote atmospheric pressure plasma systems have been developed as an inventive and environmentally friendly approach. Carboxylic-based precursors were employed as monomers within this system to introduce designated functional groups onto the surfaces of polymeric substrates. This surface functionalization aims to swiftly and efficiently modify biodegradable polymer surfaces without causing harm to the substrate.

Biography:

Dr. Wei-Yu Chen is an Assistant Professor in the International Ph.D. Program in Plasma & Thin Film Technology at Ming Chi University of Technology. He earned his Ph.D. in Materials Science and Engineering from The University of Sheffield in 2019. Dr. Chen's research focuses on plasma surface biomedical modification, atmospheric pressure plasma chemistry, plasma polymerization, and antibacterial/photocatalytic films. His professional experience includes roles as a Senior Researcher at the Taiwan Textile Research Institute and research positions at the University of Manchester and National Taiwan University.

Process Optimization of Exopolysaccharide Production: An Iterative and Integrative Approach

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Abstract

Exopolysaccharides (EPS), a group of versatile biopolymers, are polysaccharides excreted into the fermentation broth during production. They are currently of great interest for applications in pharmaceutical, cosmetic, food, agriculture, textile and packaging industries. Recent studies also explore their use in drug delivery, scaffolds, etc. Pullulan, the EPS specifically studied in this research is attractive for its film forming, adhesive, biodegradable and antimicrobial properties, among others. It is naturally produced by the yeast-like fungus, Aureobasidium pullulans. The hyphae forming growth of the fungus and continuous extracellular product formation makes the fermentation broth highly viscous, interfering with the mass transfer during fermentation and also making downstream processing difficult. This research aimed at producing high titers of pullulan by an innovative statistical optimization involving an iterative Plackett-Burman Design (PBD) and Central Composite Design (CCD) for optimizing both, media components and parameters in combination. PBD revealed the significant factors and CCD aided in further optimizing the range of the significant parameters. A titer of 97 g/L was achieved with the wild type strain A. pullulans ppkm3 (DSM 3042), the highest seen titer for any A. pullulans (WT) strain. The iterative model helped step outside the local optimum and understand the global optimum of the parameters and media concentrations. Furthermore, downstream process strategies and upscaling studies were also examined to achieve a cost-effective, holistic optimization of the process. Downstream strategies involved testing different techniques like solvent precipitation, aqueous phase precipitation, pre-treatment before precipitation, etc. Process upscaling included a Model-Based Process Design using SuperPro Designer and experimental analysis in a 2L fermenter. Fourier Transform IR spectroscopy analysis and thermal analysis were carried out to characterize differences between the polymers produced. A combination of optimal conditions from upstream and downstream showed an improved titer, indicating complete process optimization.

Keywords: Exopolysaccharides, Statistical-Optimization, Increased Titer, Bioprocess.

Biography:

Venessa Dsouza is a 2nd year Ph.D. candidate at the Professorship of Bioprocess Engineering at TUM Campus Straubing, Germany. She completed her Master of Science in Chemical Biotechnology at TUMCS and now continues research focused on exopolysaccharides, both fungal and bacterial, their upstream and downstream processing and upscaling. A part of her study also involves model based process design and cost analysis for industrial production of biopolymers and bi-products. During her Bachelor of Engineering in Biotechnology, at KLE Technological University, India, she worked on optimization of bacterial cellulose production, composite preparation and characterization, where she published 2 scientific papers, paving the way for her current research interest in biopolymers.

Development of Dextran-Pluronic Thermosensitive Hydrogel Containing Extracellular Vesicles from Adipose Derived Stem Cells for Nerve Repair

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3.Division of Biomedical Engineering and Nanomedicine Research, National Health Research Institutes, Miaoli, Taiwan

Abstract

Nerve damage usually requires surgery to repair. The clinical problem is that nerve recovery rate is slow, with an average of less than I mm/day. The latest research showed that extracellular vesicles (EVs) from adipose-derived stem cells (ADSCs) can promote peripheral nerve regeneration. According to the paper, the surface molecules of EVs was negatively charged. Therefore, this study is going to develop a positively charged thermo sensitive hydrogel as a carrier for the controlled release of ADSC EVs and promote nerve regeneration. First, the isolation of EVs using size exclusion chromatography (SEC). After isolation, the morphology of EVs was characterized by TEM and SEM. Nanoparticle tracking technology (NTA) confirmed the size and particle number of EVs. The concentration of protein is measured by Bradford assay. Finally, the tetraspanins of EVs (CD9, CD63, CD81, Hsp70) are confirmed by Western blotting. The second part is the preparation of hydrogel. First, mix the Pluronic□lysine-dextran□alginate and calcium chloride in an appropriate ratio. The electrical properties of thermo sensitive hydrogel were analyzed by Zeta potential. The rheological property of thermo sensitive hydrogel was analyzed by the rheometer. The degradation rate and the water content were evaluated. Finally, combine the EVs with the thermo sensitive hydrogel. The release profile of EVs was measured by Bradford assay. For the in vitro study, WST-1 assay and Live/Dead staining were used to test cyto toxicity. Also, the dorsal root ganglion neuron cells (DRG) and Schwann cells were removed from the rats and identified by immune fluorescence staining. WST-1 proliferation assay for measuring cell proliferation. For the in vivo study, the animal model was SD rats. In the first, second, and third months after surgery, the walking track analysis was observed. In the third month before sacrifice, compound muscle action potential, muscle contraction force, nerve conduction velocity and muscle atrophy ratio were observed. The results of showed that we isolated EVs successfully. The concentration and size of EVs were 10s-10 particles/mL and 70-120 nm. The WST-1 assay showed that the thermo sensitive hydrogel has good biocompatibility and can help Schwann cell proliferation under the release of EVs. In vivo study showed that the thermo sensitive hydrogel containing EVs can help nerve repair.

Biography:

Mr. Yeh Cheng-Hao is a Ph.D. student at the Institute of Biomedical Engineering, National Taiwan University. He holds a Bachelor's (2019–2023) and a Master's (2023–2024) degree in Mechanical and Materials Engineering from Tatung University.

XLANCE® EOL Yarn: Tailoring Elasticity while advancing Textile Sustainability

Lorenza Gardella

Abstract

XLANCE® is a melt-spun, cross-linked polyolefin-based elastic yarn, classified under the generic fiber name elastolefin (EOL). Unlike conventional polyurethane-based spandex, XLANCE® relies on a distinct chemistry and technology, making it a true innovation in the world of stretch textiles. Thanks to its exceptional chemical and physical resistance, XLANCE® not only broadens the scope of elasticity in garments, but also enables the development of high-quality, long-lasting fabrics; notably, it offers a more environmentally responsible solution for incorporating stretch into fabrics. In this presentation, I will demonstrate how the properties and performance of XLANCE® can be engineered to meet a wide range of customer needs. I will also highlight why XLANCE® yarn introduces a more sustainable approach to elasticity in textiles and explore its potential to open new opportunities for textile recycling.

Biography:

Dr. Lorenza Gardella specialized in Polymer Science at the University of Genoa(Italy). After earning a Master's degree in Chemistry with a thesis on polymer crystallization, she obtained a Ph.D. in Science and Technology of Chemistry and Materials, focusing on biopolymer synthesis. Since 2016, she has been working in the industry, exploring the fascinating world of elastomers as Head of R&D at XLANCE® SRL, an Italian company producing a unique polyolefin-based elastic fiber for textile applications.

Assessing the Green Shift: Comparing Conventional and Biopolymer Packaging

Bruna Machado1*,

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Abstract

As the food industry grows, so does the demand for packaging. Petroleum-based plastics, derived from fossil fuels, have long been favoured for their durability and cost-effectiveness, yet their fossil originraises concerns over green house gas emissions and finite resource depletion. In response, biodegradable polymers from renewable sources offer a promising alternative, reducing reliance on fossil fuels. However, thorough environmental assessments are essential to ensure that transitioning to biopolymers genuinely benefits sustainability in packaging.

The INOV.AM Hybridization project aims to integrate additive manufacturing with injection moulding using biopolymers in the food industry, focusing on the redesign of a food tray currently made from fossil-based Acrylonitrile Butadiene Styrene (ABS). The project will explore producing the tray using additive manufacturing with Polylactic Acid (PLA) as the main material.

In this preliminary study, a Life Cycle Assessment (LCA) was conducted in accordance with ISO 14040:44 standards to compare the baseline product with the novel one. Three End-of-Life (EoL) scenarios were also compared: Scenario1involved recycling, Scenario2 land fill disposal, and Scenario 3 a mixed approach based on the Portuguese plastic disposal rate. The functional unit is the production of a polymeric tray, analysed through a cradle-to-grave approach.
The inventory used primary data from the tray manufacturer and secondary data from the Eco invent database (v. 3.10). Mass allocation per cutting unit ("Cut-off, U") was applied, with the European regional database ("RER") referenced where applicable. The ReCiPe Midpoint (H) (v. 1.09) assessment method was employed.

In Scenario 1, the baseline tray showed overall impacts that were 0.2% higher than those of the novel tray. Conversely, in Scenarios 2 and 3, the novel tray exhibited higher impacts than the baseline, by 0.3% and 0.2%, respectively. Although there are differences, it can be observed that these are close to zero. In fact, most differences are more noticeable when each category is analysed separately. Baseline impacts are primarily associated with categories such as fossil resource scarcity and human carcinogenic toxicity, whereas the impacts of the novel product are more significant in categories

such as land use and freshwater eutrophication. For both baseline and novel trays, comparing Scenario 1 with Scenario 3 showed an average reduction of 42% in environmental impacts. Conversely, comparing Scenario 2 with Scenario 3 showed an increase of 46%, primarily due to Scenario2's EoL considering land fill disposal only.

The results indicate that the overall impacts for both cases are very similar. However, when analysing each impact category separately, significant differences emerge between the baseline and novel product. The impacts associated with the baseline product are primarily linked to fossil resource scarcity due to the fossil origin of ABS. On the other hand, for the novel product land use is one of the most impacted categories once the PLA has a natural origin such as corn. Improvement measures for the novel product could include redesigning to reduce material usage and sourcing alternative raw materials.

Future work will evaluate the biodegradability of PLA in the EoL stage as well as the integration of additive manufacturing.

Acknowledgement - This work is carried out within the framework of the "Agendas para a Inovação Empresarial" [Project nº 49, acro-nym "INOV.AM"), supported by the RRP -Recovery and Resilience Plan and by the European Funds Next Generation EU.
http://www.recuperarportugal.gov.pt/

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International Organization for Standardization. (2006). ISO 14044:2006 Environmental management—Life cycle assessment—Requirements and guidelines.

Keywords: Biopolymers, LCA, Sustainability, Fossil-based polymers

Biography:

Bruna Machado holds a Master's degree in Biological Engineering with a focus on Environmental Technologies from the University of Minho. Throughout her academic journey, she developed a strong passion for Environmental Management, Environmental Technologies, Life Cycle Assessment (LCA), and Sustainability. She is currently working as a researcher at PIEP – Centre for Innovation in Polymer Engineering, where she conducts LCA and Life Cycle Costing (LCC) studies. In this role, Bruna evaluates innovative solutions and products, comparing their environmental impact and cost-effectiveness with conventional alternatives. This position has deepened her understanding of sustainable practices and the importance of making informed decisions in engineering. Bruna is particularly skilled in performing sustainability analyses that encompass environmental, social, and economic factors. Her experience in the fields of Environment, Health, and Safety has provided her with a solid foundation in environmental management within an industrial context, enablingher to effectively address challenges. She takes pride in her excellent written and interpersonal communication skills, which are essential for collaborating on projects to promote a positive impact on the environment and society. By fostering relationships among various entities, she strives to contribute to meaningful change. Additionally, Bruna is a certified trainer, enhancing her skills and knowledge in environmental education and outreach. She is excited to continue her professional journey, utilizing her
expertise to drive sustainability initiatives.

Innovative Biomedical Materials & Advanced Animal Models for Infectious Disease: Bridging Research & Clinical Application

Dr. Shu-Wei Huang

Assistant Professor, National Taitung University

Abstract

Infectious diseases continue to pose a major threat to global health, particularly with the emergence of multidrug-resistant pathogens and the limitations of current therapeutic strategies. To address these challenges, our research focuses on the development of innovative biomedical materials and the implementation of advanced animal models to better simulate human infectious conditions and accelerate translational applications.

This presentation will first explore the design and functionalization of novel biomaterials, including magnesium oxide and calcium sulfate hemihydrate derived from deep ocean water, as well as plant-based compounds from Anisomeles indica, which exhibit promising antimicrobial and immunomodulatory properties. These materials offer potential for application in wound healing, implant coatings, and targeted drug delivery systems.

Next, we will discuss the integration of advanced animal models, such as zebrafish infection systems and humanized mouse models, which enable precise evaluation of host-pathogen interactions and biomaterial performance in vivo. These models bridge critical gaps between in vitro testing and clinical application, allowing for more predictive and ethical preclinical studies.

By highlighting the synergy between smart biomaterial design and sophisticated animal modeling, this talk aims to provide a translational perspective on combating infectious diseases. Future directions will focus on the development of clinically relevant, sustainable, and patient-tailored biomedical platforms through interdisciplinary collaboration.

Biography:

Dr. Shu-Wei Huang is an Assistant Professor in the Department of Applied Science at National Taitung University, Taiwan, specializing in biomedical materials for treating degenerative diseases, chronic wounds, and infections. With a Ph.D. from National Taiwan University's Graduate Institute of Biomedical Engineering and a medical engineering background from Yang Ming University, Dr. Huang's career spans research scientist and project management roles at top institutions like Wan Fang Hospital and Taipei Veterans General Hospital. Her work advances innovative animal models for osteoporosis, sarcopenia, and orthopedic infections in mice, rats, and hamsters. Recognized with awards such as the 2023 National Innovation Award for New Bone Screw Development and the Outstanding Paper Award at Wan Fang Hospital, Dr. Huang is also celebrated in the medical device community, earning accolades from the AAOS and Medical Design. She serves as a consultant for programs like the TMU SPARK Biomedical Training Program and IRCAD's Innovation Workshop, where she mentors young innovators. Dr. Huang is a sought-after speaker and educator, teaching biodesign and clinical translation at leading institutions to foster interdisciplinary healthcare solutions. Ms. Ines Costa PIEP – Centre for Innovation in Polymer Engineering, Portugal Ms. Catarina Faria PIEP – Centre for Innovation in Polymer Engineering, Portugal Ms. Bruna Gabriela Mendes Machado PIEP – Centre for Innovation in Polymer Engineering, Portugal Ms. Jeyran Ghased Seoul National University of Science and Technology, South Korea

Development of Innovative Thermotropic Materials for Cost-Effective Solar Energy Collectors

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Abstract

A significant portion of energy consumption in buildings is dedicated to space heating and domestic hot water. To meet this demand sustainably, cost-effective and high-efficiency solar collectors are essential for both residential and industrial applications. One promising approach to reduce the cost of solar collectors is the development of polymer-based systems. Polymeric collectors have the potential to lower the overall cost of solar energy systems by up to 50%.

However, a major challenge in using glass-covered polymeric collectors is the thermal degradation of polymers at high temperatures. To enable the successful adoption of polymeric collectors in the solar market, there is a need for low-cost mechanisms that prevent overheating. To address this issue, our project focused on the development of thermotropic materials—materials that change their optical properties with temperature. These materials remain highly transparent below a specific switching temperature and become reflective above it, thereby protecting the collector from excessive heat buildup.

The goal of our project was to synthesize a novel thermotropic material by incorporating nanoscale phase change particles into a polymer matrix. A key innovation in our approach was the use of bio-based fatty acids as phase change materials (PCMs). Thermal imaging of the resulting composite demonstrated that above the transition temperature, the material becomes partially opaque, effectively regulating temperature and mitigating overheating.

Keywords: Solar Energy, Thermotropic Materials, Phase Change Materials, Polymeric Collectors

Biography:

Nurten Sahan is an Assistant Professor in the Chemistry Department of Cukurova University (Adana, Turkey). Her research interests are in thermal energy storage (TES) applications with a focus on developing novel phase change materials (PCMs). Emphasis is on creating and testing sustainable and green types of PCMs to improve the technical, economic and environmental performance of TES systems. Dr Sahan has participated in several national and international projects on the R&D of various TES systems. Currently, she is conducting her 26-month Marie Curie Research Fellowship research study on new TES systems in the Department of Mechanical and Construction Engineering at the University of Northumbria in Newcastle upon Tyne (UK).

Comparative Study of Chain Extenders for the Reactive Extrusion of PLA

Ms. Franka Malsch

Abstract

Bio-based plastics such as poly (lactic acid) (PLA) are increasingly being used as a more sustainable substitute for fossil-based plastics in packaging and textile applications. However, PLA's wide spread adoption is hindered by its poor melt strength, which is further reduced by hydrolytic chain scission during processing. This makes PLA difficult to process in thermo forming methods that require high melt viscosity, such as bottle and packaging production. The melt viscosity of PLA can be increased using chain-extending reactive additives, a variety of which is available and marketed for use in poly (ethylene terephthalate). Studies on the use of these additives in PLA are usually limited to a single additive in a specific use case, often involving blended or compounded PLA, which makes them difficult to compare. This study establishes a direct comparison of PLA processed with 11 different additives marketed as melt strength or viscosity enhancers. Obtained melt rheology changes are evaluated using Rheotens melt strength measurements.

Biography:

Ms. Franka Malsch holds an M.Sc. in Chemistry from TU Dresden (2019). She worked as an Assistant Scientist at Novaled GmbH from 2019 to 2023 and has been a PhD researcher at Fraunhofer UMSICHT since 2023.

Co-polymerization of Carbon Dioxide with Propylene Oxide by Heterogeneous and Homogeneous Catalysts to Produce Low Molecular Weight Polycarbonate Ether Polyols

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Abstract

Carbon dioxide (CO_2) is an important carbon source due to its abundance, low cost, and non-toxic nature, making it a suitable raw material for chemical synthesis. The chemical fixation of CO_2 has gained significant attention, not only for the efficient use of carbon resources but also in response to increasing environmental concerns [1]. One particularly promising application of CO_2 is its direct incorporation into polymer synthesis. In this context, the copolymerization of CO_2 with propylene oxide (PO)was explored using both homogeneous and heterogeneous catalysts. The catalyst plays a significant role in selectively producing polycarbonate ether polyols, a kinetically controlled product, as it influences the copolymerization rate, selectivity, composition, and molecular weight of the resulting copolymer [2]. In this study, Cr-salen was selected as homogeneous catalyst, while as-synthesized Zn–Co double metal cyanide (DMC) and zinc glutarate were chosen as heterogeneous catalysts. Reaction conditions were optimized to produce low molecular weight polycarbonate ether polyols, which are valuable intermediates for polyurethane production.

Furthermore, the selectivity toward producing cyclic carbonate as by-product, the weight ratio of cyclic carbonate (WPC%), the CO2incorporation fraction (fco2%) in polycarbonate ether polyol, and number average molecular weight (Mn) of the resulting polymers were investigated. It was found that The Cr-salen catalyst demonstrated high catalytic activity and a high fco_2%,but it provided limited control over the Mn of the polymer. Similarly, the DMC catalyst showed strong catalytic performance; however, its lower fco_2% led to a copolymer with a higher polyether content. In contrast, zinc glutarate exhibited greater selectivity for CO_2 incorporation and produced polymers with higher Mn, although it had lower catalytic activity and reduced overall yield. According to the results, DMC catalyst was selected for further investigation. The molecular weight of the final product was tailored by adjusting the reaction conditions and using specific chain transfer agents to obtain low molecular weight polycarbonate ether polyols suitable for polyurethane synthesis.

Keywords: Carbondioxide, Double metalcyanide (DMC), Zincglutarate, Cr-salen

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[2] Angew. Chem. Int. Ed. 2004, 43, 6618– 6639

Biography:

Dr. Afsoon Farzan holds a PhD in Polymer Chemistry from Aalto University, Finland. Currently, she is working as a postdoctoral researcher in Technical Research Centre of Finland (VTT).

Multivalent Targeted Protein Degradation Polymeric Chimeras for Cancer Treatment

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Abstract

In this study, PAMAM polymer was adopted as a multivalent PROTAC carrier for developing highly efficient polymer-PROTAC therapeutics to induce proteasomal degradation of intracellular BRD4. An approximately 8 nm–sized polymer-based PROTAC chimera system, JQ/TL@PAMAM, was first prepared in which thalidomide-4 (TL) and JQ-1 were covalently conjugated to the polymer. JQ-1 in this work served as the BRD4 binding ligand and TL was used as the ligand for binding E3 ubiquitin ligase. Upon the binding of JQ/TL@PAMAM with both BRD4 and E3 ubiquitin ligase, the polymeric drug conjugates induce the degradation of BRD4 by proteasome-ubiquitin system and thus reduce the oncogenic BRD4 signaling for sensitizing cancer cells to chemotherapy. The structure and composition of JQ/TL@PAMAM were characterized. The in vitro studies with respect to cellular uptake, cytotoxicity and anticancer effect of the JQ/TL@PAMAM conjugate to sensitize colon cancer cells to various chemotherapies (including doxorubicin, oxaliplatin and irinotecan) were evaluated with murine CT26colon cancer cells. The catalytic and recycling nature of the polymer-PROTAC system promotes the degradation of target proteins and kills cancer cells substantially. The in vivo sensitization effects of JQ/TL@PAMAM on colon cancer toward chemo therapy were further analyzed by evaluating BRD family proteins (BRD4, BRD3 & BRD2), BRD4 driven signaling proteins (c-MYC, Ki-67, β-catenin, IL-1β, IL-6, IL-10 & TNF-α), cell cycle, oxidative DNA damage and its sensor (cleaved PARP-1)and apoptotic cascade proteins (cytochromeC,Bax,Bcl-2, Caspases-3&9).The in vivo data have shown great promise of the multivalent polymer-based PROTAC by enormously promoting the survival of tumor-bearing mice via BRD4 degradation and sensitization of colon cancer to chemotherapy.

Keywords: BRD4 signaling; Chemo-sensitization; Colon cancer; Polymer-PROTAC therapeutics.

Biography:

Professor Hsin-Cheng Chiu received his Ph.D. in Pharmaceutics and Pharmaceutical Chemistry from the University of Utah in 1994. After serving as a faculty member in the Department of Chemical Engineering at National Chung Tsing University for 15 years, hemoved to National Tsing Hua University in 2009. Dr. Chiu has a professional background in design, synthesis and development of stimuli-responsive supramolecular nano constructs for targeted delivery and controlled release of therapeutics. His current interests focus on exploiting hetero junction semiconductor nanomedicines for cancer theranostic applications and developing polymeric multifunctional targeted protein degradation chimeras for treatments of cancer and other diseases. He has published more than 100 peer-reviewed research articles, including those in Biomaterials, Journal of Controlled Release, Advanced Functional Materials, Angewandte Chemie, Macromo-

lecules, ACS Nano, etc. Dr. Chiu also served as the President of the Taiwan Biomaterials and Controlled Release Society from 2020 to 2022. His work has been recognized by receiving the Outstanding Research Award from National Science and Technology Council of Taiwan, the Fellow of Biomaterials Science & Engineering from the International Union of Societies of Biomaterials Science & Engineering, the Award of Excellence in Research from Li Chio Zen Biomaterial Research Foundation and Academic Excellence Award of National Tsing Hua University, etc.

Fermentative Production of Monomers for Polymers

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Abstract

Polymers are synthesized via the polymerisation of monomers. The most important monomers with respect to volume include e.g. ethylene, propylene, isobutene, butadiene, acrylic acid, vinyl chloride, adipic acid, hexamethylenediamine, caprolactam, terephthalic acid, ethylene glycol and tetrahydrofuran. Monomers are traditionally produced via chemical synthesis based on petrochemical precursors. Since petrochemistry is often associated with a rather high carbon footprint and increasingly challenged due to the use of petrochemical precursors and the related carbon dioxide emissions, fermentation technology has gained attraction as an alternative production technology. Fermentative monomers are commercially established for e.g. lactic acid (precursor for PLA), pentamethylenediamine and developing for polyhydroxyalkanoates (PHAs) though are still limited to selected products. In the last 20 years significant efforts have been undertaken to develop suitable (glucose based) fermentation hosts with natural or synthetic pathways to produce further monomers. In most of these cases a general proof of concept could be achieved, but commercialization suffered from non-competitive production costs versus mature petrochemistry. In case the monomer is a di-acid or di-base, also the costly isolation and purification of the monomer out of the fermentation broth blocked a broader commercial breakthrough. The biobased nature of the feedstock, glucose, provides in minor market arenas a marketing advantage though can usually not overcompensate the cost disadvantage versus petrochemistry. In the future, the cost position and the carbon footprint of fermentative monomers may be improved using feedstocks other than glucose, e.g. carbon dioxide, carbon monoxide, methanol and hydrogen. Additionally, monomer availability will be improved by innovative recycling technology and the volume share of »fresh« monomer via chemical synthesis and fermentation might be restricted.

Keywords: Fermentation; production technology; biochemical pathway, fermentation host

Biography:

Dr. Walter Koch joined BASF in 2002 and is Director Biochemical Technology at BASF in the unit »net carbon zero«. His work focusses on the evaluation and benchmarking of fermentation technology (i.e. production costs and carbon footprint) towards chemical intermediates and fuels in comparison to chemical technology. Fermentation is especially regarded as a potential future carbon capture and use (CCU) technology given the emerging fermentation feedstocks carbon dioxide, carbon monoxide, formate, methanol and hydrogen. He has an academic background in biochemistry and fermentation. He has studied in Tübingen, Munich and Heidelberg and received his diploma in biochemistry from Tübingen university on work related to the activation of the hemolysine of Serratia marcescens. He is author of the book “Pathway design for industrial fermentation” (Wiley 2024).

Superior Nonlinear Optical Response of Single Crystalline Bio-Reachable Polymers

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Abstract

Polyoxybenzoate (POB) is expected to have excellent performance due to its rigid structure, and has been expected to be a high-performance polymer. However, since POB is insoluble and infusible, it is difficult to obtain a high molecular weight form, and despite its attractive potential performance, its use as a material has been limited to a very small number of applications. Therefore, this POB has been developed as a thermotropic liquid crystalline polymer (LCP) that can be molded in a molten state while maintaining the orientation of the molecular chains by randomly adding copolymer components to the main skeleton. It is applied to electronic parts such as high-performance connectors for smartphones. Although some success has been achieved by making good use of the orientation state of liquid crystals, there is an order of magnitude difference between the crystalline elastic modulus of POB (140-200 GPa) and that of LCP (10-20 GPa) when defect-free extended chain crystals are formed, and it is difficult to say that LCP fully reflects the potential performance of the primary structure of the POB skeleton.

One way to overcome this problem is to incorporate non-equilibrium physical phenomena into the polymerization assumption that creates POB homopolymers, forming higher-order structures simultaneously with polymerization, and to use POB single crystal whiskers as a resin filler, and it has been suggested that POB single crystal whiskers will exhibit a value close to the theoretical elastic modulus. In this way, POB homopolymer is a very promising organic filler material that can achieve high strength and high elasticity. In addition, it can have a lower specific gravity than inorganic fillers, and because the raw material monomer, p-hydroxybenzoic acid, can be biosynthesized using bacteria, it can be provided as a 100% bio-derived polymer, and is therefore attracting attention as an environmentally friendly material.

In this study, the possibility of using this excellent bio-reachable POB homopolymer not only as a organic filler but also as a nonlinear optical material by taking advantage of its single crystal structure are implemented. A series of results will be presented.

Keywords: Polyoxybenzoate; Single crystal whisker; Nonlinear optical materials; Bio-reachable

Biography:

Team Director of RIKEN. He joined Sumitomo Chemical Industries in April 1996 and has been consistently engaged in new development and innovation. He succeeded in industrializing catalytic polymerization of liquid crystal polymers for the first time in the world, and while the market remained strong, he succeeded in developing a manufacturing method that satisfies both productivity and quality, which was incorporated into industrial production. He subsequently succeeded in developing a liquid crystal polymer that dissolves in common solvent, leading to its use in 5G antenna

substrates, high thermal conductivity substrates, speaker diaphragms, etc. In addition, he engaged in the development of transparent polyimide film, which was also used in Foldable Phones. In 2017, he moved to the planning department at the company's headquarters, where he promoted open innovation and collaborated with ventures in areas such as odor sensors, synthetic biology, and ultra-long carbon nanotubes. Since April last year, he has also been working as a specially appointed professor at Tokyo Institute of Technology (now IST) and a team director at RIKEN, while working with academia to implement strongly correlated material.

Cradle to Cradle Design Innovations

Albin Kälin

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Country: Switzerland, Presentation Category: (Oral)

Abstract

Cradle to Cradle® Design implies a paradigm shift in industrial production. The design and innovation process move from the present linear thinking towards thinking in closed cycles. Materials and processes are chosen and used in a way that the resulting products become "nutrient" at the end of their life. The materials are either reintegrated into biological cycles or remain in technical cycles. Cradle to Cradle® Design does not allow waste and strides to keep resources in endless cycles.

Sample products and projects will demonstrate the concrete application and results of the design process. Design for disassembly and avoidance of problematic substances allows for a new level of quality and safety during production and use and opens new opportunities for material reuse. This can be combined with system and business models that leave the ownership with the producer. This guarantees take back and maximal reuse of resources. The radical rethinking of design and production can go even beyond towards regenerative design.

Production processes are designed according to the model of nature. No waste, no surrender, no restrictions. The right materials at the right place at the right time, in endless cycles is the key.

Biography:

1981 to 2004 Albin Kälin was Managing Director of Rohner Textil AG in Switzerland. Under his leadership, the company won since the 90s 19 international design awards. In 1993 he stimulated the development of the product line Climatex ® (www.climatex.com) and thus the first Cradle to Cradle ® products worldwide. Albin Kälin was awarded in 2001 with UBS Key Trophy as the "Rhine Valley Entrepreneur of the Year". 2002 – 2007 member of supervisory board of Fein Elast Group in Austria. 2005 to 2009, CEO of EPEA Internationale Umweltforschung GmbH in Hamburg. 2007 in addition CEO of EPEA Netherland. 2009 – today Albin Kälin founder and CEO of epeaswitzerland gmbh
2022, 2023, 2024, 2025 30 International Awards:

Polycarboxylate Ether As Superplasticizers InConcrete, Their Current Impact On CO2Emissions And How To Reduce Them Though Biopolymer Synthon

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Abstract

Polycarboxylate ether (PCE) is a comb polymer that is widely used in chemical admixture in the construction industry as a superplasticizer to enhance the fluidity, the workability, and the strength of concretes. It allows reducing CO2 emissions in the construction field by decreasing the quantity of cement which is necessary in 1m3 of concrete while keeping high mechanical strength. This work focuses on the synthesis of PCE superplasticizers and their applications in concrete admixtures, the core activity of Saint-Gobain Construction Chemicals. After a description of the way to synthesis PCE, the focus will be done on the two main synthetic pathways: "grafting to" and "grafting through" approaches.The action mode of PCE in the improvement of concrete performances will be detailed. A link between microstructure and behaviour in cement paste will be discussed.

To decrease the CO2footprint of concrete, especially cement, producers decided to replace part of cement by alternative binders (waste or lower emitting binders) that lead to lower mechanical performances and that are more difficult to fluidify.One consequence is the increase of the amount of PCE necessary to keep concrete's performances. The part of CO2 emission due to PCE in concrete is increasing. Thus, finding solutions from bio-sourced synthons is of interest and a solution starting from vanillin will be described1 to obtain a biobased superplasticizer with an interesting adsorption efficiency.

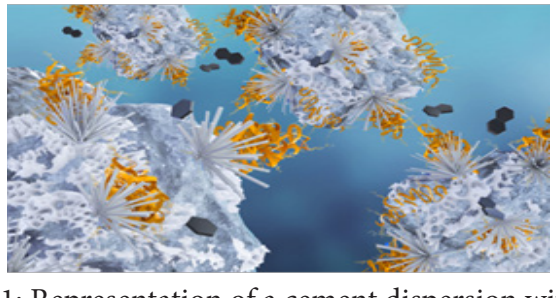

Figure 1: Representation of a cement dispersion with PCE

Keywords: Superplasticizer; Concrete; Vanillin; ADMET.

Biography:

Breilly D et al. ACS Sustainable Chem. Eng. 2024, 12, 10701−10712

Biodegradable Poly caprolactone for Cartilage Repair and Drug Delivery Applications

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Abstract

Polycaprolactone (PCL) is a biodegradable synthetic polymer that has been extensively studied in the field of biomedical engineering due to its slow degradation rate, good formability, and non-toxicity. Professor Ming-Fa Hsieh's team has been long dedicated to the development and application of PCL and its derivatives, particularly achieving significant outcomes in cartilage repair and drug delivery.

Professor Hsieh's team has utilized PCL as a scaffold material, combined with other bioactive substances, aiming to promote the regeneration and repair of cartilage tissue. They developed a PCL/hydroxyapatite (HA) composite scaffold and integrated it with a biphasic scaffold formed by a glycidyl methacrylate-modified hyaluronic acid (GMHA) hydrogel loaded with transforming growth factor-β1 (TGF-β1). This scaffold was implanted into osteochondral defects in minipigs. Histological analysis one year later showed good regeneration of both cartilage and subchondral bone in the experimental group. The morphology of the newly formed cartilage was closer to hyaline cartilage, and a tidemark appeared between the cartilage and subchondral bone, indicating that this biphasic scaffold can effectively promote the repair of osteochondral defects. Furthermore, the team explored the application of xenogeneic platelet lysate (PL) in cartilage repair. One study developed porcine platelet lysates depleted of antigens such as blood cells and complement and injected them into rabbit knee joints. The results showed that porcine platelet lysate did not cause a significant inflammatory reaction in rabbit knee joints and could effectively inhibit the formation of cartilage arthritis.

In the field of drug delivery, they synthesized a folic acid-modified star-shaped poly(ethylene glycol)-poly(ε-caprolactone) copolymer. It encapsulated the anticancer drug Doxorubicin within it. In vitro experiments demonstrated that this nanostructure had high drug-loading efficiency and exhibited time-dependent uptake in human breast cancer cells (MCF-7). Notably, in drug-resistant cell lines (MCF-7/adr), the folic acid-modified nanostructure significantly enhanced drug uptake. Another direction involves utilizing PCL to prepare transdermal drug delivery systems. The team developed a methoxy poly(ethylene glycol)-poly(ε-caprolactone)-graft-2-hydroxyethyl cellulose porous membrane to enhance the skin permeation of catechins. In vivo pharmacokinetic studies confirmed that catechins delivered transdermally via this membrane exhibited higher bioavailability compared to oral administration, without significant skin irritation.

In summary, Professor Ming-Fa Hsieh's team has conducted in-depth research on applying biodegradable polycaprolactone in cartilage repair and drug delivery over the past decade. These research findings provide a solid foundation for developing more effective and safer cartilage repair and drug delivery strategies.

Keywords: Polycaprolactone; hydroxyapatite; hyaluronic acid; poly(ethylene glycol).

Biography:

Dr. Ming-Fa Hsieh obtained his PhD in Materials Science and Engineering from National Tsing Hua University Taiwan in 2001. Since then, more than 80 peer-reviewed papers and three book chapters have been published, and seven patents were granted to him. Dr. Hsieh's main research is focused on biomedical polymeric materials. Specifically, the research themes include the nano-size drug carrier, additive manufactured orthopedic biomaterials and the microfluidics for drug screening. He was awarded 2nd Asia-Pacific Working Group Traveling Fellowship of the International Federation for Medical and Biological Engineering (IFMBE) in 2009 and then jointed Young Professionals and Career Development Working Group of IFMBE from 2009 to 2012. He is currently a professor of Biomedical Engineering, College of Engineering at CYCU.

Biopolymers Extracted from Food Waste for Packaging

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Abstract

Starch is the subject of many investigations due to their beneficial properties and the availability of some functional properties. In this instance, the main objectif of this work is to achieve two primary goals.

The first one is to use plant-derived waste by extracting starch from potato skins. To compare it with the starch extracted from potato, study the chemical composition of the two starches and determine the content of amylose and amylopectin because each of these compounds is relative to the final function and thus plays a decisive role.The structure and properties of the two powder resulting were fully characterized by Fourier transform infrared spectroscopy (ATR-FTIR), X-ray diffraction analysis (XRD) , and Thermogravimetric Analysis.

The second purpose is therefore the development of the food packaging from these two starchs using glycerol as a plasticizer at the ratio of 30% (w/w, starch basis) using a solution casting technique. The developed films were analyzed in terms of environmental and barrier properties.Their antibacterial properties were compared as well. The findings of this research provide insights that are very interesting in extracting starch from potatoes and also into the development of bio-degradable food packaging.

Keywords: Food packaging, biopolymer, potato peel,chemical composition,antibacterial properties.

Biography:

Prof. Dalila Hammiche is a Class A Lecturer and specialist in polymer composites, focusing on sustainable materials, thermoplastic and bio-based composites, and natural fiber nanocomposites. With over 100 publications, three books, and six book chapters, she is also Editor-in-Chief of the Biopolymer Applications Journal and holds an international professorship at the International Telematic University Uninettuno, Italy

From Waste to Value: Environmental and Economic Assessment of Biodegradable Shoe Shapers from Olive Pits

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Abstract

On the Mediterranean coast, the olive industry generates millions of tonnes of waste annually, primarily from olive pits. Due to their hardness, these residues are well-suited as reinforcement in composite polymeric materials, transforming waste into valuable resources. The Olive Pit project aims to use olive pits to produce biodegradable shoe shapers, offering an alternative to traditional fossil- derived shoe forms that lack organic valorisation. By achieving bio-compostability, the project intends to close the shoe shapers' life cycle, repurposing them as fertilisers in olive production. Several formulations were developed in this project with different contents of olive pit, Polylactic Acid (PLA) and additives.

This preliminary study uses prospective Environmental Life Cycle Costing (eLCC) to evaluate and compare the environmental and economic impacts of project-developed formulations for shoe shapers production with two base line market options: acrylonitrilebutadienestyrene (ABS)and polypropylene (PP). The eLCC analysis encompassed both internal costs, referring to the direct costs associated with the production process of the shoe shapers, and external costs, representing the environmental impacts. The environmental impacts were assessed using the social costs of environmental emissions derived from the Life Cycle Assessment (LCA), and were evaluated using the ReCiPe Midpoint Hierarchist perspective method (v 1.09). The external costs were quantified using the conversion factors from CE Delft Environmental Prices Handbook 2024, which monetised the environmental impacts. LCA and eLCC methodologies were performed according to ISO14040-44 standards. The declared unit was the production of the raw material needed to produce one pair of shoe shapers, with a cradle-to-gate approach. The impact assessment was performed using Sima Pro software (v 9.6.0.1), with primary data provided by PIEP and Safiplás, and secondary data from the Ecoinvent database (v 3.10).

Initially, virgin PLA formulations were tested to create a sustainable shoe shaper, but high environmental impacts led to a shift towards recycled PLA. This alternative, however, lacked the necessary rheological properties, so various additives and incorporation levels were tested, ultimately resulting in an optimal formulation that balanced environmental benefits with technical performance.

The eLCC results (Table 1) indicate that formulations incorporating olive pits (Formulations 4 to 9) present lower total costs compared to baseline options (Formulations 1 and 2). Additionally, these formulations present lower percentages of external costs, around10%.Although virgin PLA

(Formulation 3) offered favourable structural properties, it exhibited the highest total cost and the greatest environmental impact among the formulations.

In conclusion, this preliminary study highlights the environmental and economic benefits of using recycled materials and olive pit residues in polymer composites for biodegradable shoe shapers, supporting the Olive Pit project's goal of converting agricultural waste into valuable resources. Further more, future work will focus on abroad erevaluation, considering the benefits of the end-of-life of the developed shoe forms.

Table1: eLCCresults

Formulation	Composition	Total cost(€)	Internal Cost(%)	External Cost(%)
1	100% ABS	0.23	63	37
2	100% PP	0.20	67	33
3	100% vPLA	0.27	64	35
4	68% rPLA + 25% OP + 7% ESBO	0.13	89	11
5	63% rPLA + 30% OP + 7% ESBO	0.12	90	12
6	65% rPLA+25%OP+3% Additive 1+7% ESBO	0.15	89	10
7	60% rPLA+30%OP+3% additive1+7% ESBO	0.14	90	10
8	66% rPLA+25%OP+2% Additive 2+7% ESBO	0.16	89	9
9	61% rPLA+30%OP+2% Additive 2+7% ESBO	0.15	90	10
*ABS-AcrylonitrileButadieneStyrene;PP-Polypropylene;vPLA-virginPolylacticAcid;rPLA-recycled Polylactic Acid; OP - Olive Pit; ESBO – Plasticiser.				

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Keywords: OlivePit;Biodegradability;Recycling;EnvironmentalLifeCycleCosting.

Biography:

Catarina Faria holds a degree in Environmental Engineering and began her career in an environmental analysis lab, where she quickly embraced new challenges. Starting with hands-on laboratory techniques, she soon expanded her role to include training and auditing, which enhancedher resilience and multitasking abilities. Currently, Catarina works as a project manager at PIEP – Centre for Innovation in Polymer Engineering, specializing in LCA and LCC studies, particularly in product development within the plastics sector. Her work focuses on evaluating the environmental impacts of innovative products and providing training on sustainable practices in the Circular Economy. These experiences have deepened her expertise in environmental analysis and sustainability while strengthening her skills in communication, analytical thinking, and teamwork.

Operationalising an Integrated Holistic Impact Assessment to Accelerate Safe and Sustainable Design (SSbD) Acceptance in the Plastic Value Chain

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Abstract

Plastic pollution is a major threat to humanity, requiring urgent action. Polyvinyl Chloride (PVC), one of the most widely used plastics in long-life applications, poses significant environmental and health risks due to often containing plasticisers, such as phthalates, which can leach into the environment, causing potential harm to human health and ecosystems. Additionally, when burnt, PVC can release hazardous gases, including dioxins, which present acute and chronic health threats.

In this vein, the European ANALYST project aims to develop an integrated approach for a holistic health, environmental, social, and economic impact assessment that supports the transition towards safer and more sustainable industrial value chains (with a focus on the plastic sector) by influencing decision-making process and policymaking while also expanding the knowledge on the Safe and Sustainable by Design (SSbD). To do this, the integrated approach will be tested through three use cases across the PVC value chain, namely suspension-PVC (flexible), emulsion-PVC (flexible) and suspension-PVC (foamed rigid). In all use cases, the conventional PVC will be compared with bio-circular attribution PVC, a material derived from renewable feedstocks, that aligns with circular economy principles.

The SSbD approach will be used to evaluate the impacts of conventional, more sustainable and safer alternatives to PVC. SSbD consists of five steps that perform hazardous assessment and sustainability assessment to address four dimensions: health, environmental, economic, and social.

This project includes three key components: (i) developing a comprehensive impact assessment methodology for plastics, including PVC, (ii) creating an open platform featuring a digital decision-making tool to facilitate better sustainability practices, and (iii) implementing a validation program for PVC applications in key sectors like automotive and construction.

To ensure the success of the validation program, a roadmap plan will be developed. Stakeholders will first receive comprehensive guidelines to test the innovative integrated approach. Through specialised training, they will evaluate traditional materials within the SSbD framework. Following this, stakeholders will identify specific requirements they aim to assess to drive innovation. The process will then involve gathering feedback and insights to perform a thorough analysis of lessons learned, existing gaps, and associated risks. This analysis will play a crucial role in improving the

integrated approach and refining the SSbD framework while also offering actionable recommendations to ensure the framework's applicability extends beyond the project's lifespan. It is essential to highlight that this roadmap is iterative, requiring multiple revisions to shape the final vision effectively.

In the end, the ANALYST project represents a significant step forward in advancing an SSbD approach for the innovation process for chemicals and materials across the PVC value chain and the broader plastic sector. By promoting sustainable industrial practices and healthier ecosystems, the project sets a foundation for a more resilient and sustainable future.

The ANALYST project has received funding from the European Union's Horizon Europe Research and Innovation Programme under the Grant Agreement No 101138548.

Keywords: PVC (Polyvinyl Chloride); Bio-circular attributional PVC; Circular Economy; Sustainable decisions

Biography:

Inês Costa holds a master's degree in Environmental Engineering from the University of Porto (Portugal). Currently, she is a Principal Researcher at PIEP – Centre for Innovation in Polymer Engineering, where she focuses on Life Cycle Assessment (LCA), Life Cycle Costing (LCC), and Carbon Footprint studies, among other topics. Her work primarily revolves around evaluating the environmental, economic, and social impacts of materials and processes, with a special emphasis on the plastic sector. She aims to support the transition towards more sustainable practices and circular economy models by identifying and promoting solutions that can reduce the environmental footprint of industrial activities. She brings strong skills in teamwork, organisation, and a continuous drive for learning and innovation to all her projects. These capabilities allow her to collaborate effectively with cross-disciplinary teams, ensuring the successful execution of complex research tasks. In addition to her work as a researcher, she is also a certified trainer in environmental education and outreach, where she focuses on sharing her knowledge and expertise to guide others towards adopting more sustainable practices in their own industries and daily lives.

Influence of Amorphous PHA on the Crystallization Behaviour and Rheological Properties of Semi-Crystalline PHA Blends: Key Insights for Foaming Potential

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Abstract

Conventional plastics pose issues not only due to their fossil origins but also because of their non- degradability, leading to severe waste management concerns. A logical solution to these problems is the development of eco-friendly materials such as bio-based and biodegradable polymers.

Polyhydroxyalkanoates (PHAs) are a promising class of materials that fulfil these criteria. Among their potential applications, packaging stands out, particularly due to their excellent oxygen barrier properties. However, while foam packaging is growing, research on PHA foams remains limited. In foaming, crystallization and rheological properties are key influencing factors. A deep understanding of the material properties is necessary to assess a polymer's foaming potential. This project aims to blend two types of PHA: a semi-crystalline poly (3-hydroxybutyrate-co-3- hydroxyvalerate) and an amorphous poly(3-hydroxybutyrate-co-4-hydroxybutyrate) (P3,4HB). By blending both PHAs, crystallinity, melt strength, and viscosity can be adjusted depending on the blend ratio. The morphology, crystallization behaviour, and rheological properties of the blends are investigated as they are crucial in investigating foaming behaviour.

PHA blends were compounded using a twin-screw extruder. Blend morphologies were analysed by transmission electron microscopy (TEM). To understand the influence of the amorphous component on PHBV crystal formation and stability as well as evaluating the changes in crystallinity, differential scanning calorimetry (DSC), polarized optical microscopy (POM) and Fourier-transform infrared spectroscopy (FTIR) were used. Shear viscosity was measured using a plate-plate rheometer, while melt strength was evaluated with a Rheotens device.

The results indicate that PHBV/P3,4HB blends are immiscible in melt blending as co-continuous phases were shown on TEM for the 50/50 blend. Despite their immiscibility, adding the amorphous component enhance heterogeneous nucleation in the semi crystalline phase resulting in more stable PHBV crystals while reducing the overall crystallinity of the blend system. The combination of FTIR and DSC with POM provided insights into how the P3,4HB influenced the overall crystalline structure of PHBV. Relative crystallinity went from 57% for neat PHBV to 33% for the 50/50 blend following the rules of mixture for the other blends. Additionally, blends with higher melt strength values compared to pure PHBV were obtained, and the increase of the shear viscosity was highlighted. The zero-shear viscosity was increased from 121 Pa.s for pure PHBV to 624 Pa.s for the 50/50 blend. By combining the results from the crystallization and rheological behaviour, promising compositions were defined for further foaming tests.

Keywords: Polyhydroxyalkanoate immiscible blends; Crystallization behaviour; Rheology; Phase morphology.

Biography:

M.Sc.-Ing Malvina Boutigny has been working as a research assistant at the Department of Polymer Engineering in the Polymer Foams Division since October 2023. Her scientific work is focused on the foaming behaviour of modified PHB(V) by using digital methods to predict the process parameters and the foam properties.

From 2020 to 2023, she studied Material and Sustainable Development at ESIREM Engineering School in Dijon(France). During those three years, she did a first internship at the Institute of Polymer Technology (LKT) in Erlangen and focused on the thermoforming of recycled polypropylene. She did a second internship focusing on the elaboration of biobased chitosan resins for micro-electronic applications, at the Institute of polymer materials (IMP) in Lyon (France). During the last year of engineering degree, she studied control and durability of materials in order to complete a master´s degree at the University of Burgundy (France).

Development of Beta-Cyclodextrin based MOFs for Volatile Molecule Stabilisation and Delivery

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Abstract

The use of volatile molecules such as essential oils in various sectors such as pharmaceuticals and packaging is often constrained because of their lower stability in environmental conditions. To increase the functionality of essential oils, Metal-Organic-Frameworks can be used as a material for their encapsulation and delivery at the required site. Though the usage of MOFs also possess some disadvantages due to the presence of different metals and ligands which are cytotoxic in nature. In our study, we have developed MOFs using Beta cyclodextrins which are proved to biocompatible and are considered GRAS by FDA.. The work performed involves stabilization of Eugenol (a volatile compound) by BCD-MOFs, the development of which was performed through the Vapour Diffusion technique using Potassium ions as linkers (Potassium ion is biocompatible). This was followed by different characterization techniques such as FT-IR, SEM, TGA and XRD. The incorporation of Eugenol was performed through Vapour diffusion and the presence of Eugenol inside MOFs was confirmed through TGA, NMR, and UV-Visible. The results obtained from SEM showed the formation of highly crystalline and porous cyclodextrin MOFs having cuboidal shape. The crystallinity of the MOFs was confirmed through XRD. TGA analysis indicated the higher degradation temperature of cyclodextrin MOFs. The NMR results also showed the presence of Eugenol. The UV-Vis results showed the adsorption as well as the release behaviour of Eugenol. Eugenol was solubilised in Ethanol to make a stock solution and different quantities of K-BCD-MOF's were suspended in it. The absorbance was checked after 24, 48, 72 and 96hrs respectively. The absorbance was found to be decreasing with the increasing concentration of MOF's indicating that more and more Eugenol is being encapsulated in the cavity of MOF's. Also, there was no substantial change in the absorbance with time indicating the saturation of most of the cavities within 24 hours as well as inferring to the stability of eugenol inside the cavity after encapsulation. The FT-IR showed no peaks of eugenol indicating that the eugenol was completely encapsulated in the cavities and was not just present on the surface.

Keywords: Cyclodextrins; Metal Organic Frameworks; Eugenol; Encapsulation

Biography:

I am from India & currently pursuing my doctorate under the supervision of Professor Manuel Jose Lis Arias at Universitat Politécnica de Catalunya. I have a background in Polymer science and love to work in the packaging domain. Currently, I am trying to develop functional packaging with cyclodextrin for different applications in food sector. Apart from the main aim of my PhD, I am also focusing on understanding the properties of cyclodextrins in different conditions and systems. Previously I have worked in different projects related to bio-packaging during my graduation and post-graduation. I have also worked in a Project on Waste water remediation at Indian Institute of Technology-Delhi (INDIA). With strong hands on experience in various characterizations, testing, processing techniques and my interest in research domain, I am moving in the direction of my dream to be a professor

Innovative Applications of Injectable Hyaluronic Acid Hydrogels in Orthopedics

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Abstract

Degenerative joint and spinal disorders are major causes of pain and disability, significantly influencing patients' quality of life. Conditions such as intervertebral disc (IVD) degeneration and cartilage defects are prevalent in both aging and active populations, yet current treatment options are often invasive, limited in efficacy, or unsuitable for early-stage disease. There is a growing clinical need for minimally invasive, regenerative strategies that not only provide mechanical support but also promote tissue regeneration.

Hyaluronic acid (HA), a naturally occurring glycosaminoglycan with excellent biocompatibility and viscoelastic properties, has been a common injectable hydrogel for orthopedic applications. Here, we introduce two novel applications of HA-based injectable hydrogels for tissue repair. The first application involves an in situ-forming, HA hydrogel for IVD regeneration. The hydrogel gels within 3 minutes at body temperature, possesses appropriate visco elasticity, and has good compatibility with cells. Furthermore, the results also show that it promoted the expression of COL2A1 and ACAN mRNA, suggesting its potential as a hydrogel for early disc repair.

The second approach utilizes the same HA hydrogel system, modified by incorporating acellularized porcine cartilage extracellular matrix (ACM) for the treatment of cartilage defects. The addition of ACM could enhance chondrogenesis, cellular recruitment, and tissue integration. In vitro studies demonstrated that this composite hydrogel upregulated SOX9 and COL2A1 mRNA expression in mesenchymal stem cells (MSCs), indicating its potential to support cartilage-specific differentiation.

Taken together, HA-based hydrogels demonstrate excellent injectability, cell compatibility, and bioactivity, making them promising candidates for orthopedic tissue regeneration. They may offer a strong potential to replace or support traditional surgeries via personalized, minimally invasive approaches.

Keywords: injectable hydrogels; hyaluronic acid; intervertebral disc; cartilage defects

Biography:

Dr. Yu-Chun Chen is an Assistant Professor at the Department of Chemical Engineering, National United University, Miaoli County, Taiwan. Her research focuses on hydrogel development, tissue regeneration, and stem cell applications. Dr. Chen received her Ph.D. fromthe Institute of Biomedical Engineeringat National Taiwan University, where she focus on developing injectable hyaluronic acid hydrogels for intervertebral disc regeneration. She then worked for seven years

as a researcher in the Department of Orthopedics at Far Eastern Memorial Hospital, focusing on cartilage repair and regeneration. She later served as an Assistant Professor at National United University. In recent years, Dr. Chen's research covers the field of orthopedics, vitreous substitutes and conductive biomaterials for skin repair. Additionally, she serves as a Laboratory Safety and Health Supervisor at National United University. She is also dedicated to mentoring students, providing them with in-depth knowledge of anti-inflammation and their biomedical applications. She would like to linking basic research with clinical applications.

Home Compostability of Thermoplastic Biocomposites under Laboratory Conditions: Multiscale Characterization and Bioaugmentation Strategy to Increase Biodegradability

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Abstract

Biodegradable plastics offer a solution to the accumulation of plastics in ecosystems by degrading within a reasonable timeframe under specific conditions. However, their end-of-life management affects the overall environmental balance. Home composting is a practical way to dispose of biodegradable plastic waste, as it is both logistically simple and promotes environmental awareness. However, its lower biodegradative capacity compared to industrial composting limits its application. Enhancing the biodegradability of these plastics under home composting conditions remains a key research focus for improving this waste management approach.

Thermoplastic biocomposites based on biodegradable polyesters (PLA, PBS, PBAT) and lignocellulosic fillers from agro-industrial waste (i.e., orange peel, brewery grains) were fabricated and characterized. Their home-compostability and the phytotoxicity of the resulting compost were evaluated via an ultimate aerobic biodegradation test, following the French standard [NF T51-800]. A selective isolation method on a minimal medium identified bacterial strains capable of degrading the composites. Some were then inoculated onto vermiculite activated by a compost extract for a second biodegradability test. A carbon balance, including mineralized carbon and microbial biomass, was assessed using an indirect quantification approach to study its distribution.

The biocomposites were successfully fabricated and characterized, displaying contrasting mechanical and thermal properties as well as differences in water vapor sorption behaviour. These variations reflect differences in matrix-filler interactions. The incorporation of an organic filler enhanced their home-compostability under laboratory conditions, primarily by increasing the specific surface area of the biocomposites due to fragmentation, which resulted from the loss of mechanical cohesion. The resulting compost exhibited no significant phytotoxicity. The combination of two bacterial strains that isolated in the first stage led to an almost twofold increase in the mineralization rate of PBS alone during the second biodegradability test.

Keywords: Home-composting, Biocomposites, Biodegradable Thermoplastics, Agro-industrial Wastes, Bioaugmentation

Biography:

Jules Bellon is a Ph.D. candidate at the University of Rouen Normandie (France). His research, conducted at the Institut Polytechnique UniLaSalle, focuses on the biodegradation of biobased biodegradable plastics, particularly in the context of domestic composting and the development of this sector. Trained as an agronomy engineer, he holds both a bachelor's and a master's degree in life sciences. Initially drawn to plant sciences, he explored the impact of water stress on root development in seed legumes during his final-year internship at INRAE's Agroecology UMR in Dijon (France). With a naturally inquisitive mind and a strong awareness of the multidisciplinary nature of environmental challenges, he chose to fully commit to the BioDPlast project, contributing to the development of sustainable solutions for the future.

Beyond the Surface: How Degradation Transforms Microplastic-Soil-Plant Interactions

Helen Gordillo

Abstract

Photodegradation alters the effects of microplastics (MPs) on soil and plants depending on their shape and polymer type. In our study, UV-degraded fibres and foams increased soil respiration and plant biomass, while degraded foams reduced soil aggregation. Films showed minimal effects after degradation, likely due to their resistant polymer structure and additives.

Biography:

Ms. Helen Gordillo Rocha is a biologist from Lima, Peru, with a deep passion for environmental science, soil ecosystems, and plant–microbe interactions. She completed her Master's degree in Biology at the Freie Universität Berlin, where she focused on the impact of microplastics on soil health and plant performance. Her academic journey led her to investigate the effects of pristine and UV-degraded microplastics on fungal communities and Daucus carota (carrot) growth, resulting in a co-authored publication in the Journal of Applied Ecology. The research group involved is the AG Rillig at the FU Berlin. Beyond the lab bench, Helen has explored a broad spectrum of life science fields including instrumental analysis, parasitology, microbiology, clinical chemistry, serology, and hematology. At the BAM in Berlin, she supported projects in molecular biology and zoology, particularly focusing on termite and cockroach behavior through RNA extraction and dissecting microscopy techniques. Her interdisciplinary experiences and collaborative spirit reflect a dynamic, curious mind—equally at home discussing polymer degradation as she is digging into the complexities of fungal networks in soil. Helen brings to the conference a grounded, friendly energy and a commitment to advancing our understanding of plastic polymers in ecological contexts.

Polyhydroxyalkanoate Copolymer Production from Brewery Wastewater via Mixed Microbial Cultures

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Abstract

Polyhydroxyalkanoates (PHAs) are biodegradable polyesters produced by microorganisms for intracellular carbon and energy storage. Polyhydroxybutyrate (PHB) is the most widely studied PHA, since it is similar to standard polymers like polypropylene. However, PHB's brittleness limits its practical use. To address this limitation, the copolymer poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) was developed, which offersenhanced flexibility and toughness, making it more suitablefor a wide range of industrial applications such as packaging materials, medical implants, and agricultural films. Despite these advantages, current PHBV production systems commonly rely on pure bacterial cultures and expensive carbon sources such as glucose or sucrose, which significantly hinder their economic feasibility and large-scale deployment. To address this issue, this study proposesa sustainable and cost-effective method for producing PHBV utilizing enriched mixed microbial cultures (MMC). In this method, brewery wastewater serves as the sole carbon source, offering thedual benefits of waste valorization and reduced production costs. Initially, the MMC was enriched under aerobic conditions to selectively promote the growth of PHA-accumulating bacteria. This pre-enrichment procedure enhancedthe microbial community's ability to accumulate intracellular PHAs. Following enrichment, the culture underwentalternating feast and famine periods. During the feast phase, all essential nutrients, including organic carbon, were provided to promote active microbial growth and PHA formation. In contrast, famine periods involved reduced nitrogen availability, creating nutritional stress conditions that promoted PHA synthesis and intracellular storage. The isolated biopolymers were characterized using analytical techniques such as UV-visible spectroscopy, Fourier Transform Infrared Spectroscopy (FT-IR), and cell dry weight. These analyses enabledthe qualification of polymer yield, identifiedfunctional groups, and evaluatedoverall production efficiency. The data revealed considerable PHBV accumulation, with compositional differences regulated by varyingnitrogen ratios during different famine stages. Notably, the use of propionic acid as a precursor during specific stages promoted the incorporation of hydroxyvalerate units. These findings demonstratethat combining waste valorization with microbial biotechnology can yield high-value bioplastics. The technique promotes circular bioeconomy principles, reduces environmental impact, and offers a viable path to industrial-scale PHBV synthesis using low-cost substrates and robust microbial consortia.

Keywords: PHBV; Brewery wastewater; Mixed microbial cultures; Biodegradable polymer

Biography:

Jeyran Ghased is a Master's student in the Department of Environmental Engineering at Seoul National University of Science and Technology (SeoulTech), South Korea. She is currently conducting research under the supervision of Professor Hyun-Suk Oh in the Biological & Membrane Water Treatment Laboratory, which focuses on developing sustainable and carbon-neutral solutions for wastewater treatment. Her research centers on utilizing mixed microbial cultures and industrial waste streams, such as brewery wastewater, for the eco-friendly production of polyhydroxyalkanoates (PHAs), particularly the copolymer PHBV. By implementing feast-famine regimes and nutrient modulation, her work aims to enhance biopolymer yield while promotingwaste valorization. Jeyran is passionate about advancing circular economy approaches through innovative microbial technologies and sustainable bioprocessing solutions.