8th of December

8th International (PaCE) Christmas Symposium 2023

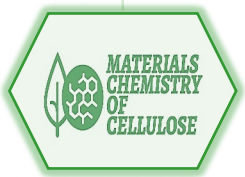
Program & Book of Abstracts

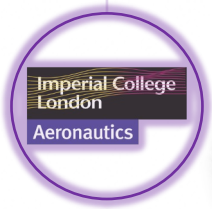
Organized by:

Alexander Bismarck (University of Vienna, Austria)

Eero Kontturi (Aalto University, Finland)

Koon-Yang Lee (Imperial College, UK)





Institute of Materials Chemistry & Research

University of Vienna

1090, Vienna, Austria

09:00 – 09:10


Alexander Bismarck


Eero Kontturi


Koon-Yang Lee

Opening Remarks

09:10 – 09:30

Antje Potthast *(BOKU, Austria)*

In the heat of the night – Fire damage of historical papers and books

EVerba volant, scripta manent – Analysis and possible conservation strategies for the fire-damaged papers from the Duchess Anna Amalia Library.

09:30 – 09:40

Daniela Włoch *(Imperial College, UK)*

Transparent armour reinforced by bacterial cellulose nanopaper

One of nature's masterpiece, bacterial cellulose is used to create laminated, transparent composites with improved impact protection capabilities, surmounting those of industry "gold standard" polymer sheets.

09:40 – 10:00

Milo Shaffer *(Imperial College, UK)*

Multiscale and multidimensional characterization of carbon nanomaterials and nanocomposites

Macroscale assemblies and composite structures, built upon graphene and graphene-related nanomaterials, are promising for a range of applications and devices. Consequently, there is growing demand for more comprehensive characterisation of graphene-based structures. The primary challenges revolve around understanding the morphology, dispersion, and spatial arrangement of the individual graphene flakes, as well as their interactions with other material phases. This presentation…
Click here to see more

09:40 – 10:00

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Multiscale and multidimensional characterization of carbon nanomaterials and nanocomposites

Macroscale assemblies and composite structures, built upon graphene and graphene-related nanomaterials, are promising for a range of applications and devices. Consequently, there is growing demand for more comprehensive characterisation of graphene-based structures. The primary challenges revolve around understanding the morphology, dispersion, and spatial arrangement of the individual graphene flakes, as well as their interactions with other material phases. This thesis develops multiscale and multidimensional characterisation methodologies for investigating various graphene-based structures, employing a combination of optical and electron microscopic techniques, image processing and analysis methods.

Confocal laser scanning microscopy (CLSM) is developed as a valuable tool for microstructural investigation of graphene nanomaterials and nanocomposites, exploiting the technique's distinctive features, including high-contrast and non-invasive imaging, as well as depth discrimination. Using confocal reflection and total interference contrast imaging, the flake thickness distribution in graphene oxide (GO) films is mapped rapidly and quantitatively. In addition to passive characterisation, this thesis shows that CLSM can be used for simultaneous imaging and processing studies: GO films can be selectively reduced in-situ to produce functional patterns at a range of lengthscales from millimetre to sub-micron; multi-modal tracking allows the conversion mechanism to be explored during the process.

Full characterisation of graphene dispersion, particularly in nanocomposites, requires methods for volumetric characterisation; a variety of complementary 3D imaging methodologies are therefore developed. Non-destructive CLSM stack imaging, using reflection and fluorescence modalities, is applied for large-scale examination of graphene nanocomposites. General guidelines are established through discussions of applicability, sample requirements and imaging conditions. 3D characterisation methods based on destructive, serial array tomography are developed, enabling correlative optical and electron microscopic imaging. Multiscale correlative characterisation is demonstrated to be highly significant in extracting rich structural details, unveiling the local organisation, flake orientation, and morphology of various graphene nanocomposites. The availability of 3D datasets provides exciting chances to quantify structural features, as demonstrated through statistical dispersion and distribution analysis of functionalised graphene nanocomposites. This study provides valuable insights into the real structure of graphene films and nanocomposites; the methodologies developed will be widely applicable in the nanomaterials field.

10:00 – 10:10

Hande Barkan *(University of Vienna, Austria)*

Continuous Cr(VI) removal from synthetic wastewater using one-pot functionalised lignin foam

Black liquor, a by-product of paper production, was directly used to synthesize in situ amine-functionalized lignin foams. These foams were then effectively employed for the removal of toxic Cr(VI) from water.

10:10 – 10:30

Stefan Spirk *(TU Graz, Austria)*

Enzyme kinetics at polysaccharide surfaces

Alongside cellulose and lignin, xylan is one of the main polymeric components of the plant cell wall. Its unique properties make xylan an attractive target for use in a variety of industries, including pulp and paper, food, biofuel and biochemical production. However, because it is closely associated with other plant cell wall polymers, it is difficult to… *Click here to see more*

10:30 – 11:30

Coffee Break ☕ **& 1st Poster Session**

11:30 – 11:50

Kristiina Oksman *(Luleå Unviersity of Technology, Sweden)*

Making use of recycled textiles in composites: Fibrillation of recycled textiles and compounding with thermoplastic polymers

The presentation is about the development of a manufacturing process for recycled textiles with thermoplastics by using a co-rotating twin-screw compounding extruder equipped with a side extruder and how different textile fibers can affect the properties of thermoplastic polymer resins used. The process of using recycled textile as fabric strip is a simple method to transform used textiles into materials that can be injection molded or 3D printed into various products. Use of recycled textiles would reduce costs, add value for waste materials and lower carbon dioxide emissions.

10:10 – 10:30

Stefan Spirk ***(TU Graz, Austria)***

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11:50 – 12:00

Dharu Smaradhana *(Imperial College, UK)*

Transforming Oil Palm Waste into Robust, Mouldable All-Cellulose Fibreboards

Empty fruit bunch (EFB) is regarded as waste biomass from palm oil milling. By mimicking papermaking, we've turned EFB into rigid and mouldable fibreboards without synthetic polymers, comparable to industry standards and shaping the future of eco-friendly materials.

12:00 – 12:20

Tekla Tammelin (*VTT, Finland)*

Beer drinking promotes materials engineering

Approximately 6.5 – 8 million tons of rice husks and 2.1 million tons of brewer's spent grain (BSG) are produced annually as industrial waste in Thailand and Germany, the world's 6th and 5th largest producers of paddy rice and beer, respectively. This talk reveals how solid-state photosynthetic cell factories benefit from beer drinking.

12:20 – 12:30

Vishnu Arumughan (*Aalto University, Finland)*

Chitin derived zwitterionic nanostructures: A versatile platform for fundamental studies and advanced applications

This investigation introduces a facile method to fabricate zwitterionic nanostructures from chitin. It also explores their potential as a model substrate for fundamental studies and applications ranging from photosynthetic cell factories to energy storage.

12:30 – 12:50

Wim Thielemans (*KU Leuven, Belgium)*

Solving the plastics recycling problem, one string at a time

We developed a scalable, energy and material efficient method for chemical recycling of polyesters, polycarbonates, and polyamides. Selective conversion of specific polymer chains to monomers from a physically inseparable polymer mixture is possible.

12:50 – 13:50

Lunch 🍽️

13:50 – 14:10

Annika Järvinen *(BioNavis, Finland)*

Unveiling biomaterial intricacies

Embark on a scientific journey delving into polymer research with Multi-Parametric Surface Plasmon Resonanceinsights (MPSPR). From molecular interactions to surface properties, deepening our understanding of material behavior. #bionavis #MPSPR

14:10 – 14:30

Kunal Masania *(TU Delft, Netherlands)*

Three shaping of photosynthetic hydrogels containing Chlamydomonas reinhardtii algae

Exploring Engineered Living Materials (ELMs): Our study delves into the growth and spatial distribution of Chlamydomonas reinhardtii microalgae within 3D hydrogels. By leveraging location-specific growth patterns, we design and print photosynthetic ELMs with enhanced CO2 capturing rates. Mimicking plant leaf adaptations, our approach boosts productivity and offers insights into cluster formation of immobilized algal cells. #ELMs #Bioengineering #Sustainability #AdditiveManufacturing

14:30 – 14:40

Qixiang Jiang (*University of Vienna, Austria)*

Structural Composite Battery

Carbon fibre reinforced anodes and cathodes decorated with LTO and NMC111, respectively, were impregnated with a polymer gel electrolyte. The electrode / electrolyte prepregs were hot consolidated to produce full cells of structural composite batteries.

14:40 – 15:00

Rupert Kargl *(TU Graz, Austria)*

Some observations on the correlation of material properties with charges and network structures

Many polysaccharides easily form charge complexes or other non-covalent aggregates. The network domain size can range from the molecular to the visible scale. This talk shows examples on how charge and network manipulation can control the physical properties of polysaccharide biomaterials.

15:00 – 15:20

Ian Hamerton *(Bristol University, UK)*

Development of benzoxazine nanocomposite blends for space applications

The University of Bristol has been selected by the European Space Agency (ESA) to participate in the Euro Materials Ageing 1 campaign (AO-2020-EMA). From June 2024, four CFRP composite systems (three novel polybenzoxazine resins and a cyanate ester resin), will spend 12-18 months within the SESAME module attached to the Bartolomeo platform of the International Space Station (ISS) to examine their stability in low Earth orbit (LEO). In this presentation, the terrestrial data for the polybenzoxazine (PBZ) resin blends and nanocomposites will be discussed.

15:20 – 16:30

Coffee Break ☕ **& 2nd Poster Session**

16:30 – 16:50

Steffen Müller-Probandt
(*Dienes Apparatebau, Germany)*

Development of Sustainable Carbon Fibres Based on Cellulosic Feedstocks

Introduction to lab and pilot scale wet spinning and carbonisation modular lines for the production of sustainable carbon fibres based on cellulosic feedstocks.

16:50 – 17:10

Tommy Horozov *(Hull University, UK)*

A Christmas cake approach to the immobilisation of plasmonic structures

Searching for Christmas cake recipes we developed a method for immobilization and transfer of non-close packed particle structures assembled at a fluid interface. Sweet!

17:10 – 17:20

Tine Kalac *(Aalto University, Finland)*

Structural colour in carbonized CNF

Pyrolysis of crosslinked cellulose nanofibrils films results in dense carbon membranes with low porosity, tuneable through the degree of swelling. In samples with low swell, a thin film forms on the surface, resulting in a striking metallic lustre.

17:20 – 17:40

Fergal O'Brien (*Royal College of Surgeons, Ireland)*

Learnings from COVID: Biomaterials-based Delivery of Gene Therapeutics for Enhanced Tissue Repair

The once-in-a-century pandemic was conquered using revolutionary mRNA treatments. This has given new momentum to gene therapy research for a myriad of applications. Our group has had success in this area using a scaffold-mediated gene therapy approach in regenerative medicine. This presentation will provide an overview of ongoing research in our lab in this area with a particular focus on gene-activated biomaterials for promoting bone, cartilage, nerve and wound repair.

17:40 – 18:00

Alexander Bismarck

Eero Kontturi

Koon-Yang Lee

Closing Remarks

18:00 - 🍽️ 🍻 🎉 🎁

Nr. 1

Hassan Almousa (***Imperial College, UK)***

Can Carbon Nanotube Grafted Carbon Fibres Improve Compression Performance?

Grafting carbon nanotubes onto carbon fibres creates 'fuzzy' fibres, enhancing fibre/matrix adhesion and interfacial shear strength. This approach, shown to improve compressive strength, delays kink band formation, preventing buckling.

Nr. 2

Philip Verdross ***(University of Vienna, Austria)***

Foam composites from another angle

In order to produce lightweight and durable foam composites based on biological fibres, the interfacial properties of matrix/fibre are basically the only thing that matters. I will tell you why.

Nr. 3

Anne Zhao ***(University of Vienna, Austria)***

From Fungi to Fashion

This study investigated the potential of processing fungi-derived chitin into yarns. The resulting yarns exhibit promising mechanical properties, suggesting their feasibility for environmentally friendly applications in the fashion industry.

Nr. 4

Paul Schweng ***(University of Vienna, Austria)***

A Robust and Low-Cost Sulfonated Hypercrosslinked Polymer for Atmospheric Water Harvesting

The availability of freshwater is rapidly declining due to climate change. Here, we report a sulfonated hypercrosslinked polymer able to repeatedly harvest significant amounts of water directly from air even in the harshest environments on Earth.

Nr. 5

Bengisu Çiftçioğlu ***(Gebze Technical University, Turkey)***

Biodegradable Polymer Based with Agricultural Waste Reinforcement: Polyhydroxyalkanoates/Nanocellulose Biocomposites

The rapid increase in the use of petroleum-derived plastics and the fact that non-biodegradable microplastics are found even in the human placenta in addition to freshwater, air and soil ecosystems reveal the extent of the ecological imbalance. However, the main challenges in the competition of biodegradable bioplastics with conventional plastics remain current. This study is based on two main challenges, one is cost and the other is mechanical performance. In order to reduce the cost of biodegradable microbially produced PHA, the carbon source was obtained from wastewater. Another challenge was overcome by adding nanocellulose from hemp fibers to the matrix to utilize its mechanical properties. In this study, the potential to protect the polymer/nanocellulose scaffolds based on the Thermally Induced Phase Separation (TIPS) technique was investigated. The temperature drop was triggered using a liquid nitrogen bath to prevent agglomeration. Furthermore, the effect of nanocellulose content (1, 5, 10, 30 wt%) on the mechanical properties of PHA biocomposites was investigated. The 10% nanocellulose reinforced PHA biocomposite showed optimum mechanical performance. Its Young's modulus increased from 757 MPa to 1149 MPa and its tensile strength increased from 26.3 MPa to 31.5 MPa with no loss of elongation.

Nr. 6

Neptun Yousefi ***(Aalto University, Finland)***

Shimmering Sustainability: From Glitter Ban to Cellulose Nanocrystals Transformation

EU's glitter ban sparks a wave of eco-conscious change, introducing cellulose nanocrystals with high yields and diverse applications, ushering in a cleaner and more sustainable future.

Nr. 7

Han Tao ***(Aalto University, Finland)***

Thermodynamically Controlled Multiphase Separation of Heterogeneous Liquid Crystal Colloids

In the current work, we develop a series of heterogeneous colloidal suspensions that exhibit both liquid-liquid phase separation of semiflexible binary polymers and liquid crystal phase separation of rigid, rod-like nanocellulose particles.

Nr. 8

Jessica Borges Vilches ***(Aalto University, Finland)***

Controlling macromolecular properties in cellulose nanocrystal-gelatin systems through intermolecular insights

Better understanding and controlling CNC-gelatin systems is crucial to tailor their performance for specific applications. Modifying the pH-induced intermolecular interactions in this system is a feasible strategy to tune its macromolecular properties.

Nr. 9

Roozbeh Abidnejad ***(Aalto University, Finland)***

Cellulose nanofibers-based Pickering foams, from fundamentals to application

Particles to replace surfactants in systems, introducing CNF for superior interfacial stabilization. This boosts foamability/lifespan, making lightweight materials. Ideal for fire retardancy, insulation and reducing reliance on petroleum-based foams.

Nr. 10

Yingfeng Wang ***(Aalto University, Finland)***

HCI gas alcoholysis of cotton linter fibers

Lignocellulose alcoholysis enhances solubility, depolymerization, and yields valuable chemicals. Using gaseous HCl on cotton-based filter paper samples offers an efficient, clean approach for cellulose hydrolysis.

Nr. 11

Topias Kilpinen ***(Aalto University, Finland)***

Pre-treatment to retrieve xylose and xylooligosaccharides by HCl gas directly from biomass

In this study, HCl gas was employed to selectively hydrolyze hemicellulose from aspen wood flour in a gas-solid system. Selectivity for hemicellulose was achieved by adjusting the acid concentration inside wood flour to 36% during gas hydrolysis.

Nr. 12

Ville Helle ***(Aalto University, Finland)***

Producing high aldehyde content cellulose

Increasing aldehyde content in cellulose improves reactivity, thus enhancing its potential as a raw material for value added products. We aim at a sustainable route via electrochemical oxidation.

Nr. 13

Cunxin Liu ***(Aalto University, Finland)***

Using inorganic solutions to dissolve cellulose and generate functional hydrogel

This work is using cost-effective, recyclable inorganic solutions to dissolve cellulose and preapre hydrogels with functional property like ionic conductivity, strain sensitivity, etc. These gels may find application in energy storage and sensing fields.

Nr. 14

Marcel Kröger ***(Aalto University, Finland)***

Covalently bound cellulose-based fillers for pHEMA-composites

With the idea in mind of preventing crack fromation and enabling better load transfer from matrix to filler, we are aiming for more attractive Stress/Strain curves by inserting vinylized, crystalline nanocellulose rods into the polymer backbone.

Nr. 15

Teemu Suutari ***(Aalto University, Finland)***

Solid-state cell factories from CNC hydrogels

CNC hydrogels, cross-linked with MLG produce strong hydrogels. Photosynthetic cells trapped within the hydrogel remain metabolically active for extended time. Will this be the future of sustainable biomanufacturing?

Nr. 16

Ira Smal ***(Aalto University, Finland)***

Charge Matters: Probing the influence of Surface Charge on Non-Ionic Polymer Adsorption

Investigating diverse surface charges' impact on non-ionic polymer adsorption onto natural fibers. This study explores the complex interplay between surface charges, water interactions, and polymer adsorption processes.

Nr. 17

Laura Koskelo ***(Aalto University, Finland)***

CEBON –bone-like composites of nanocellulose

Composite made CNC hydrogel, casein micelles and hydroxyapatite have bone-like nanostructure and probably bone-healing potential. Casein micelles release Ca2+ and PO43+-ions due to acidic CNC matrix and control HAP crystallization as in bone tissue.

Nr. 18

Nashwa Attallah ***(Aalto University, Finland)***

Hyperspectral imaging for hydrolyzed cellulose

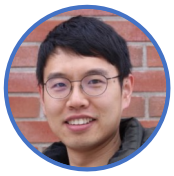
Classify cotton samples with different degree of polymerization (DP) using hyperspectral imaging and ML and Correlate with experimental DP measurements. This work aims to swiftly use hyperspectral system to predict DP of cellulosic materials and other polymer characteristics.

Nr. 19

Valentina Guccini *(Aalto University, Finland)*

Osmotic (de)hydration to assemble nanocellulose based hydrogels for photosynthetic microorganisms

At the interface between chemistry, biology and material science we are looking into new ways to prepared tailored biocompatible matrixes to trigger a desired biological response. Less waste and carbon dioxide, more clean water and valuable compounds!



Nr. 20

Wenyang Xu *(Aalto University, Finland)*

An exotic solid-state adsoprtion meets woods sprking their piezeoelectric generation

Solid-state adsorption renews its application on non-delignified wood, facilitating a peculiar piezoelectric performance, i.e., around 10-time higher output voltage than delignified wood, beyond a nano-scale hydrophobic coating.

Nr. 21

Thuy Linh Phi *(Aalto University, Finland)*

Exploring Surfactants Absorption on CNCs: A Quart Crystal Microbalance (QCMD) Study

This research unveils the advanced capability of a distinctive surfactant to successfully adsorb onto cellulose nanocrystals (CNCs), a feat unachievable by conventional surfactants.

Nr. 22

Jiayi Sun (*Imperial College, UK*)

Reconstituded wood: cellulose reinforced lignin composites from ionic liquid

We're turning lignin from wood chips into high-strength composites, challenging traditional materials! A low-cost green ionic liquid that extracts and crosslinks lignin effectively, unlocking the next generation of #SustainableStructures!

Nr. 23

Jiawei Zhang (*Imperial College, UK*)

Manufacturing wooden foams from wood particles with deep eutectic solvent

Foams from wood species are produced using a selected deep eutectic solvent (DES). Mechanical frothing is applied to foaming the dark slurry, contributing to green materials for advanced applications.

Nr. 24

Joanne Li (*Imperial College, UK*)

Multi-functional nanocellulose coating in protective clothing

An ultra-low grammage of functionalised nanocellulose coating for enhanced filtration performance in chemical protective garment & give insight in choosing the best solvent for dispersing nanocellulose.

Nr. 25

Paul Eid (*Imperial College, UK*)

Creating Superhydrophobic Powders from Waste Chicken Eggshells for use in Oil-Water Separation

This study examines the feasibility of using waste chicken eggshells as a superhydrophobic powder for use in oil-water separation. The eggshells are boiled, dried, blended and functionalised with stearic acid to impart superhydrophobic properties.

Nr. 26

Paulina Gordina (*Imperial College, UK*)

Reinforcing Calcium Carbonate Reservoirs via a Dual Polymer Chemical Consolidation Approach

A dual-polymer based approach showed increase in unconfined compressive strength of CaCO3 compared to untreated samples and those treated with only one polymer. This shows promise of using multiple polyacrylamides for reinforcement of carbonate wells in the oil, gas and carbon capture industries to manage fines migration.

Nr. 27

Yifang Zhang (*Imperial College, UK*)

Upcycling of carbon fibre epoxy resin prepreg into syntactic foam

Microsphere syntactic foams are successfully manufactured using carbon fibre epoxy prepreg waste. Liquid nitrogen, as one of the cheapest cryogenic fluids, is used to reduce prepreg's tackiness, forming the syntactic foam with enhanced mechanical performance.

Nr. 28

Mikhail Koreshkov (*BOKU, Austria*)

Sustainable Food Packaging – Modified Kombucha Derived Bacterial Cellulose Nanofillers in Biodegradable Polymers

Addressing plastic pollution with sustainable food packaging! Modified bacterial cellulose enhances biodegradable composites, reducing oxygen permeability, accelerating biodegradation, and preserving mechanical properties. A green solution! 🌿

Nr. 29

Veronika Biegler *(University of Vienna, Austria)*

Pushing the (material) limits – Expectations and potential of pulp fiber foams

Through an evaluation of morphology and the resulting quasi-static material properties, the potential applications and suitability of pulp fiber foams will be unveiled.

Nr. 30

Lukas Brandfelldner

(University of Vienna, Austria)

Sliding the slope of friction factors

2D surface fitting was employed to capture the onset of drag reduction – the Reynolds number threshold after which the friction factor in turbulent flow is decreased – of polymer solutions in long-term degradation experiments. #turbulence #ViEDRA

Nr. 31

Kathrin Weiland *(TU Delft, Netherlands)*

3D-printed hierarchical electrodes for microbial electrosynthesis

Microbial electrosynthesis (MES) has emerged as a promising technology to foster the utilization of anthropogenic CO2. Electrons are supplied to living microorganisms, which convert CO2 to higher-value chemicals. AM techniques are investigated to prepare hierarchically porous cathodes with optimized geometries featuring biofilm formation and highly controlled flow to replenish nutrients.

Nr. 32

Amy Ho *(City University of Hong Kong, Hong Kong)*

Polymer fibre/nanofibrillated cellulose hybrids and composites

Incorporating polymer fibres into brittle nanocellulose films forms tough hybrid films that as a preform can be converted into nanocellulose reinforced composites with high tensile strength, even when wet.

Nr. 33

Diana Bratilescu *(University of Vienna, Austria)*

High performance amorphous polymer composites

Polyetherimide represents a suitable choice to be a matrix for composite materials used for high-temperature applications having a glass transition temperature of 217 °C. We present a simple alternative to hot-melt processes to produce carbon fibre-reinforced polyetherimide composites.

Nr. 34

Nesrine Battoul Debabèche *(University of Vienna, Austria)*

ALL-CELLULOSE SANDWICHES

Have you ever wondered how to make moulded cellulose pulp foams stronger? We will demonstrate that the mechanical properties of these lightweight cellulose foams can be significantly improved using different sandwich approaches.

Nr. 35

Pankaj Goyal ***(Aalto University, Finland)***

Exploring the unexplored light response mechanism of cellulose synthesis in Bacteria.

The study focuses on the unknown phenomenon of light-responsive cellulose synthesis in bacteria. We evaluate the effect of the continuous exposure of visible light with different wavelengths and photon flux densities on the cellulose production.

Nr. 36

Emina Muratspahic ***(University of Vienna, Austria)***

Superpower' of poly(acrylamide-co-styrene): from drag reducing agent to emulsifier

Poly(acrylamide-co-styrene) was tested as drag reducing agent and for 'self-removal' from aqueous solutions after drag reduction applications. Recovered polymer was used as emulsifier stabilising oil/water emulsions to produce superporous hydrogels.