International Conference

PolyChar World Forum on Advanced Materials

31st edition

Program | Book of Abstracts

UMONS – University of Mons
Mons | Belgium | September 10 - 12, 2025
https://web.umons.ac.be/en/agenda-events/polychar31/

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UMONS
UMONS extension

Edited by

Rosica MINCHEVA

Jean-Marie RAQUEZ

Cover by

Rosica MINCHEVA

Dear PolyChar'31 attendants

It is our pleasure to invite you to attend the 31st edition of PolyChar World Forum on Advanced Materials (PolyChar'31) organized between 10 and 12 September 2025 at the University of Mons (UMONS) in Mons (Belgium).

Created by Witold Brostow, Michael Hess and Kevin P. Menard and first organized in 1992 at the University of North Texas, Denton (TX) (U.S.A.), PolyChar is focused on giving researchers from academia and industry the opportunity to present their work to a large international audience, to meet prominent scientists, and to attend tutorials held by worldwide recognized experts.

From Denton, the conference proceeded to different parts of the world: Portugal (2004), Singapore (2005), Japan (2006), Brazil (2007), India (2008), France (2009), Germany (2010), Nepal (2011), Croatia (2012), South Korea (2013), South Africa (2014), USA (2015), Poland (2016), Malaysia (2017), Georgia (2018), Italy (2019), Armenia (2022), France (2023), Romania (2024).

Initially focused on polymer characterization, hence the name PolyChar, the conference subsequently included hot areas covering all materials of all classes: Concrete; Metals; Alloys; Modelling; Nanomaterials and Smart Materials; Natural and Biodegradable Polymers, Recycling and Sustainability; Polymer Synthesis; Polymers for Energy; Rheology, Solutions and Processing; Mechanical Properties and Processing; Characterization and Structure-Property Relationships; Biomaterials and Tissue Engineering; Dielectric and Electrical Properties; Surfaces, Interfaces and Tribology; Predictive Methods.

By tradition, PolyChar'31 will include a one-day lecture session dedicated to younger participants and a two-day scientific meeting following a broad range of topics.

This meeting could not have been organized without the generous and tireless support and contribution of many individuals and groups within and outside the UMONS. Therefore, we would like to acknowledge all the invited lecturers, speakers, board and committee members, chairpersons, sponsors and all the people that have been involved in the organization and presentation of relevant results and perspectives.

Best wishes for a professionally rewarding conference!

Rosica MINCHEVA, Fanny LALLEMAND, Nathalie VANDEREST and Jean-Marie RAQUEZ

Hosting PolyChar'31

Hosting of PolyChar'31

Rosica MINCHEVA, Fanny LALLEMAND, Nathalie VANDEREST and Jean-Marie RAQUEZ

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- Fanny LALLEMAND

Awards and Prices

Carl Klason Student Award for young scientists

Bruce Hartmann Prize for young scientists

Svante Arrhenius International Materials Research Prize for senior scientists and engineers

Paul J. Flory International Materials Research Prize for senior scientists and engineers

PolyChar'31 Venue

The Conference is held in the 020 room of the Vesale building (⑦ UMONS at the Campus Plaine de Nimy

Address: Avenue de Champs de Mars 7000 Mons (GPS : 50°27'43.9"N and 3°57'11.7"E)

Accessibility from the Gare de Mons:

1.3 km (20 – 25 minutes) walking distance

3.9 km (5 minutes) driving distance

15 minutes buss drive (buss numbers 14 – every 120 min - or 22 + 7 – every 20 min)

To access the Gare de Mons please take direct train from:

→ Brussels Airport-Zaventem (1 h & 15 min, direction Lille-Tournay, SNCB official website - Buy your train tickets online)

→ Brussels Airport-Zaventem (35 min, direction Lille-Tournay, Charleroi Sud to Mons train tickets from €6.92 | Rail Europe)

POLY CHAR'31

– UMONS –

The University of Human Dimensions

University of Mons – UMONS – The University of Human Dimensions

About the University of Mons

The University of Mons, abbreviated to "UMONS", is a French-speaking university in the province of Hainaut, Belgium, near the French-Belgian border. It is approximately 50 kilometres from Brussels, the capital of Europe.

UMONS was created in 2009 following a merger between the University of Mons-Hainaut and the Faculty of Engineering of Mons, the university's oldest faculty, founded in 1837.

UMONS is one of five academic centers set up in the Wallonia-Brussels Federation as part of the restructuring of higher education, and is one of the founding members of the **Pôle hainuyer**. It assumes the co-presidency of this cluster, which groups together 3 universities, 3 hautes écoles, 3 graduate art schools and 26 continuing education institutions, and offers nearly 600 courses in 21 fields of education to more than 30,000 students in the province of Hainaut.

Education

UMONS has around 100 different degree programs on offer at Bachelor, Master and PhD level in fields as diverse as Law, Psychology, Social Sciences, Biomedical Science, Economics, Electrical Engineering, Management, Material Sciences, Mechanical Engineering, Urban Planning, Computer Science, Architecture, Interpretation, Linguistics, Physics, Speech Therapy, Mathematics, Chemistry, Pharmacy, Translation, Education, Biology, Geology, Medicine, and many more.

- Students are the Main Priority

Accommodating students in a learning environment characterised by a human dimension is a priority of UMONS. Through the education on offer at UMONS, we promote critical thinking, open-mindedness, tolerance, responsibility, and autonomy, and develop students' and researchers' intellectual, cultural and human experiences in order for them to become responsible members of society.

- A Wide Support Network to Ensure Student Success

Assisting new students in making the smoothest of transitions from secondary education to university is also a priority. For improved student success, UMONS offers remediation activities, tutoring, mentoring, improvement of working methods, and mock exams.
New IT is incorporated into the education service, such as online courses and distance learning. E-learning also offers many innovative and effective teaching solutions for students, for example self-assessment and video streaming.

- From Undergraduate Studies to a PhD

The university offers three levels of education: Bachelor, Master and PhD. Classes mainly take place during the day, but evening classes are also held at the Charleroi campus.
As a pioneer in the field of further education in evening classes, UMONS has welcomed adults returning to education for nearly 30 years, thus contributing to the improvement and development of their professional careers.

Several types of educational training are offered:

1. Degree programmes: official and recognised degrees (Bachelor, Master, Specialised Master)
2. Certified programmes: (a minimum of 8 credits) leading to a university certificate
3. Short courses (day courses, half day courses or evening courses)
4. Courses leading to a teaching qualification: several teaching qualifications for higher education
5. Foreign language courses
6. Research-focused courses.

A constant concern of UMONS is to be able to provide appropriate courses, which reflect current challenges and which are closely linked to research. The university guarantees the education of young and mature students by upholding scientific and academic teaching through programmes rooted in the human and societal difficulties of the 21st century.

- Education in the Province of Hainaut

As part of its Quality Charter, UMONS works towards developing quality education in its home province of Hainaut. The skills conveyed to students are aimed at promoting the economic and social restructuring of the local community.

Research

Scientific research is now one of the pillars which our society depends on to meet the social and economic challenges facing it, in order to improve the quality of life and to alleviate threats to the environment while allowing our economies to remain competitive.

With more than 900 researchers, research objectives in UMONS are pursued both regionally and internationally. The common goal of all UMONS researchers is to develop expertise on a large scale, subsequently benefiting society, particularly the region.

The expertise of the University's researchers is internationally recognised. To demonstrate this, three researchers from the chemistry and materials domains have been acknowledged and classified among the Top 100 Global Researchers who have been most influential in their disciplines over the last decade, on account of their publications (classified by the Thomas-Reuter Agency for 2001-2010). UMONS also holds the European label for “Research in Excellence”.

Through its research and close links with industry, UMONS is also actively involved in regional development. It maintains close links with scientific research centres, as well as university spin-off and start-up companies, the majority of which are located on the outskirts of the town centre.

Since 2012, the University of Mons has restructured its research activities via 10 research institutes, accounting for approximately 100 researchers.

As such, the University is able to consolidate the excellence of its basic research by encouraging collaborations between its crossdisciplinary research teams from its various faculties.

UMONS also pays particular attention to knowledge transfer in order to serve society by striving to maintain the close relationships with its socio-economic environment in a number of areas in which it excels.

The Department for Research Support and Technology Transfer (AVRE) of UMONS supports researchers in their missions, both in the preparation phase (setting-up and financing) as well as in the final phase of their projects (intellectual property rights, partnership agreements, licensing agreements, and assisting the setting-up of university spin-off companies). AVRE also offers its services to companies in need of particular scientific expertise.

Services to Society

Since its creation, through its research and close ties it has forged with industry, the University of Mons is the perfect partner for the re-development and economic recovery of the region.

Its research centres, plus Multitel, Materia Nova and the Belgian Ceramic Research Centre, which belong to the university, as well as the University's spin-off and start-up companies, are mostly located in the Initialis Science Park on the outskirts of Mons.

These include:

- The European Group, Acapela (speech technology)
- Polymedis (medical technology)
- ACIC (intelligent vision systems)

- Decizium (intelligent decision support)
- IT-Optics (free software)
- Smartware (smart clothes)
- Biosentech (biosensors)
- EuroVlab (multimedia learning environment for the dissemination of science)
- Madagascar Holothurie (research on sea cucumbers from Madagascar)
- Polyris (consulting company in the field of major accidents assessment, prevention and management)

The geographical proximity between these centres and the University, as well as the small size of these enterprises, allows many valuable exchanges.

In late 2011, UMONS and ULB set up a medical imaging centre located in the Gosselies Aeropole, on the outskirts of Charleroi.

Services to society provided by UMONS also cover a wide range of concrete actions through studies, which aim to, for example, forecast floods in the Haine Basin and underground and karstic collapsing; find iguanodon skeletons buried in Bernissart, carry out energy audits of buildings, or foresee the SEVESO safety measures in high-risk companies.

In addition, UMONS actively participates in touristic and cultural development of the region, through activities coordinated by the non-profitable organisation, Extension UMONS, which organises prestigious conferences, language courses and specific training sessions for outsiders. Other organisations, such as Carré des Sciences and ApplicaSciences, as well as Espace Terre et Matériaux, undertake actions of popular science suited to a large young audience.

UMONS was one of the official partners of MONS 2015. Several projects carried by its community have benefited from the official label and financial support.

As a pioneer in the field of further education in evening classes, UMONS has welcomed adults returning to education for nearly 40 years, thus contributing to the improvement and development of their professional careers.

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A Message from the Rector

A Message from the Rector

The University of Mons (UMONS) was created by the association of the Faculty of Engineering and the University of Mons-Hainaut in 2009. As such, while the current UMONS structure is relatively new, it has inherited all the achievements of all its individual faculties and looks back on a collective historical tradition in the region of Hainaut of last 170 years.

It offers about **a hundred degree programmes**, from Bachelor to PhD, at its **ten faculties and schools**: the Faculty of Architecture and Urban Planning, the Faculty of Medicine and Pharmacy, the Faculty of Engineering, the Faculty of Psychology and Education, the Faculty of Science, the Faculty of Translation and Interpretation, the Warocqué School of Business and Economics, the School of Human and Social Sciences, and, in collaboration with ULB, the Law School and Teacher training School.

The University of Mons strives to:

- **Give students quality education**: special attention is paid to the standard of teaching in our university, which prides itself on having instructors who are supportive of, and available to, their students
- **Prepare students for their future professional life all the while encouraging their intellectual, cultural and human development**: beyond the mere course content, UMONS offers intensive training in reflection, critique, argumentation, and the active search for information. This provides our students with the skills essential for responsible citizens who will be the true actors of tomorrow's society
- **Enrich teaching through high quality research**: universities must be able to count on instructor-researchers who enhance their teaching with results of large-scale research carried out within national and international networks
- **Contribute to the cultural and economic life of the region**: built on a basis constituted by education and research, the university makes the knowledge that it develops widely available to society. Strongly rooted in its setting, and sensitive to its needs, UMONS is eager to take part in the development of its region by meeting expectations from cultural, economic and social actors, as well as requests coming from companies and public or private organisations.

The UMONS buildings are spread throughout the **historical centre of Mons, which is the original campus of the university.**

The University's teaching activities mainly take place in Mons, however, **day and evening classes** are also held at the **Charleroi campus**. The courses offered in Charleroi are mainly in Computer Science, Psychology and Education, Management and Business Engineering.

The University of Mons is a founding partner of the ***Pôle hainuyer***, which brings together all the higher education institutions (universities, haute écoles, art colleges, and continuing education establishments) in the province of Hainaut.

UMONS is also strongly involved in scientific collaborations across the globe, hosts foreign students and researchers, and **supports the mobility of its students and its researchers**, particularly within European programmes, such as **Erasmus+**.

If, one day, you find yourself at the University of Mons, you will have the opportunity to discover the passion of its professors, scientists and administrative and technical staff, who all pursue their missions of research and education with determination and enthusiasm. They will ensure excellent working conditions while you acquire the key benefit of an UMONS education.

Philippe Dubois
Rector of UMONS


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BOOK of ABSTRACTS

CONTENT

BOOK of ABSTRACTS

POLY CHAR'31

CONFERENCE PROGRAM

CONFERENCE PROGRAM

* Day 1 (Wednesday, September 10, 2025)

8:30~9:00 **Registration**

9:00~9:10 **Opening remarks**: Prof Jean-Marie RAQUEZ, Prof Alice Mija & Prof Witold BROSTOW

SESSION 1: Chairperson - Jean-Marie RAQUEZ

COURSES 1-3

9:10~10:00	Prof Veronica AMBROGI	Integrating circular economy principles in polymeric material development

10:00~10:10 - Coffee break

10:10~11:00	Prof Antonella ESPOSITO	Advanced Thermal Analysis for Amorphous and Semicrystalline Polymers
11:00~11:50	Dr Paolo EDERA	Rheology of vitrimers: from the basics of characterization to microscopic insights

11:50~13:20 - Lunch break

SESSION 2: Chairperson - Antonella ESPOSITO

COURSES 4-7

13:20~14:10	Prof Cosimo CARFAGNA	Mechanical Recycling of multilayer flexible packaging: a virtous route towards environmental sustainability
14:10~15:00	Prof Kevin MENARD	Analytical Techniques for Recycling Polymers

15:00~15:30 - Coffee-break

15:30~16:20	Prof Witold BROSTOW	The viscoelasticity of polymers and composites
16:20~17:10	Dr Jeremy ODENT	Complexity for free using stereolithography

* Day 2 (Thursday, September 11, 2025)

SESSION 3: Chairperson - Paolo EDERA

PLENARY LECTURE 1

9:30~10:10	Prof Ke-Ke YANG	Fabrication of shape memory biomedical devices via an adaptable FDM-based 4D printing strategy

ORAL PRESENTATIONS

10:10~10:30	Yana SHYMBORSKA	'Smart' polymer sandwiches from hydrogel nanocoatings attached to stimuli-responsive grafted brush coatings: changing the cell behavior
10:30~10:50	Anastasiia CHEBOTAR	Development of plant oil-based polymer brushes with unexpected T- and pH-responsive properties

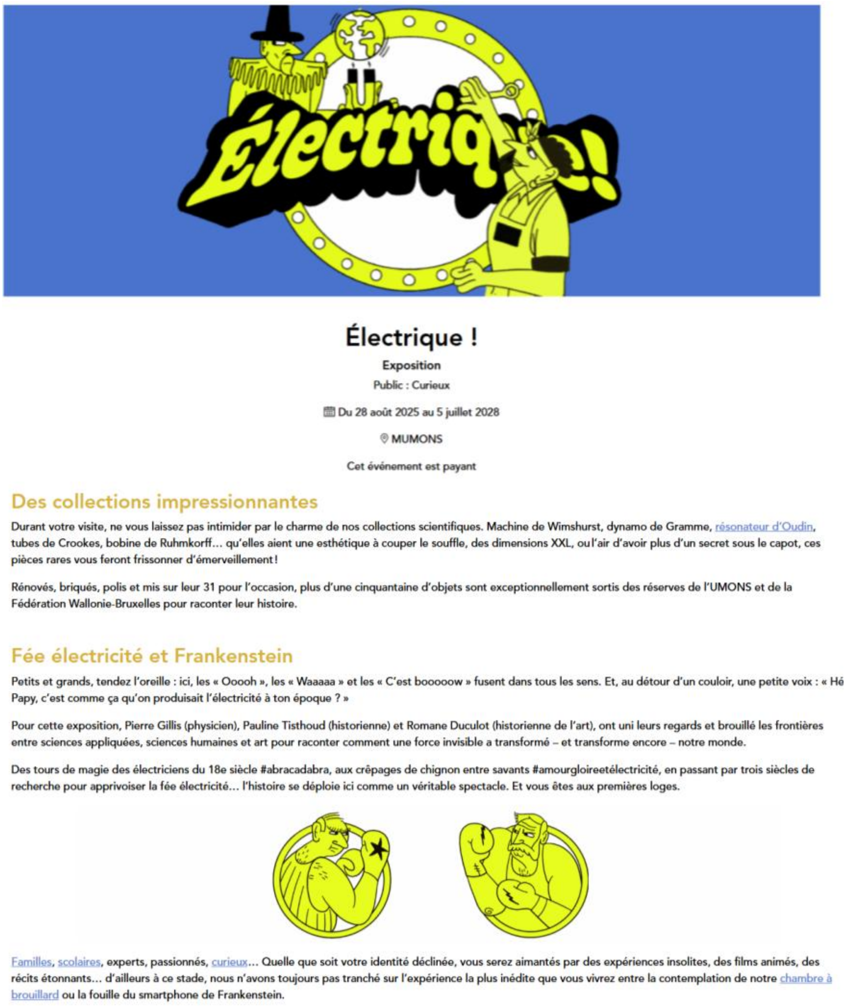
10:50~11:20 - Coffee break		
SESSION 4: Chairperson - Giada LO RE		
ORAL PRESENTATIONS		
11:20~11:40	Juan A. GUERRERO	Hydration-driven boost in piezoionic sensors
11:40~12:00	Angela MAROTTA	Kinetic study of the curing process in resorcinol-based epoxy/anhydride thermosets
12:00~12:20	Felipe GONCALVES	Electrically responsive starch films for controlled nitric oxide and ligand release
12:20~14:00 - Lunch break		
SESSION 5: Chairperson - Veronica AMBROGI		
PLENARY LECTURE 2		
14:00~14:40	Prof. Philippe LECLERE	Towards quantitative mapping of mechanical properties at the nanoscale of soft materials: When AI meets materials !
ORAL PRESENTATIONS		
14:40~15:00	Alma Lucia VILLELA ZUMAYA	Integrated COSMO-RS and Experimental Strategy for Developing Stable, 3D-Printed PLA-Based Methotrexate Formulations
15:00~15:20	Elizabeth Alvarez PEREZ	Synthesis of eco-friendly benzoxazine resin
15:20~15:50 - Coffee-break		
SESSION 6: Chairperson - Cosimo CARFAGNA		
PLENARY LECTURE 3		
15:50~16:30	Prof Halima KERDJUDJ	Strategies based on umbilical cord derivative and regenerative medicine
ORAL PRESENTATIONS		
16:30~16:50	Sandu CIBOTARU	Lignin-based aldehydes for sustainable thermosetting resins with dynamic covalent networks
POSTERS INSTALLATION		
SOCIAL EVENT		
17:00~18:00	MUMONS	Social Event – visite MUMONS - Électrique ! - MUMONS
GALA DINNER		
19:00~22:00	La table du boucher	La Table du Boucher | Restaurant à Mons

* Day 3 (Friday, September 12, 2025)

SESSION 7: Chairperson - Jeremy ODENT		
PLENARY LECTURE 4		
9:00~9:40	Prof Giada LO RE	Sustainable-by-design polymer-based materials
9:40~11:40		**POSTER SESSION and Coffee-break**
PLENARY LECTURE 5		
11:40~12:20	Prof Karine GLINEL	Engineered Living Materials for Therapeutic Applications
12:20~14:00 - Lunch break		
SESSION 8: Chairperson – Rosica MINCHEVA		
PLENARY LECTURE 6		
14:00~14:40	Halyna OHAR	Synthesis and properties of new macrophotoinitiators with pendant moieties of benzoin derivatives
AWARDS & CLOSING REMARKS		

14:40~15:00 **PolyChar'32 introduction**: Prof Anita GROZDANOV
15:00~15:20 **Awards**: Prof Witold BROSTOW
15:20~15:30 **Closing remarks:** Prof Alice Mija, Prof Witold BROSTOW & Prof Jean-Marie RAQUEZ

Social Event – visite MUMONS - Électrique ! - MUMONS



Électrique !

Exposition

Public : Curieux

Du 28 août 2025 au 5 juillet 2028

MUMONS

Cet événement est payant

Des collections impressionnantes

Durant votre visite, ne vous laissez pas intimider par le charme de nos collections scientifiques. Machine de Wimshurst, dynamo de Gramme, résonateur d'Oudin, tubes de Crookes, bobine de Ruhmkorff… qu'elles aient une esthétique à couper le souffle, des dimensions XXL, ou l'air d'avoir plus d'un secret sous le capot, ces pièces rares vous feront frissonner d'émerveillement !

Rénovés, briqués, polis et mis sur leur 31 pour l'occasion, plus d'une cinquantaine d'objets sont exceptionnellement sortis des réserves de l'UMONS et de la Fédération Wallonie-Bruxelles pour raconter leur histoire.

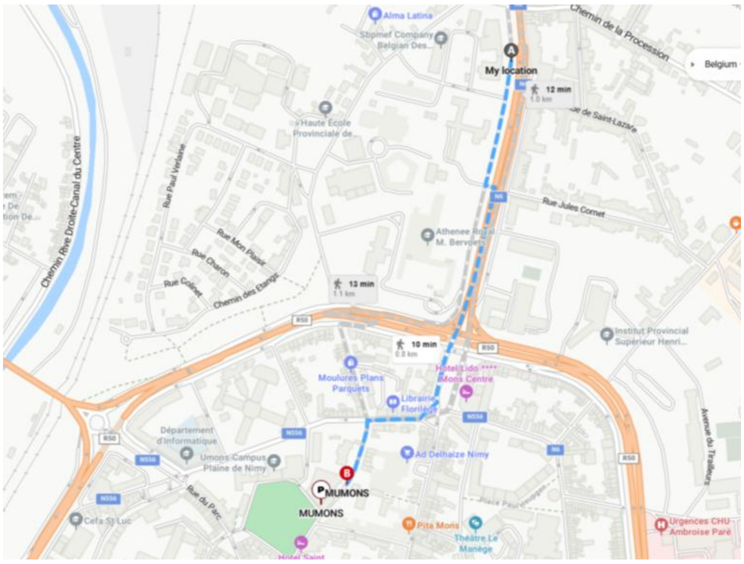
Fée électricité et Frankenstein

Petits et grands, tendez l'oreille : ici, les « Ooooh », les « Waaaaa » et les « C'est booooow » fusent dans tous les sens. Et, au détour d'un couloir, une petite voix : « Hé Papy, c'est comme ça qu'on produisait l'électricité à ton époque ? »

Pour cette exposition, Pierre Gillis (physicien), Pauline Tisthoud (historienne) et Romane Duculot (historienne de l'art), ont uni leurs regards et brouillé les frontières entre sciences appliquées, sciences humaines et art pour raconter comment une force invisible a transformé – et transforme encore – notre monde.

Des tours de magie des électriciens du 18e siècle #abracadabra, aux crêpages de chignon entre savants #amourgloireetélectricité, en passant par trois siècles de recherche pour apprivoiser la fée électricité… l'histoire se déploie ici comme un véritable spectacle. Et vous êtes aux premières loges.

Familles, scolaires, experts, passionnés, curieux… Quelle que soit votre identité déclinée, vous serez aimantés par des expériences insolites, des films animés, des récits étonnants… d'ailleurs à ce stade, nous n'avons toujours pas tranché sur l'expérience la plus inédite que vous vivrez entre la contemplation de notre chambre à brouillard ou la fouille du smartphone de Frankenstein.



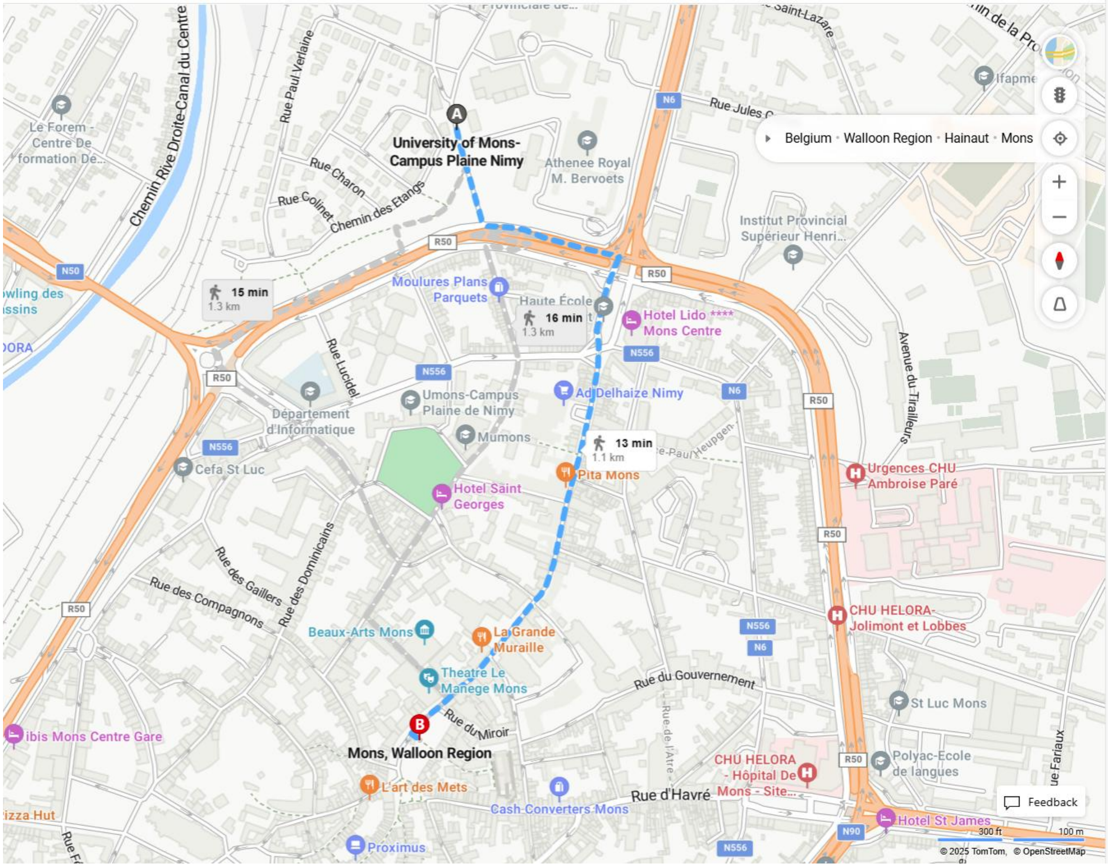
MUMONS, Pl. du Parc 24, Rue du Rossignol, 3, 7000 Mons

GALA DINER

Restaurant: La table du Boucher - La Table du Boucher | Restaurant à Mons

Address: Rue d'Havré 49, 7000 Mons, Belgium

Walking map:



CONTRIBUTIONS

C Courses (50 min, Q & A included)

PL Plenary lectures (40 min, Q & A included)

OP Oral presentations (20 min, Q & A included)

PP Poster presentations (A1 size, portrait orientation)

will be posted after registration and will remain displayed during the entire conference

Language

The conference language is English

Participation	Participant	Title
C1	Veronica AMBROGI	Integrating circular economy principles in polymeric material development
C2	Antonella ESPOSITO	Advanced thermal analysis for amorphous and semicrystalline polymers
C3	Paolo EDERA	Rheology of vitrimers: from basics of characterization to microscopic insight
C4	Cosimo CARFAGNA	Mechanical recycling of multilayer flexible packaging: a virtous route towards environmental sustainability
C5	Kevin P. MENARD	Analytical Techniques for Recycling Polymers
C6	Witold BROSTOW	
C7	Jérémy ODENT	Complexity for free using stereolithography
PL1	Ke-Ke YANG	Fabrication of shape memory biomedical devices via an adaptable FDM-based 4D printing strategy
PL2	Philippe LECLERE	Towards quantitative mapping of physical and chemical properties of soft materials: When IA meets materials!
PL3	Halima KERDJOUDJ	Strategies based on umbilical cord derivative and regenerative medicine
PL4	Giada LO RE	Sustainable-by-design polymer-based materials
PL5	Karine GLINEL	Engineered living materials for therapeutic applications
PL6	Halyna OHAR	Synthesis and properties of new macrophotoinitiators with pendant moieties of benzoin derivatives
OP1	Sandu CIBOTARU	Lignin-based aldehydes for sustainable thermosetting resins with dynamic covalent networks
OP2	Yana SHYMBORSKA	'Smart' polymer sandwiches from hydrogel nanocoatings attached to stimuli-responsive grafted brush coatings: changing the cell behavior
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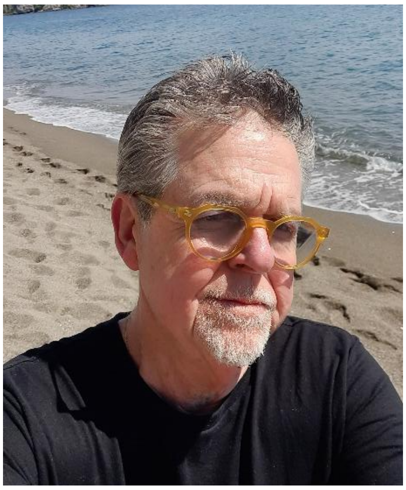
OP4	Juan A. GUERRERO	Hydration-driven boost in piezoionic sensors
OP5	Angela, MAROTTA	Kinetic study of the curing process in resorcinol-based epoxy/anhydride thermosets
OP6	Alma Lucia VILLELA ZUMAYA	Integrated COSMO-RS and experimental strategy for developing stable, 3D-printed PLA-based methotrexate formulations
OP7	Elizabeth ALVAREZ PEREZ	Synthesis of eco-friendly benzoxazine resin
OP8	Felipe GONÇALVES	Electrically responsive starch films for controlled nitric oxide and ligand release
PP1	Felipe GONÇALVES	Electrically responsive starch films for controlled nitric oxide and ligand release
PP2	Anthony KEVER	3D-printed drug-eluting scaffolds for periodontal bone repair
PP3	Roza KHEIRODDIN	Solid-state modification of ABS (acrylonitrile butadiene styrene) for dynamic and reprocessable plastics

PP4	**Esra YALCINKAYA**	**Light-responsive PNIPAM/gold nanospheres hydrogel-based actuators for biomedical applications**
PP5	**Clémentine CUVELIER**	**Polymers and gas permeability: a structural synergy**
PP6	**Ilona DICHIARA**	**Exploring recycling routes for polyolefins**
PP7	**Léa GRATIER**	**Developing reactive flame-retardant for thermoplastic polyurethane using reactive extrusion**
PP8	**Jacques Kevin WANDJI**	**Modification of poly(butylene terephthalate) by incorporation of a photoreactive cinnamamide moiety via reactive extrusion solid-state**
PP9	**Martial KUETE**	**Synthesis and characterization of eco-friendly thermoplastic composites based on recycled polyethylene terephthalate reinforced with banana fibres**

INVITED LECTURERS SHORT CVs

(Alphabetic order)

Antonella ESPOSITO – An Italian scientist currently living and working in France. She is Associate Professor (Maître de Conférences Hors Classe HDR) at Université de Rouen Normandie, where she belongs to a small department focusing on the physical characterization of disordered systems, glasses, and polymers (Systèmes Désordonnés et Polymères) within a larger research unit specialized in the physical and microstructural characterization of organic and inorganic materials on different length scales (Groupe de Physique des Matériaux). She was born in 1979 (Terni, Italy). As a teenager, she was passionate about classical studies (ancient Greek, Latin, philosophy, art history) until 1998, when she decided to move to modern science. She graduated from Università degli Studi di Perugia (Terni, Italy) in 2005 as a Materials Engineer with an M.Sc. in Innovative Materials, then moved to France where she completed her Ph.D. degree in 2008 in Polymers and Composite Materials at the Institut National des Sciences Appliquées in Lyon. After a two-year teaching experience in Oyonnax, she got a permanent position at the Université de Rouen Normandie in 2010. Since then, she investigates the relations between chemistry, microstructure, and properties of biobased and/or biodegradable polymers, and their evolution with time, accounting for molecular relaxations within complex two- and three-phase microstructures with different coupling between the ordered and disordered domains.



Cosimo CARFAGNA – Full professor of Chemistry at the "Federico II" University in Napoli (Italy). For 16 years he directed the Institute for Polymers, Composites and Biomaterials (IPCB) of the National Research Council based in Naples, Catania and Lecco. He was president of the NA3 research area of the National Research Council. His career began as a researcher in Enichem (Istituto Guido Donegani). His research activities in the over 40 years of career concern the following topics: polymers chemistry and technology, functionalization of polymers, synthesis of polymers, liquid crystalline polymers for electro-optical applications, composites and nanocomposites, functional tissues, recycling and transformation of plastic materials, use of intermediates from renewable sources for the stabilization of polymers, materials for packaging, materials for the textile sector. He has published about 300 works in scientific journals, is the author of numerous patents and has been invited as Plenary Lecturer in numerous national and international congresses.

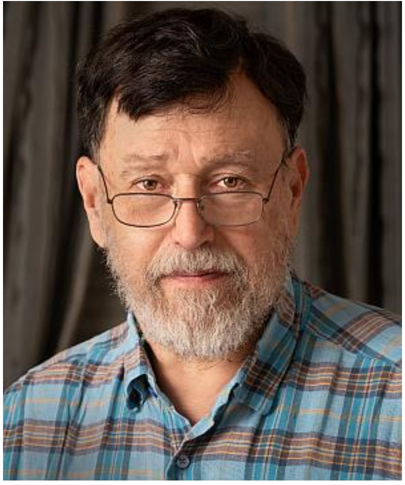
Giada LO RE - An Associate Professor at the Department of Industrial and Materials Science of Chalmers University at Gothenburg (Sweden) and at the Department of di Civil e Industrial Engineering of University of Pisa, Italy. Her research focuses on understanding the relationships between the processing, structure, and properties of materials at both molecular and nanoscale levels, with a particular emphasis on the molecular and macromolecular engineering of sustainable polymeric materials. She was awarded the Italian Prize for the Best National PhD Thesis in Chemical Engineering and Materials Science (AIMAT, Italy) in 2012. She later received the Green Materials Prize 2016 (Institution of Civil Engineers, London, UK). She serves as an expert evaluator on behalf of the Natural Sciences and Engineering Research Council of Canada (NSERC) and for the European Commission.

Halima KERDJOUDJ - Professor of Cell Biology at the University of Reims Champagne-Ardenne, France. Her research focuses on the immunomodulatory effects of biomaterials on mesenchymal stem cells and the development of perinatal tissue–based biomaterials for applications in bone regeneration and peripheral nerve tissue engineering. She earned her PhD in 2007 from Nancy University, where she investigated layer-by-layer polyelectrolyte assembly and vascular tissue engineering. In 2008, she joined Prof. Alexander Seifalian's group at University College London (UCL) as a postdoctoral fellow, working on progenitor cell differentiation and muscle tissue engineering. She is the co-author of over 90 peer-reviewed publications and three patents.

Jeremy ODENT - associated professor at University of Mons (UMONS, Belgium). His research focuses at the Laboratory of Polymeric Materials and Composites are centered around the development of stimuli-responsive polymeric materials and nanocomposites of desired properties and key-functionalities as well as the possibilities sustained by advanced additive manufacturing technologies to meet the ever-increasing demand of complex device platforms. As a means of generating parts with novel functionality, the core technology of his research mainly rely on the generation of smooth structural gradients within the 3D-printed materials. Among his recent investigations, he designed new 3D-printed polymeric inks capable of forming tough structural elements and providing novel electrical and optical functionalities for sensing and soft robotic applications.

Karine GLINEL – Professor and Research Director at the Belgian Fund for Scientific Research (FNRS) leading a research group within the Bio and Soft Matter division of the Institute of Condensed Matter and Nanosciences at UCLouvain (Belgium). She earned her PhD in polymer chemistry from the University of Rouen (France) in 1999, followed by postdoctoral work at UCLouvain and the Max Planck Institute of Colloids and Interfaces (Germany), deepening her expertise in soft matter and biointerfaces. In 2002, she joined the CNRS as a full-time researcher. She returned to UCLouvain in 2009 as an FNRS MIS-ULYSSE fellow and later became a permanent FNRS researcher. Her international experience includes visiting scholar positions at the Melville Lab (University of Cambridge, UK, 2007) and the Langer Lab (MIT, USA, 2016). Prof. Glinel's research focuses on the design of macromolecular biofunctional surfaces and materials to control bacterial and mammalian cell behaviors, including proliferation, secretion, and differentiation, through innovative combinations of (bio)polymer chemistry, macromolecular self-assembly and 3D bioprinting strategies.

Ke-Ke YANG – Full Professor in College of Chemistry, Sichuan University (China). Ke-Ke Yang received her BSc degree in Polymer Materials (1994), MSc degree in Chemical Fiber (1997), and PhD in Material Science (2001) from Sichuan University, China. She joined the faculty at Sichuan University in 1997 and is currently a Full Professor in Polymer Chemistry and Physics. Her research focuses on biodegradable polymers, polymer composites, shape-memory polymers, and self-healing materials. She has published 134 peer-reviewed publications and holds over 30 granted invention patents.



Kevin P. MENARD – Worked in a range of industries, including aerospace, oil and gas, polymers, scientific instrumentation, food, cosmetics, and academia. He and his sons founded and continue to operate Veritas Testing and Consulting, a thermal analysis and rheology contract laboratory. He has over 200 publications or presentations, including monographs, encyclopedia articles, and chapters, mostly dealing with thermal analysis. His most recent publication is Dynamic Mechanical Analysis: A Practical Introduction, K. Menard and N. Menard, Francis and Taylor, Boston, 2020.

Paolo EDERA – Physicist - member of the "Formulation Chemistry and Physicochemestry" team at ESPCI-C3M unit. He obtained his PhD at the Università Statale di Milano in 2020, with a thesis on the microscopic signatures of plasticity in yield-stress fluids and is currently a postdoctoral researcher with an independent research position in October 2025. His research focuses on shapeable materials, ranging from colloidal systems (yield-stress fluids) to vitrimers (polymeric dynamic networks). He works on both fundamental questions—such as the microscopic understanding of yielding, mechanical memory, and aging—and applied challenges, including the development of soft materials with tailored linear and non-linear mechanical properties.

Philippe LECLERE – Full Professor at UMONS, head of the Laboratory for Physics of Nanomaterials and Energy at the Physics Department, and a visiting scientist at the Institute of Complex Molecular Systems at TU/e. His research interests mostly deal with the (1) characterization by means of scanning probe microscopy (SPM) techniques of (i) the morphology and the nanoscale properties (such as electrical and mechanical properties) of organic and hybrid systems including polymer blends, nanocomposites, block copolymers, liquid crystals, hydrogels, and supramolecular (nano)structures (build by self-assembly of functional (macro)molecules); (ii) the piezo and flexoelectric properties of piezoelectric polymers films, nanofibers, and nanocomposites; and (2) the development of (iii) novel SPM techniques (such as in situ electrochemical cell, in situ photoconductive atomic force microscopy, …) and methodologies to quantitatively determine mechanical and electrical properties of polymeric materials and nanocomposites at the nanoscale; and (iv) Machine Learning algorithms (Python codes) for SPM data acquisition validation and clustering, model optimization, and deep learning processes. He is (co)author of over 210 papers and many chapter books in international peer-reviewed journals (Hirsch factor: 47), and the President of the Royal Belgian Society for Microscopy (RBSM), of PromOptica, and of NanoWal.

Veronica AMBROGI - Since 2021, Veronica AMBROGI is Full Professor in the Department of Chemical, Materials, and Production Engineering (DICMaPI) at the University of Naples Federico II, where she currently serves as Vice-Director. She is the author of 150 papers in peer-reviewed international journals (H-index: 38; citations: 4,221, Source Scopus), five book chapters, and one patent. She has participated in several competitively funded research projects focused on polymeric materials. Her research interests include the synthesis, modification, and characterization of thermoplastic and thermosetting polymers, polymer composites and nanocomposites, as well as the recycling and reprocessing of polymers.

Witold BROSTOW – Regents Prof. of Materials Science and Engineering, University of North Texas and the President of the International Council on Materials Education (45 countries represented). Research Philosophy: *giving ambitious tasks to undergraduates doing research increases the number of students who decide to go to a graduate school. Those that do so have a much easier start. Thus postdocs, visiting researchers and graduate students have support in their work from enthusiastic undergraduates*. W. Brostow & H.E. Hagg Lobland, Materials: Introduction and Applications, John Wiley & Sons, New York 2017. Publications cited 16708 times (Google Scholar, 15 April 2024).

POLY CHAR'31

BOOK of ABSTRACTS

COURSES

C1

Integrating circular economy principles in polymeric material development

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The rapid evolution of materials technology has played a pivotal role in the development of human civilization. However, this unprecedented growth has led to an unsustainable dependence on non-renewable resources, resulting in environmental degradation and increased waste generation. The dominant model of economic growth, the linear economy, follows a “take-make-dispose” paradigm that is no longer viable within the constraints of a finite planet.

This presentation explores the scientific and technological approaches required to transition toward a circular economy as a sustainable alternative. It redefines product life cycles by emphasizing waste prevention, material recovery, and sustainable design from inception to end-of-life.

A significant focus is given to the challenges and opportunities in eco-design and plastic recycling. Mechanical recycling, including primary (closed-loop) and secondary (downcycling) methods, remains the most widely used technique. However, it is limited by issues such as material contamination, differences between thermosets and thermoplastics, and heterogeneous polymer compositions. For more complex or contaminated waste streams, chemical recycling (tertiary recycling) offers promising solutions such as pyrolysis, gasification, and depolymerization. These methods break polymers down into monomers or basic chemicals that can be repurposed into new products, thus enhancing circularity even for degraded plastics. Energy recovery (quaternary recycling), though commonly used, poses environmental risks and is considered a last resort due to toxic emissions.

To support decision-making and validate the environmental benefits of these strategies, the presentation also introduces Life Cycle Assessment (LCA), a scientific methodology for quantifying the environmental impacts of products and processes by analyzing energy and material flows throughout their life cycle. LCA enables comprehensive evaluations, guides sustainable innovation, and prevents the shifting of impacts between lifecycle stages.

Overall, this lecture underscores the critical role of materials engineering, sustainable design, and policy in driving the transition to a circular economy.

C2

Advanced thermal analysis for amorphous and semicrystalline polymers

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Whether amorphous or semicrystalline, all polymers require a careful characterization of their microstructural features and/or of their relaxation dynamics. The relaxation dynamics in amorphous macromolecular materials provide insights about their mechanical responses in different conditions, and can be used to predict how stable they are over time. The crystallization kinetics and crystal morphologies developed in semi-crystalline polymers (as a result of specific chemical interactions or compositions, macromolecular architectures or processing conditions) are crucial to master their microstructure, tune their properties, and predict their suitability for industrial applications.

Assessing the glass-forming ability (or else the crystallization ability) of a polymer is essential to anticipate how easy it is to melt-quench it into a glass, or to develop anisotropic microstructures, which in turn affects macroscopic properties such as stiffness, strength, chemical resistance, thermal stability, gas permeability, biodegradability, and of course processability and physical aging. In most cases, the correlation between specific properties and the microstructural evolution of a polymer can be investigated by advanced thermal analysis, i.e. by experimental techniques running temperature-based protocols and providing temperature-based measurements, giving access to thermodynamical parameters such as the specific heat capacity, the glass transition temperature, the melting temperature and enthalpy, and any other temperature-dependent expression of molecular mobility in complex environments with different topological constraints (specific molecular interactions, entanglements, crystallites, spherulites...).

This oral contribution provides some examples of advanced thermal analysis techniques (Modulated-Temperature Differential Scanning Calorimetry MT-DSC, stochastically perturbed differential scanning calorimetry TOPEM, Fast Scanning Calorimetry FSC, Dielectric Relaxation Spectroscopy DRS) applied to both amorphous and semicrystalline polymers with different purposes.

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C3

Rheology of vitrimers: from basics of characterization to microscopic insight

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Keywords: mechanical reprocessability, rheology, time temperature superposition, topology.

Since their introduction, vitrimers have been recognized as an interesting class of materials due to their ability to change their mechanical response in relation to temperature. In particular, depending on the temperature, vitrimers may or may not exhibit their dynamic nature, showing either thermoset-like or thermoplastic-like rheological behavior, without altering their topology.

On the one hand, this tunability—which allows for both robustness and reprocessability—is one of the main reasons for the technological interest in vitrimers. On the other hand, such high responsivity makes the rheological characterization challenging.

In the first part of the talk, I will present the basic principles and practical considerations required to properly characterize the rheological response of different vitrimeric systems, and I will discuss the applicability of the time–temperature superposition principle.

In the second part of the talk, I will use the rheological methods described thus far to explore the connection between rheological response and network topology.

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C4

Mechanical Recycling of multilayer flexible packaging: a virtous route towards environmental sustainability

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The European Union (EU) policies aim to achieve 100% sustainable packaging by 2030. Sustainability represents an economic driver for companies, considering that, according to the Harvard Business Review, 65% of young people prefer to buy products from brands that support environmental sustainability.

But what is sustainable packaging really?

Sustainable packaging is packaging developed and created in such a way as to reduce the environmental impact and ecological footprint, without losing sight of its main missions: the packaging protects the content (from production to the shelf, up to consumption) and, at the same time, informs (thanks to ad hoc labels, it provides useful information on safety and hygiene) and attracts the consumer, encouraging them to purchase.

As global consumption of packaged goods continues to rise, the management of post-consumer packaging waste has become a critical environmental challenge. Mechanical recycling remains one of the most widely used and economically feasible methods for the recovery and reuse of packaging materials, particularly plastics. This lecture explores the fundamental principles of mechanical recycling, focusing on sorting, washing, shredding, and reprocessing technologies that convert waste materials into secondary raw materials.

The topics covered may be useful to PhD students in materials engineering and polymer chemistry, as well as to post docs involved in research activity in polymer processing and recycling.

C5

Analytical Techniques for Recycling Polymers

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While certain polymers have been successfully recycled to the degree where Coca-Cola proclaims bottles are 100% recycled, it not always as easy or successful. Other polymers haven't recycled as efficiently as PET, and some industries have been moving away from using recycled materials at all, particularly in key applications.

Many of the problems being seen are due to the changes in properties of the material in use. This is very evident in how much more difficult it is to deal with post-consumer recycled (PCR) materials. Applications of thermal analysis and supporting techniques allow a window into polymer behavior that can help to understand these issues.

C6

Viscoelasticity of polymers and composites

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Much work on polymers and polymer-based materials (PBMs) is devoted to mechanical properties. Highly important are also tribological properties of moving parts made of polymers and PBMs.

As noted in a textbook of Materials Science and Engineering, worldwide friction and wear costs per year are of the order of US$ 1 trillion. [1] Putting the term "wear" into the Google Scholar provides the answer "4,050,000 results". We have provided equations defining for PBMs their brittleness B in 2006 and their flexibility Y in 2019 [2, 3].

We also have obtained an equation relating PBMs flexibility Y to their linear isobaric thermal expansivity, α_L – a connection of a mechanical property to a thermodynamic one. [4]

Different materials expand at different rates on the temperature increase; the same applies to contraction on cooling. Thus, a temperature change can cause disintegration of a composite with no mechanical force involved.

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C7

Complexity for free using stereolithography

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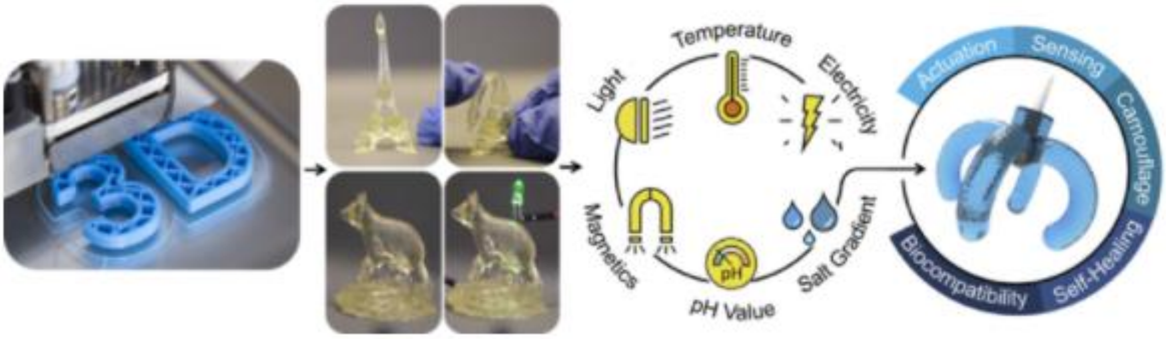
Slowly yet steadily, additive manufacturing technologies have become a major player in the fabrication of polymeric devices with controlled architectures such as personalized prototypes, soft electronics, sensors and actuators as well as tissue and biomedical engineering. Based on a layer by layer fabrication, with resolution in the range of micro- to nanometers per layer, the computer-assisted printing significantly speeds up the development of custom 3D devices without actually inflating the costs. Despite the irrefutable progress made around 3D printing, the technique still suffers from rigid and static properties of the printed parts and lack of fabrication approaches controlling the material anisotropy. The latest efforts along these lines involve a family of 3D-printed materials including (1) multi-responsive functionally graded hydrogel-based actuators capable of rapid, controllable motion in response to environmental parameters, (2) self-powered iontronic touch sensors which utilize touch-induced ionic charge separation in ionically conductive hydrogels, (3) structurally-colored composite elastomer exhibiting a stress-dependent color change and high toughness using submicron-sized silica particles and arranging them in a periodic structure in the elastomer, and (4) phenylboronic acid-containing implants with on-demand glucose-triggered drug release abilities for personalized medicine. This work represents a flexible platform for designing more advanced 3D-printed polymeric materials beyond the present studies that would promote new potential applications.



POLY
CHAR'31

PLENARY LECTURES

PL1

Fabrication of shape memory biomedical devices via an adaptable FDM-based 4D printing strategy

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Shape-memory aliphatic polyesters (SMAPs) have emerged as promising materials for minimally invasive biomedical application, owing to their unique programmable shape-changing capacities in response to external stimuli. Meanwhile, fused deposition modeling (FDM), a widely accessible and customizable 3D printing technique, offers a significant platform for manufacturing complex medical devices from SMAPs. However, conventional FDM often suffers from weak interlayer bonding, resulting in anisotropic mechanical properties that limit the application of materials. To address this challenge, we established a UV-assisted FDM-based 4D printing strategy for the adaptable fabrication of multifunctional biomedical devices using SMAPs. In detail, functional monomers contained photo-crosslinkable groups, such as fumaric acid, itaconic acid, and cinnamic acid, were chemically incorporated into various biodegradable aliphatic polyester matrices, including poly(ε-caprolactone) (PCL), poly(lactic acid)-b-PCL (PLA-PCL), PLA-b-poly(ethylene glycol), which exhibit tunable mechanical properties and enhanced bioactivity. Using this method, we successfully fabricated a range of shape-memory biomedical devices, including external adaptive protectors, internal bone scaffolds, and vascular stents, tailored to diverse therapeutic needs. The printed devices demonstrated robust structural stability in aqueous environments, excellent shape-memory effects, and precise adaptability to complex defect geometries, supporting minimally invasive implantation. This UV-assisted FDM strategy provides a versatile and effective route for the development of smart biomedical devices, achieving a desirable balance among shape-memory performance, biodegradability, 3D printability, and biocompatibility.

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PL2

Towards quantitative mapping of physical and chemical properties of soft materials: When IA meets materials!

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Over the past few decades functional materials have replaced existing materials in many applications from aerospace to cosmetics. With these novel materials impacting every part of our lives, they have become ubiquitous. Mechanical property mapping can provide critical insights into the fundamental processes at the local scale that lead to deformation phenomena in these materials or their degradation upon external mechanical stress.

This talk will focus on the latest cutting-edge developments of scanning probe microscopies (SPM) and spectroscopies for the characterization of materials surfaces and interfaces in soft polymeric materials.

Beyond surface imaging, we will highlight the abilities of SPM to characterize the properties of materials with particular attention on the quantitative mapping of nanomechanical properties such as adhesion, indentation, rigidity modulus, storage modulus, loss modulus using various recent SPM-based techniques (*PeakForce Tapping, nanoDynamic Mechanical Analysis)*.

In this context, Machine Learning has been perceived as a promising tool for the design and discovery of novel materials for a broad range of applications. We will shortly discuss computational methods and ML algorithms dealing with data clustering (such as *K-Means* or *Automatic Gaussian Mixture Model*) that can be used to detect the different domains and (inter)phases in materials by partitioning the recorded data (i.e. the observables) into clusters according to their similarities. For instance, we proposed adapted protocols for the data analysis (i.e. validation of the data acquisitions, data clustering, …), expecting to help the scientific community to better understand the key parameters in the optimization of the behaviour of materials not only for fundamental aspects but also for industrial applications.

This algorithmically driven approach will enable analyze materials with more complex architectures and/or other properties, opening new avenues of research on advanced materials with specific functions and desired properties leading to the creation of functional, more reliable and ideally eco-responsible materials.

In fine, we will discuss our recent approach of correlative analysis of the mechanical and chemical properties combining SPM with IR and Raman spectroscopies as well as Scanning Electron Microscopy.

PL3

Strategies based on umbilical cord derivative and regenerative medicine

Halima KERDJOUDJ
Université de Reims Champagne Ardenne

Perinatal tissues such as placenta and umbilical cord are bio-rich, sustainable, and ethically accessible. They provide stromal cells with high viability and strong immunomodulatory properties, as well as extracellular matrix components with antibacterial and antifibrotic effects. In particular, Wharton's jelly combines unique biochemical composition—collagens, hyaluronic acid, growth factors—with remarkable mechanical flexibility, protecting the embryo during development. Hydrogels derived from Wharton's jelly are emerging as promising biomaterials: they support cell adhesion and function, but their rapid degradation and low stiffness remain challenges for bone repair. In this talk, I will highlight recent advances in Wharton's jelly–based biomaterials and their potential in bone regenerative medicine.

PL4

Sustainable-by-design polymer-based materials

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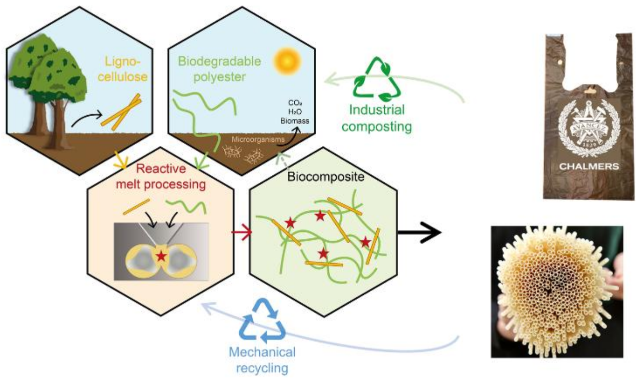

Figure 1. Scheme representing reactive melt processing as a sustainable and scalable strategy to tackle the drawbacks of poor lignocellulose dispersion and interface adhesion to the polymer matrix, preserving the material's biodegradability and mechanical recyclability.

The development of biodegradable and recyclable bio(nano)composites based on renewable resources can help mitigate the effects of plastic pollution and the depletion of fossil fuels. In this frame, thermoplastic biodegradable polyesters blended with lignocellulosic derivatives are of interest. Reactive melt processing is a sustainable and scalable strategy for tackling the drawbacks of poor lignocellulose dispersion and adhesion to the polymer matrix, preserving the material's biodegradability and mechanical recyclability (Figure 1). Reactive melt processing combines melt compounding with chemical reactions, and it has been explored to tune the interface of bio(nano)composites, enhance their performance, and introduce new functionalities. Different categories of interface design have been investigated, including the modification of the polymer matrix, of the lignocellulose, the addition of a third component, and *in-situ* polymerisation.

Peroxide-initiated branching/crosslinking carried out in synergy with the water-assisted feeding of lignocelluloses enabled the formation of a uniform hybrid polymer/lignocellulose network that provided creep resistance and shape memory properties (Avella et al., 2024). Grafting of bio-sourced oils onto industrial lignin was explored to plasticise lignin and favour its miscibility with polyesters (Avella et al., 2023). Chemical modification of cellulose fibres decreases their glass transition temperature, allowing their melt processing with the use of water as a temporary plasticiser (Lo Re et al., 2023). *In-situ* polymerisation of bio-sourced ethylene brassylate to graft the polymer from the cellulose surface resulted in an effective method for (nano)cellulose dispersion and stress-transfer with the matrix (Avella, Angelica et al., 2024). Amphiphilic copolymers were designed as third components to mediate the interface between cellulose nanofibrils and the polyesters, enabling their dispersion, increasing stiffness and strength, while preserving the deformation of the biocomposites (Kaldéus et al., 2019). A deeper understanding of the interface of bio(nano) composites proposes sustainable alternatives for the industrial replacement of conventional plastics and paves the way for future investigations.

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PL5

Engineered living materials for therapeutic applications

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Engineered Living Materials (ELMs) are an emerging class of materials that consist in living cells embedded within structural matrices to create dynamic systems capable of sensing, responding, and adapting to their environment. Central to their functionality is cell activity, encompassing metabolism, proliferation, differentiation, intercellular communication, etc. which enables these systems to perform complex biological functions. Among these, ELMs with secretory capabilities are particularly promising for medical applications, as they can continuously synthesize and deliver therapeutic agents such as antimicrobial peptides, growth factors, hormones, or anti-inflammatory compounds directly at the site of need. This localized and sustained delivery approach offers significant advantages, including enhanced therapeutic efficacy, reduced systemic side effects, and improved patient outcomes. In certain pathological contexts, these systems also offer a valuable alternative to conventional treatments, such as antibiotics, whose overuse poses growing clinical challenges.

In this work, we present different approaches that combine polymer gelation, 3D bioprinting and polymer assembly to fabricate ELM's containing either pancreatic islets secreting insulin for diabetes treatment or commensal bacteria producing an anti-inflammatory and antimicrobial agent for skin treatment. Our strategy enables precise spatial and temporal control over cell encapsulation, preserving cell viability, proliferation, and secretory activity over extended periods. This is achieved by tuning key physicochemical parameters of the polymer matrix, such as stiffness, porosity, thickness, and chemical composition, to create a supportive microenvironment tailored to each cell type. Additionally, we describe the fabrication of biocompatible polymer devices designed to safely entrap these living materials for in-vivo applications. These devices ensure robust cell containment, sustained therapeutic release, and immune-isolation, thereby advancing the design of next-generation bio-integrated therapeutic systems.

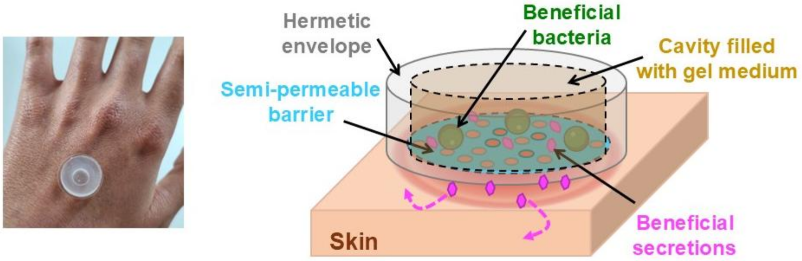

Figure 1. Patch entrapping commensal bacteria to treat skin inflammation.

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PL6

Synthesis and properties of new macrophotoinitiators with pendant moieties of benzoin derivatives

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Macrophotoinitiators (MPIs) are defined as reactive polymers containing photoactive chromophores, which through a light absorption process can generate active species able to initiate the monomer polymerization and the crosslinking of diverse polymer compositions. MPIs attract a rising interest as promising initiators of radical reactions because of the high initiation rates, the possibility to be applied at room temperature, as well as the simplicity of the method for initiation of processes at certain local areas, which opens up new opportunities for creating diverse composites and photolithographic materials on their basis. Other main advantages, inherent in MPIs owing to their high molecular weight, are: low tendency to migration in both the initial uncured and finally cured compositions; low volatility, reducing odor of the composition; weakening of the yellowing effect; good compatibility with other ingredients of photocompositions.

There are two main approaches to the synthesis of MPIs with pendant moieties of PIs. One of them is a two-step process, which involves: i) at the first stage, the synthesis of polymerizable derivatives of low-molecular PIs with an unsaturated substituent, i.e. the synthesis of monomer-photoinitiators; ii) at the second stage, polymerization of these monomer-photoinitiators or their copolymerization with other monomers results in the MPI obtaining.

Another approach considers the application of polymer modification reactions for MPI synthesis. With this approach, MPIs with the pendant photoactive moieties are synthesized via reactions of the reactive group in molecules of low-molecular PI with the corresponding functional groups in macromolecules of polymer carrier. The advantages of this approach are a simplicity in MPI synthesis and availability of various low-molecular PIs that can be tethered to macromolecules of polymer carriers.

Here we report on the new macrophotoinitiators that have been synthesized via the acylation reaction of the hydroxyl group of benzoin or some of its derivatives by anhydride groups of copolymers derived from maleic anhydride and methacrylates. IR, UV, NMR spectroscopies, as well as DSC and TGA analyses have been used to confirm the structure and investigate the properties of the MPI synthesized.

Photolysis of MPIs in comparison with their low-molecular counterparts has been investigated in details using a mercury-quartz lamp DRT-400. The results obtained witness that the PI moieties retain their photo-initiating ability after tethering to a macromolecular carrier.

MPIs have been found to be effective surface modifiers of mineral fillers such as titanium dioxide, zinc oxide, and nanohydroxyapatite; and behave as effective photoinitiators when immobilized on the surface these fillers. The benefits of using the fillers surface-modified by MPIs in photo-curable polymer composites are discussed.

POLY CHAR'31

BOOK of ABSTRACTS

ORAL PRESENTATIONS

OP 1

Lignin-based aldehydes for sustainable thermosetting resins with dynamic covalent networks

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The increasing demand for environmentally friendly materials has driven the search for sustainable alternatives to petroleum-based epoxy resins containing bisphenol A (BPA), a known endocrine disruptor [1, 2]. In the pursuit of sustainable and eco-friendly alternatives to traditional epoxy resins, Schiff-based epoxy thermosets have emerged as a promising strategy [3]. In this study, we developed Schiff-based epoxy thermosets using lignin-derived aldehydes such as vanillin and syringaldehyde. These aldehydes were converted into Schiff-based monomers and subsequently glycidylated to form novel epoxy resins. A self-polymerization strategy was implemented, eliminating the need for external curing agents. The resulting thermosets exhibit excellent performance, with high storage moduli (1.5–2.2 GPa), elevated glass transition values (138–249 °C), and outstanding thermal stability ($T_5\%$ = 310–350 °C). They also demonstrate inherent flame retardancy (LOI = 33–36%) and low apparent density (0.74–1.09 g/cm^3), making them ideal for lightweight applications. Importantly, their dynamic imine bonds enable both thermal reprocessing and chemical recycling, underlining their potential in sustainable and circular material design [4].

Acknowledgements:

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Keywords: Bio-based thermosets, Schiff bases, High-performance, Dynamic linkages

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OP 2

'Smart' polymer sandwiches from hydrogel nanocoatings attached to stimuli-responsive grafted brush coatings: changing the cell behavior

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In an effort to provide a universal platform for remotely controlling the behavior of various cell lines, we present a strategy for fabricating 'smart' polymer sandwiches using a nanogel attached to temperature-responsive grafted brush coatings. These coatings can be easily modified to meet the requirements of specific cell types while preserving responsiveness. First, temperature-responsive grafted copolymer brush coatings of poly(oligo(ethylene glycol) methyl ether methacrylate) (POEGMA) with a small amount of hydroxyethyl methacrylate (HEMA) were synthesized on glass surfaces. Subsequent modifications involved using multifunctional alcohols, amines, or their combinations with proteins to react with divinyl sulfone, forming a cross-linked polymer matrix with a surface nanogel structure attached to grafted copolymer brushes containing hydroxyl groups. The resulting sandwich coatings were comprehensively characterized, revealing maintained temperature-responsiveness for various structures of the grafted nanogel. Compared with P(OEGMA-co-HEMA) brushes, these temperature-responsive sandwich coatings exhibited improved biocompatibility while retaining the ability to regulate cell morphology and detachment of dermal fibroblasts through external temperature control. Rheological analysis of live cells was performed on the developed platforms to reveal their impact on cellular behavior. The application of these new materials opens exciting possibilities for tissue engineering.

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OP 3

Development of plant oil-based polymer brushes with unexpected T- and pH-responsive properties

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Polymeric materials are frequently modified to enhance their biological performance. Among such systems, polymer brushes – assemblies of macromolecular chains covalently anchored to a solid substrate – are of particular interest due to their ability to respond to external stimuli, including temperature, pH, redox potential, light, and magnetic fields.[1,2] Adjusting structural parameters such as chain length, grafting density, and molecular interaction capability enables fine control over their physicochemical behavior and broadens their range of potential applications.[3]

In the present study, polymer brushes derived from castor oil-based monomers (CSM) were synthesized on glass substrates via surface-initiated atom transfer radical polymerization (SI-ATRP) and comprehensively characterized. Castor oil, rich in hydroxyl-functional ricinoleic acid, offers a versatile platform for advanced material design. The coatings were analyzed using ToF-SIMS, XPS, AFM, and ellipsometry, and their wettability and morphology were evaluated under controlled variations in temperature and pH. The results demonstrate reversible, stimulus-responsive changes in surface wettability and morphology, indicative of "smart surface" behavior. Temperature sensitivity was most pronounced between 15-20 °C, correlating with chain reorganization and transitions between elastic and viscoelastic states. pH responsiveness was maximized at pH 5-7, decreasing at more acidic or alkaline conditions, an effect attributed to the hydroxyl functionalities of the monomers. These findings confirm that CSM-based polymer brushes exhibit significant, tunable responses to temperature and pH, underscoring their potential for biomedical applications and the development of intelligent polymeric materials.

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OP 4

Hydration-driven boost in piezoionic sensors

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Piezoionic sensors are a novel type of electromechanical sensor that has brought interest in recent years due to its characteristics such as high sensitivity and self-powering. The piezoionic effect is based on an ion gradient generated by a mechanical deformation applied to a polyelectrolyte, resulting in a transient voltage with respect to the separation of ions of different mobilities[1-3]. While there has been no research regarding the effect of water content in the piezoionic performance, this work explored the effect on the water content on a piezoionic material obtained by photopolymerization of a neutral monomer (2-methoxyethyl methacrylate), an ionic monomer ([2-(Methacryloyloxy)ethyl]trimethylammonium chloride) and a crosslinker (polyethylene glycol dimethacrylate Mn=750). While the water content was controlled by storing the films on desiccators with controlled humidities (33, 45, 55, 60, 75 and 84 % RH) and the water uptake was followed by gravimetry, its influence in the mechanical properties was studied by DMA under controlled humidity. In addition, the ionic conductivity as a function of the water content was determined, highlighting and increase in the ionic conductivity (from ~0.0001 to 0.001 S/cm; going from 33-84 RH%) as the water content in the material increases, due to a higher amount of free mobile ions and the creation of conduction pathways. Finally, the electromechanical characterization under controlled humidities was tested, showing the voltage generated increased with the water content under the same mechanical stimulus. In particular, the voltage generated at ~10kPa was around 20, 70 and 100 mV, for films equilibrated at 60, 75 and 84 RH%, respectively.

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OP 5

Kinetic study of the curing process in resorcinol-based epoxy/anhydride thermosets

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Epoxy resins are a widely used class of thermosetting polymers, valued for their excellent adhesion, chemical resistance, and mechanical strength, making them indispensable in coatings, adhesives, composites, and electronics. However, most commercial epoxy systems rely on petrochemical-derived precursors, raising environmental and sustainability concerns. This has driven significant research interest toward biobased alternatives that can match the performance of conventional systems while reducing environmental impact. [1] In the development of such sustainable materials, understanding and controlling the curing reaction is essential, as the crosslinking process governs the final network structure, morphology, and ultimately the mechanical and thermal properties of the resin. In this study, diglycidyl ether of resorcinol (DGER) is introduced as a sustainable alternative to the conventional diglycidyl ether of bisphenol A (DGEBA) for producing high-performance epoxy resins. DGER is synthesized via the diglycidylation of resorcinol, an aromatic diol obtainable through glucose or catechin fermentation, and its curing behavior is investigated by differential scanning calorimetry (DSC) using various anhydrides as hardeners and several imidazole-based initiators. The most promising hardener/initiator pairing is further investigated through chemorheological analysis: the reaction progress is chemically monitored by ATR-FTIR spectroscopy, tracking the disappearance and the appearance of bands typical of epoxy/anhydride crosslinking, while rheological test shows the physical development of the crossilinked stucture. Further, a kinetic study is conducted on data gathered from ATR-FTIR performed in both isothermal and non-isothermal mode. Data fitting confirms an autocatalytic crosslinking mechanism, from which kinetic parameters are determined. Thermomechanical testing and chemical stability assessments demonstrate that DGER-based thermosets combine high mechanical strength with good thermal resistance, highlighting their strong potential for applications demanding superior performance.

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OP 6

Integrated COSMO-RS and experimental strategy for developing stable, 3D-printed PLA-based methotrexate formulations

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Methotrexate (MTX) is a potent antifolate drug widely used against various solid tumors and other malignancies. However, its clinical application is limited by poor aqueous solubility, low bioavailability, and dose-related toxicity [1]. Combining amorphous solid dispersions (ASDs) and 3D printing addresses these challenges, enhancing bioavailability and dissolution rates of poorly water-soluble active pharmaceutical ingredients, while enabling personalized dosage forms [2, 3]. In this study, polylactide (PLA), a biodegradable and biocompatible polymer, was investigated as a carrier of MTX to enhance its pharmacokinetics. Yet, the addition of a plasticizer is usually required to improve the processability of PLA [4]. To rationalize the selection of formulation components (i.e., type of plasticizer, amount) the phase behavior of MTX/PLA/plasticizer systems was predicted using the quantum mechanical approach i.e., conductor like screening model for real solvents (COSMO-RS). After pre-screening using COSMO-RS, polyethylene glycol (PEG) with two different molecular weights Mn 400 and 2000 Da was selected for its potential to enhance PLA–MTX miscibility and filament printability [5]. Particular attention was given to modeling solubility and glass transition temperature (Tg) curves, essential for understanding stability of the blends and thereafter 3D printed ASD dosage forms [6, 7]. Initial experimental formulations were prepared using compression molding to validate COSMO-RS predictions and assess their solid-state properties. Optimized formulations were further processed by melt extrusion, generating potential filaments for 3D printing. Their solid-state properties (crystalline/amorphous state) were assessed, and their long-term physical stability at 25 °C in dried conditions was monitored using DSC, XRD and FTIR techniques. This work demonstrates an integrated computational and experimental approach for the design of PLA-based ASDs, with the goal of developing stable, customizable MTX dosage forms for improved chemotherapy treatment.

Keywords: amorphous solid dispersion; PLA; PEG; methotrexate; COSMO-RS; phase diagram

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OP 7

Synthesis of eco-friendly benzoxazine resin

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This study presents the synthesis of a novel, fully bio-based benzoxazine resin derived from vanillin and furfurylamine as a sustainable alternative to petroleum-based resins. Employing a Mannich reaction under green solvent conditions, we successfully produced a high-performance benzoxazine resin. Structural characterizations (FTIR, NMR) confirmed successful monomer and resin formation, while thermal and thermomechanical analysis (DSC, TGA, DMA) demonstrated exceptional properties: a polymerization temperature below 200°C (enabling energy-efficient curing) and a glass transition exceeding 250 °C, competing conventional resins. Mechanical testing validated its robustness for demanding applications. Key achievements include: (1) a 90% bio-based formulation, (2) an optimized green synthesis minimizing environmental impact, and (3) successful recycling trials, enhancing circularity. By combining sustainability with high performance, this work provides a scalable, eco-friendly solution for advanced polymer applications, addressing both regulatory and ecological challenges.

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OP 8

Electrically responsive starch films for controlled nitric oxide and ligand release

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Nitric oxide (NO) is an endogenously generated signaling molecule that plays a crucial role in physiological processes such as vasodilation, wound healing, and antimicrobial defense. Its short lifetime and high reactivity demand the development of systems capable of controlled NO delivery. Several classes of NO donors have been investigated, including diazeniumdiolates (NONOates), which release NO spontaneously under physiological conditions, and nitrosyl-containing compounds, which can deliver NO triggered by light or redox processes. Incorporating such redox-active NO donors into polymeric matrices offers a pathway to create stimuli-responsive biomaterials. Recently, we demonstrated that certain redox-active nitrosyl compounds can release, under electrical stimulation, both NO and a coordinated ligand. Based on this concept, we conceptualized starch-based films containing a nitrosyl compound as a dual-function delivery platform. By applying an external potential, decomposition of the NO-donor within the film was induced. The process was monitored in real time using Fourier-transform infrared (FTIR) spectroscopy. Preliminary results indicate that the material retains the dual-release behavior observed in solution, enabling controlled release of NO together with a secondary compound. Looking forward, this project aims to develop new NO-donors containing ligands with greater biological relevance, expanding the potential of these smart materials for applications especially in wound healing.

Keywords: nitric oxide release, redox-active nitrosyl compounds, starch films, conductive biomaterials, smart materials, dual-release system, electrochemical drug delivery.

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DOI: 10.1039/C4TB00996G

BOOK of ABSTRACTS

POSTER PRESENTATIONS

PP 1

Electrically responsive starch films for controlled nitric oxide and ligand release

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Nitric oxide (NO) is an endogenously generated signaling molecule that plays a crucial role in physiological processes such as vasodilation, wound healing, and antimicrobial defense. Its short lifetime and high reactivity demand the development of systems capable of controlled NO delivery. Several classes of NO donors have been investigated, including diazeniumdiolates (NONOates), which release NO spontaneously under physiological conditions, and nitrosyl-containing compounds, which can deliver NO triggered by light or redox processes. Incorporating such redox-active NO donors into polymeric matrices offers a pathway to create stimuli-responsive biomaterials. Recently, we demonstrated that certain redox-active nitrosyl compounds can release, under electrical stimulation, both NO and a coordinated ligand. Based on this concept, we conceptualized starch-based films containing a nitrosyl compound as a dual-function delivery platform. By applying an external potential, decomposition of the NO-donor within the film was induced. The process was monitored in real time using Fourier-transform infrared (FTIR) spectroscopy. Preliminary results indicate that the material retains the dual-release behavior observed in solution, enabling controlled release of NO together with a secondary compound. Looking forward, this project aims to develop new NO-donors containing ligands with greater biological relevance, expanding the potential of these smart materials for applications especially in wound healing.

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PP 2

3D-printed drug-eluting scaffolds for periodontal bone repair

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Periodontitis is a chronic inflammatory disease of the gums that leads to progressive destruction of the supporting alveolar bone and is the leading cause of tooth loss in adults worldwide. Conventional treatments often fail to regenerate the lost bone structure, limiting the long-term success of dental rehabilitation. Recent advances in additive manufacturing and biomaterials have opened new opportunities to design patient-specific, bioactive implants that can promote bone regeneration and improve quality of life. In this work, we present a digital light processing (DLP) 3D-printing strategy to build personalized scaffolds for periodontal regeneration [1]. To that end, a photo-crosslinkable resin is developed from bioactive gelatin methacryloyl (GelMA) and low-molecular-weight poly(ethylene glycol) diacrylate (PEGDA) to enhance mechanical stability while maintaining biodegradability [2]. Localized therapeutic action is proided by incorporating curcumin as bioactive agents while further acting as a photoblocker and a radical scavenger to improve printing resolution and cytocompatibility [3]. Nanohydroxyapatite was added to mimic the mineral composition of bone and enhance osteoconductivity. We systematically investigated how key design parameters such as triply periodic minimal surface (TPMS) infill architecture (e.g., gyroid, diamond), porosity and functionally graded structures affect the mechanical performance and drug-release profiles of the scaffolds. In parallel, we developed a cell microencapsulation method that provides a temporary protective environment during the printing process [4]. Together, these strategies highlight the potential of 3D-printed, drug-eluting scaffolds as a personalized regenerative therapy for periodontitis.

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PP 3

Solid-state modification of ABS (acrylonitrile butadiene styrene) for dynamic and reprocessable plastics

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The growing accumulation of plastic waste, particularly from durable engineering polymers such as acrylonitrile butadiene styrene (ABS), necessitates innovative upcycling approaches that go beyond conventional mechanical and chemical recycling. This project explores a sustainable and energy-efficient method for the functional upcycling of ABS via solid-state modification (SSM) [1-2], a solvent-free technique that introduces new functional groups into the polymer matrix without melting. The approach centers on the integration of maleimide compounds bearing dioxaborolane functionalities, enabling dynamic covalent bonding and conferring reprocessability to ABS. Two complementary pathways are under investigation. In the first, the key functional comonomer [3] is synthesized and grafted onto ABS via reactive extrusion (REX) assisted SSM. Reaction conditions are carefully optimized, and various monomer/polymer ratios are tested to determine the structure-property relationships. In the second route, REX-SSM is applied in a one-pot strategy: ABS is initially grafted with specific reactive groups, followed by sequential reactions to incorporate the targeted monomer. The modified ABS materials undergo systematic characterization (GPC, NMR, DSC, mechanical testing) to assess their structural, thermal, and mechanical properties. By comparing both strategies, this project aims to identify the most efficient route for generating reprocessable, high-performance dynamic ABS materials. The overarching objective is to contribute to a more circular plastics economy by extending the lifespan and reusability of engineering-grade polymers.

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PP 4

Light-responsive PNIPAM/gold nanospheres hydrogel-based actuators for biomedical applications

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Light stimuli are considered a safe and effective option for in vivo applications due to their ability to enable non-contact, rapid, precise, and remotely controlled spatial activation [1,2]. As a result, considerable efforts have been directed toward the development of light-driven photothermal polymer nanocomposite actuators for biomedical applications. Among various photothermal materials, gold nanoparticles are particularly notable for their high efficiency in converting light energy into localized heat through a non-radiative relaxation process known as localized surface plasmon resonance (LSPR) [3]. In this study, polyethylene glycol thiol (PEG-SH) surface-modified gold nanospheres (AuNSs) were embedded into a temperature-responsive poly(N-isopropylacrylamide-acrylamide) (PNIPAM) hydrogel via photopolymerization. By utilizing the photothermal effect of AuNSs, which convert photon energy into heat, photo-actuation was successfully achieved. The resulting PNIPAM/AuNSs nanocomposite hydrogel, containing only 0.011 wt.% of AuNSs, demonstrated a significant bending response under green light irradiation (wavelength: 532 nm, intensity: 5 A LED current), achieving a bending angle of 148.8° within 7 seconds. This light-responsive hydrogel shows strong potential as a soft actuator, particularly for supporting miniaturized cameras in navigating endoscopic pathways.

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PP 5

Enzyme immobilization for polymer degradation

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Enzymes are being increasingly considered for polymer degradation [1-2]. They offer a number of advantages, such as the use of non-polluting solvents and mild reaction conditions (temperature, pressure) [3-6].

However, the disadvantages of native enzymes tend to limit their applications. They lack long-term stability and have low recovery and reuse rates [7-8]. In response, enzyme immobilization has been proposed as a solution [9-10]. Immobilization can be achieved using a variety of supports, such as polymer matrices or gold nanoparticles. The latter would not only enhance enzyme performance and capabilities but also enable remotely controllable nanobiocatalysis [11-13].

References

PP 6

Exploring recycling routes for polyolefins

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Plastic waste management has become a major environmental issue in the 21st century []. Polyolefins, such as polypropylene (PP) and polyethylene (PE), are a major environmental concern. They constitute nearly 50% of global plastic production, mainly as single-use packaging which is often discarded in large quantities[1]. Recycling is considered as the most sustainable option, as it reduces waste and preserves resources. However, the current method, mechanical recycling, remains expensive, lowers the polymer quality, and results in inconsistent products[2], [3].

The aim of this work is to explore different recycling routes for polyolefins through either depolymerization (metathesis of LDPE) or functionalization (post-polymerization functionalization of PP).

Metathesis between polyethylene and a liquid alkane oligomer has been effective in depolymerizing PE at low temperatures, but it has drawbacks like long reaction times and high pressures. The goal was to optimize reaction conditions by lowering the pressure, improving selectivity, and using a commercial catalyst[4], [5]. The ^{1}H NMR results showed characteristic peaks of double bonds, indicating that the first step, consisting of dehydrogenation of the polymer, was complete.

A PP-g-MA matrix was used as model to demonstrate the feasibility of post-synthetic functionalization of PP through reactive extrusion-assisted solid-state modification. This involved grafting a specific flame retardant to create[6] [7] inherently intumescent material. The ^{1}H NMR results indicated the potential grafting of the flame retardant after 40 and 60 minutes of reaction.

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PP 7

Developing reactive flame-retardant for thermoplastic polyurethane using reactive extrusion

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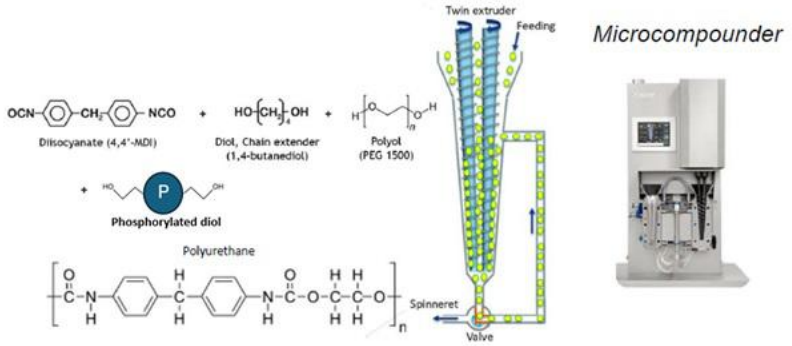
This study is part of a PhD thesis that aims to prepare flame-retardant thermoplastic polyurethane (TPU) using a solvent-free reactive extrusion process. The adopted strategy involves using bifunctional phosphorus-containing diols to replace diols segments commonly used in TPU production. These phosphorus-containing polyols will be thus incorporated directly into the macromolecular chain through reactions with isocyanate groups, leading to the formation of urethane bonds [1]. Reactive extrusion was chosen due to its advantages [2].

To achieve this, the TPU precursors and the reactive flame-retardant diols were directly incorporated into the extruder hopper (Fig. 1) at different contents to prepare flame-retardant TPU with varying amounts of phosphorus. Extrusion conditions and blend compositions were studied to determine optimal conditions and compositions. The obtained materials were used for structural, thermal, mechanical, and flame-retardant analyses.

Several analyses were used to characterize our material (FTIR and TGA).



Scheme 1 : Synthesis of TPU using twin-screw extruder and Brabender Plastograph EC

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PP 8

Modification of poly(butylene terephthalate) by incorporation of a photoreactive cinnamamide moiety via reactive extrusion solid-state

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Over the past 70 years, the success of plastic materials is highlighted by their exponential production with over 400 million metric tons of plastics produced per year to date [1]. However, their plastic pollution, elevated carbon footprint, and linear plastic economy are the three major pressing and persistent global environmental challenges risen due to the insufficient end-of-life management of these plastic wastes [2], [3]. These challenges may view as an opportunity for academics and industrials to rethink the future of plastics via innovative upcycling approaches for more sustainable added-value circular plastic materials. In this work, we propose to reduce the burden of plastic wastes by redesigning polyester wastes, i.e., by post-functionalization of poly(butylene terephthalate) (PBT) with a photoreactive N,N-Bis(2-hydroxyethyl) cinnamamide (BHECA) monomer via reactive extrusion solid-state modification (REx-SSM) approach. At first, the optimal operating SSM reaction conditions with minimal degradation extent between PBT and BHECA were investigated via TGA and 1H NMR, which revealed 150 °C and 30 minutes as the optimal SSM reactions conditions for this system. Secondly, these optimal conditions were transferred to a REx-SSM process to investigate the feasibility of exchange reactions. Thirdly, further optimization of this process involved the effect of varying the catalyst concentration, DBTO in this case, on the thermal and molecular properties of the obtained copolyesters. At the fourth step, after ten hours UV irradiation, the P(BT-co-BHECAT) with 0.60 % molar DBTO in a CDCl3/TFA (9:1) solution surprisingly turned yellowish with no gel formation suggesting no [2π + 2π] photocycloaddition reaction. In addition, 1H NMR finding revealed the occurrence of E→Z photoisomerization, confirming previous result. Furthermore, Single crystal X-Ray diffraction (SC-XRD) revealed a γ-crystal form (5.025 Å) of E-BHECA not satisfying the Schmidt distance criterium, accounting for its incapability of undergoing a [2π + 2π] photocycloaddition reaction. This work highlights the potential of REx-SSM as a versatile and sustainable approach for redesigning thermoplastics paving the way for sustainable added-value plastic materials.

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PP 9

Synthesis and characterization of eco-friendly thermoplastic composites based on recycled polyethylene terephthalate reinforced with banana fibres

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The growing accumulation polyethylene terephthalate (PET) waste, particularly in developing countries, underscores the urgent need for sustainable recycling strategies. This study explores the chemical recycling of PET via glycolysis with 1,3-propanediol, followed by reaction with succinic anhydride and solid state polymerization to produce saturated polyesters (ScP). Theses ScPs are subsequently melt-blended with banana fibres (BF) derived from Pseudo-stems (5-20%) to fabricate bio-composite materials under environmentally friendly conditions. FTIR analysis is employed to quantify chain end concentrations, enabling estimation of the number -average molecular weight (Mn). Result reveal a significant reduction in chain-end groups in ScP compared to PET co-oligomers. Despite similar Mn values, ScPs exhibit lower melting and glass transition temperatures than the original PET. Injection-moulding of BF-ScP composites demonstrate high storage modulus, attributed to strong fibres orientation in the deformation direction and excellent matrix-fibres cohesion. These findings highlight the potential of bio-sourced additives and natural fibres to enhance the value and performance of recycled PET materials.

Keywords: Recycling, glycolysis, PET, succinic anhydride, saturated polyester, bio-composite

PP 10

Characterisation of the physicochemical properties of conjugated materials blend for organic photovoltaics

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Organic photovoltaics (OPV) has emerged as a promising technology, offering the possibility of producing flexible, lightweight, and low-cost solar cells. The performance of these systems depends heavily on the nanoscale physicochemical properties of the mixture of conjugated donor and acceptor materials that form the active layer. The characterization of these mixtures is essential for studying their ability to generate and transport electrical charges. Various Scannig Probe Microscopy (SPM) techniques have played a crucial role in acquiring fundamental knowledge to improve efficiency and design new high-performance systems [1].

In our study, we focused on characterizing the morphological, electrical, photovoltaic, and chemical properties of Thiophene Quinoxaline (TQ1):PC70BM blend using various SPM modes. Figure 1 (b) shows the typical topography of this type of mixture, namely the acceptor domains (PC70BM) characterized by a spherical morphology and the donor domains (TQ1) constituting the matrix. This sample was analyzed by photoconducting AFM. Figure 1 (c) illustrates the response of the blend during in situ illumination by a suitable solar simulator. In this situation, the tip detects the photogenerated holes and the substrate collects photogenerated electrons [1]. These results show how, under these conditions, electrons are transferred from TQ1 to PC70BM. In addition, detailed analysis of the I-V curves in both regions provides us with more information on the charge transport mechanisms. The blend analysis using KPFM mode showed a correlation between surface morphology characteristics and surface potential. This result indicates correct alignment of the energy levels of the two materials for effective charge separation at the donor : acceptor interface. Ultimately, we were able to identify the two phases using Nano-IR microscopy thanks to their chemical properties characteristic, as shown in Figures 1 (e) and (f).

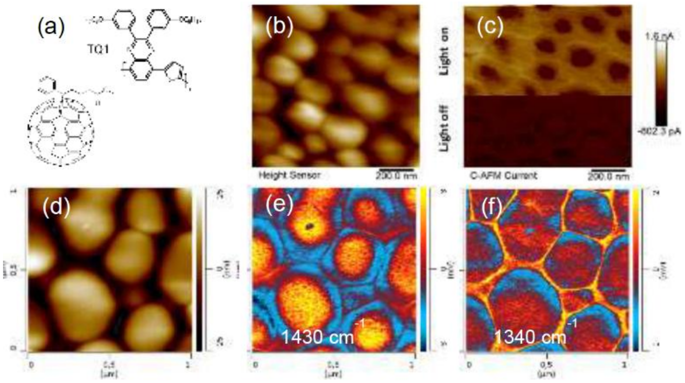

Figure 1. Characterization of the TQ1:PC70BM (1:3) blend starting from a solution in chloroform (a) Chemical structures, (b) Topography, (c) Photocurrent, (d) Topography, (e) Chemical properties (PC70BM phase); (f) Chemical properties (TQ1 phase).

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PP 11

Mechanical Behavior of Processed PBS Monofilaments for Marine Applications

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The development of various industrial sectors has been largely driven by the strategic use of petrochemical-derived plastics that are valued for their tunable properties, ready availability, solvent-free melt processability, and low production costs. In this regard, aquaculture has significantly benefited from the advances in polymer engineering: polymer-based materials are widely used for nets, cages, tanks, and piping systems due to their durability, chemical resistance, and design flexibility [1]. However, their environmental footprint is questionable, particularly when the end-of-life management is concerned. Due to the inertness of the polymeric backbones, most of these plastics are environmentally persistent, leading to the ultimate release of microplastics during the polymer degradation [2]. In this context, biodegradable and biobased polymers represent a promising solution, particularly poly(butylene succinate) (PBS). This bio-based aliphatic polyester is highly recyclable and affords acceptable biodegradability and mechanical properties that are suitable for temporary marine applications [3]. This study investigates the mechanical behavior of PBS monofilaments purposely designed for aquaculture net applications. Three commercial PBS grades were processed via melt-spinning in order to induce its macromolecular orientation. Structural (XRD) and thermal (DSC) analyses confirmed the semi-crystalline PBS nature, highlighting the drawing impact on crystalline organization. Tensile tests revealed grade-dependent mechanical performances and significant improvements in stiffness and tensile strength after drawing. These results provide insights into the suitability of PBS monofilaments for next-generation aquaculture equipment.

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