HYBER-FinnCERES Symposium 2019

15-17 May, Wanha Satama, Helsinki

FinnCERES Materials Cluster

HYBER

HYBER Centre of Excellence in Molecular Engineering of Biosynthetic Hybrid Materials

FinnCERES Flagship of Materials Bioeconomy

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HYBER-FinnCERES Symposium 2019

15-17 May
Wanha Satama, Pikku Satamakatu 3-5, Helsinki

Day 1 – Wednesday 15.5.

8:30 – 9:00 Morning coffee

9:00 – 9:15 Welcome by Olli Ikkala

Session 1 – Chair: Olli Ikkala

9:15 – 10:15 Akif Tezcan,
University of California, San Diego
Functional protein assemblies by chemical design

10:15 – 10:45 Coffee break

10:45 – 11:45 Darshil Shah, University of Cambridge
Working with nature: Designing a structural biocomposite

11:45 – 12:45 Johannes (Bas) Overvelde, AMOLF
Soft robotic matter

12:45 – 14:15 Lunch (posters)

Session 2 – Chair: Markus Linder

14:15 – 15:15 Daniel Harries,
Hebrew University of Jerusalem
How macromolecules respond to changes in solution: From bridging to depletion interactions

15:15 – 15:45 Coffee break

15:45 – 16:45 Helmut Cölfen, University of Konstanz
From biominerals to advanced mesostructured materials

16:45 – 17:15 Jaakko Timonen, Aalto University
TBA

17:15 – 17:45 Markus Linder, Aalto University
Nacre mimetics: Sticking stiff elements together

18:00 – Poster Session, Wine & Buffet
Wanha Satama, A-Sali

Day 2 – Thursday 16.5.

Session 3 – Chair: Merja Penttilä

8:30 – 9:00 Morning coffee

9:00 – 10:00 Ilja Voets,
Eindhoven University of Technology
Engineering biosynthetic extremozymes for cascade reactions in harsh environments

10:00 – 11:00 Steve Eichhorn, University of Bristol
Gels, fibres and composites from cellulose

10 min short break

11:10 – 12:10 Akira Isogai, University of Tokyo
Biomass refinery-related fundamentals and applications

12:10 – 14:15 Lunch (posters)

Session 4 – Chair: Orlando Rojas

14:15 - 15:15 Lennart Bergström, Stockholm University
Interfacial engineering of nanocellulose-based hybrid foams

15:15 – 15:45 Coffee break

15:45 – 16:45 Antje Potthast, University of Natural Resources and Life Sciences, Vienna
The book in a test tube

16:45 – 17:45 José Carlos del Río, Institute of Natural Resources and Agrobiology of Seville
Engineering plant lignins: Novel lignin monomers derived from 'outside' the canonical monolignol biosynthetic pathway

19:30 Invited Speaker Dinner

Day 3 – Friday 17.5.

Session 5 – Chair: Tekla Tammelin

8:30 – 9:00 Morning coffee

9:00 – 10:00 You-Lo Hsieh, University of California, Davis
Material innovations: from tunable chemical functionalities to hierarchical structures

10:00 – 11:00 Raul Fangueiro, University of Minho
Natural fibers and textiles

11:00 – 11:30 Coffee break

11:30 – 12:30 Julien Bras, Grenoble Institute of Engineering
Use of nanocellulose for active and intelligent packaging

12:30 – 13:30 Orlando Rojas, Aalto University
Science and impact of HYBER and FinnCERES

13:30 – 14:30 Lunch

FinnCERES Materials Cluster

HYBER
Molecular Engineering of Biosynthetic Hybrid Materials Research

Session chairs

Professor Olli Ikkala
Aalto University

Ikkala is the director of the Academy of Finland Centre of Excellence in Molecular Engineering of Biosynthetic Hybrid Materials Research (HYBER) and heads the Molecular Materials laboratory at the Department of Applied Physics of Aalto University. His research focuses on developing functional materials based on hierarchical self-assemblies, biomimetics, and materials originating from nature, such as nanocellulose. The laboratory is multidisciplinary, combining physics, chemistry, and materials science.

Professor Markus Linder
Aalto University

Linder is the vice director of HYBER and leads the Biomolecular Materials research group in the School of Chemical Engineering at Aalto University. The Biomolecular Materials group seeks to understand and utilize biological design strategies for materials. In particular, they try to understand and mimic how high-performance materials function in nature, starting from the molecular level, and explore how the molecular structure and interactions result in different materials properties. Proteins are especially interesting for this because detailed molecular engineering of their structure is now possible.

Professor Merja Penttilä
VTT Technical Research Centre of Finland and Aalto University

Penttilä is a HYBER PI, a research professor at VTT, and an adjunct professor at Aalto University. Her main focus is on advancing science and technology in the fields of industrial biotechnology and synthetic biology. Microbes are used as cell factories to produce enzymes, chemicals and material components such as bioplastics precursors and silk. Synthetic biology enables the design and rapid construction of microbes with functionalities found anywhere in nature and engineering of novel properties. Recently, she has been establishing the Synbio Powerhouse, an innovation ecosystem initiative for enhancing synthetic biology activities in Finland.

Professor Orlando Rojas
Aalto University

Rojas is a PI of both HYBER and FinnCERES, and leads the Biobased Colloids and Materials research group (BiCMat) at Aalto University. The BiCMat group works towards supporting global sustainable development through research on the fundamental and utilization aspects of renewable resources, including lignocellulose, proteins and other biopolymers. His research focus is on finding competitive alternatives to fossil materials through research into bio-based materials at different size scales, mainly those displaying large interfacial areas such as fibres (micro/nanofibres), fibre networks, particles, foams and colloidal systems.

Research Professor Tekla Tammelin
VTT Technical Research Centre of Finland and Aalto University

Tammelin is a research professor in biomaterials engineering and design at VTT, a FinnCERES PI and a docent in bioproduct technology at Aalto University. Her research promotes innovative biomaterial concepts, aiming at future breakthroughs, including bio-based structures as selective membranes and filters, smart textiles, intelligent packaging, (bio)sensors and energy materials. Her expertise encompasses the development of bio-based materials, especially nanocellulosic materials and hemicelluloses, the formation of films, foams and webs, and applications of these materials via an understanding of their structure-function relationships and the decisive role of interfaces.

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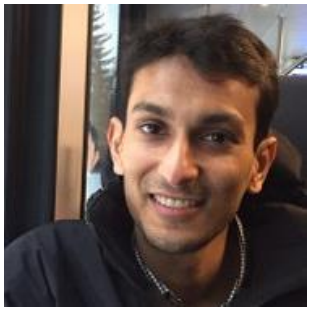
Invited speakers

Professor Akif Tezcan
University of California, San Diego (USA)

Functional protein assemblies by chemical design

Tezcan is a professor and Leslie Orgel Faculty Scholar in the Department of Chemistry and Biochemistry at UC San Diego. His research group uses a diverse array of tools for building functional protein assemblies and novel biological materials, and for understanding and expanding the roles of metals in biology. Major research themes include metalloprotein design and evolution, novel protein self-assembly through chemical design, molecular dynamics simulations, developing protein crystal-polymer hybrids and protein-metal-organic-frameworks (protein-MOFs), and studies on elucidating and augmenting the catalytic activity of nitrogenase.



Dr Darshil Shah
University of Cambridge (UK)

Working with nature: Designing a structural biocomposite

Shah is a senior research associate at the Centre for Natural Material Innovation at the University of Cambridge, specializing in natural materials science and technology. He works with scientists across disciplines developing biomaterials, such as engineered wood, bamboo, and natural fibre composites as lightweight, sustainable, and structural alternatives to conventional materials for various application sectors, including wind energy, construction, transport, healthcare, and consumer products. A major aim is to combine sustainability with performance and functionality. Three principle areas include applied research developing low-embodied energy structural composites; fundamental research exploring natural materials and structures for bioinspiration; and a combined approach designing smart, functional biomaterials.

Dr Johannes T. B. (Bas) Overvelde
AMOLF (The Netherlands)

Soft robotic matter

Overvelde is group leader of the Soft Robotic Matter research group at AMOLF. His focus is on computational research, especially numerical simulations, solid and fluid mechanics, materials science, and mathematical optimization. These fields have exciting applications in biomedical engineering and soft robotics. The group focuses on the design, fabrication, and fundamental understanding of materials capable of autonomously adapting to – and harnessing – environmental variation. The aim is to uncover principles that help us understand how non-linearity and feedback can result in the emergence of complex but useful behaviours in soft actuated systems. The group uses computational, experimental, and analytical tools to explore active and sensing elements to implement feedback capabilities, and for computation in soft architected materials. Combining concepts from soft robotics and architected materials provides new and exciting opportunities for the design of compliant structures and devices with highly non-linear behaviour.

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Professor Daniel Harries
Hebrew University of Jerusalem (Israel)

How macromolecules respond to changes in solution: From bridging to depletion interactions

Harries is a professor at the Institute of Chemistry and the Fritz Haber Center for Molecular Dynamics of the Hebrew University of Jerusalem. His research explores how biologically diverse environments create conditions for macromolecules to associate and dissociate and form complexes that carry out specific functions in cells. Examples include enzymes that interact and remodel lipid membranes, proteins that fold and unfold in crowded solution and may associate to form aggregates, including amyloid fibres. The group studies these themes in several biologically relevant systems involving collections of self-assembling macromolecules, such as peptide folding and aggregation and viral assembly. They use theory, simulations and experiments to address these molecular mechanisms and their far-reaching implications, including in biotechnological applications.

Professor Dr Helmut Cölfen
University of Konstanz (Germany)

From biominerals to advanced mesostructured materials

Cölfen is a professor of physical chemistry at the University of Konstanz where he leads a research group investigating and applying mineralization principles. His research interests include nucleation, classical and non-classical crystallization, bio-mineralization, synthesis of functional polymers, directed self-assembly of nanoparticles, and fractionating methods of polymer and nanoparticle analysis, especially analytical ultracentrifugation. The group has made contributions to high-resolution particle size analysis with Ångstrom resolution in solution, microcrystals, non-classical nucleation and crystallization, CaCO3 crystallization, bio-inspired mineralization, synthesis of double hydrophilic block copolymers, and additive controlled crystallization.

Professor Jaakko Timonen

Aalto University (Finland)

TBA

Timonen is an assistant professor of experimental condensed matter physics and leads the Active Matter research group at the Department of Applied Physics at Aalto University. He is also an Academy of Finland Research Fellow 2018-2023. Timonen's research is broadly focused on the physics of soft and biological materials. Some examples include pattern formation in ferrofluids, lotus-mimicking superhydrophobic surfaces, magnetic tweezing of 'non-magnetic' matter, the coloration of a certain spider from Madagascar and fundamentals of slippery lubricated surfaces. His current Academy Research Fellowship focuses on developing techniques for controlling phase transitions in microscopic active matter systems.

Professor Ilja Voets
Eindhoven University of Technology (The Netherlands)

Engineering biosynthetic extremozymes for cascade reactions in harsh environments

Voets is a professor in the Department of Chemical Engineering and Chemistry at Eindhoven University of Technology. She leads a team of chemists, physicists, biologists, and engineers, studying self-assembly processes in (biological) soft matter. The goal is to gain fundamental insights into these processes and translate them into rational design strategies for novel functional soft materials. She is interested in colloidal self-organization, polymer assembly and folding, and protein biophysics. She studies how to control intra- and intermolecular copolymer assembly to reveal key structure-property relations, package fragile biomolecules, develop artificial enzymes, enhance colloidal stability and tailor smart materials. Voets has a particular fascination for ice-binding proteins that help fish, insects, and plants to survive in extreme environments at sub-zero temperatures. Another key research challenge is that of orchestrating colloidal self-assembly with remote cues such as light and temperature.

Professor Steve Eichhorn
University of Bristol (UK)

Gels, fibers and composites from cellulose

Eichhorn is a professor and is head of the School of Materials Science and Engineering at the University of Bristol. His research interests are at the interface between natural and biomaterials research with a particular emphasis on cellulosic materials and composites. He also has ongoing research interests in the following areas: natural fibre composites, high performance cellulose fibres, carbon fibres from sustainable precursors, cellulosic gels, and nanocomposites. In terms of techniques, he has particular expertise in the use of Raman spectroscopy, synchrotron x-ray diffraction, and molecular dynamics/mechanics modelling of polymeric materials.

Professor Dr. Akira Isogai
University of Tokyo (Japan)

Biomass refinery-related fundamentals and applications

Isogai is a professor in the Department of Biomaterial Sciences at the University of Tokyo. His research activities extend from fundamentals to applications of cellulose, chitin, and other polysaccharides. Fundamental research themes include chemical and nano-structural studies on plant cells and plant components, e.g. cellulose and hemi-cellulose. Applied themes include investigations into the preparation, characterization, and utilization of new bio-based nanomaterials and nanocomposites, and the development of paper devices for medical/electronic applications. For further quantitative utilization of biomass materials in high-tech fields, and to establish a sustainable society using renewable resources, fundamental and applied studies of polysaccharides and related research projects are under development. These are based on a deep understanding of natural/synthetic polymers from the molecular- and nano-levels to bulk materials.

Professor Lennart Bergström
Stockholm University (Sweden)

Interfacial engineering of nanocellulose-based hybrid foams

Bergström is a professor in the Department of Materials and Environmental Chemistry at Stockholm University. His research group studies the self-assembly of nanoparticles and novel process routes for nanocrystals, porous materials, and other inorganic colloids to form novel nanostructured materials with useful properties. The aim is to generate a better understanding of molecular or mesoscopic assembly mechanisms. Biomimetic synthesis, which involves the integration, directed assembly, and controlled crystallization of inorganic materials with polymers and biomolecules, is another field of interest. The group also explores traditional methods to treat fibres from renewable resources.

Professor Antje Potthast
University of Natural Resources and Life Sciences Vienna (Austria)

The book in a test tube

Potthast is a professor in the Department of Chemistry at the University of Natural Resources and Life Sciences, Vienna, and leads the Biopolymer and Paper Analytics research group. The group studies lignocelluloses and polysaccharides, especially cellulose, hemicelluloses, and lignin. They apply established analytical tools to various species and tasks, and develop new analytical methods. One major focus is on advanced cellulose and lignin analytics, e.g. fast characterization of the quality and function-property relationships of technical lignins. Cellulose and process characterization in the pulp and paper industries requires robust techniques, which are supported by a comprehensive database of more than 500 cellulosic substrates. Another research area relates to modern conservational science, by addressing the molecular mechanisms of cellulose aging, paper (de)acidification, ink corrosion, damage assessment, and recommending treatments for valuable historic cellulosic objects.

Dr José Carlos del Río
Institute of Natural Resources and Agrobiology of Seville (IRNAS, Spain)

Engineering plant lignins: Novel lignin monomers derived from 'outside' the canonical monolignol biosynthetic pathway

Del Río is a Senior Researcher in the Department of Plant Biotechnology at the Institute of Natural Resources and Agrobiology of Seville (IRNAS-CSIC), Spain, where he leads a research group exploring lignocellulosic materials of industrial interest. His research activity is aimed at the chemistry of the plant cell-wall components and the study of the mechanisms of their chemical, microbial and/or enzymatic transformation. Dr. del Río has high expertise in the structural characterization of lignins from woody and non-woody plants. His investigations led to the discovery of different phenolic compounds derived from outside the canonical monolignol biosynthetic pathway, namely the flavonoid and stilbene pathways, that behave as authentic lignin monomers, and that challenged the traditional definition of lignin.

Professor You-Lo Hsieh
University of California, Davis (USA)

Material innovations: from tunable chemical functionalities to hierarchical structures

Hsieh is a Distinguished Professor in the Department of Materials Science and Engineering (Textiles and Clothing) at UC Davis. Her research group integrates polymer chemistry with materials engineering to develop sustainable strategies for deriving 0D and 1D bio-nanomaterials and engineering 1D to 3D advanced functional materials, including hierarchical and hybrid nanofibers, micro-/meso-porous fibers, thin films, and network structures like hydrogels, aerogels, and membranes. These approaches expand the potential of soft materials to create novel structures, foundation nanomaterials, and biological nanomaterial innovations.

Professor Raul Fangueiro
University of Minho (Portugal)

Natural fibers and textiles

Fangueiro is a professor and senior researcher in the School of Engineering at the University of Minho, Portugal. He leads the Fibrous Materials Research Group with expertise in advanced materials (nano, smart, composites) and structures (3D, auxetic, multiscale). He is also the coordinator of Fibrenamics, a multidisciplinary, international platform including 200 partners, developing the promotion, dissemination, technology transfer, and research activities on fiber-based advanced materials.

Associate Professor Julien Bras
Grenoble Institute of Engineering (France)

Use of nanocellulose for active and intelligent packaging

Bras is an associate professor at the Grenoble Institute of Technology (Grenoble INP Pagora). He is also deputy director of the Laboratory of Pulp and Paper Science and head of the Multiscale Biobased Material group at Grenoble. Bras's group focuses on research on biomaterials, nanocellulose, and specialty papers. His expertise deals particularly with nanocellulose, and bio-based and smart materials. Bras has proposed a new approaches to the production, characterization, and functionalization of nanocellulose for a variety of applications.

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List of posters

	Presenter	Title
1	Rubina Ajdary	Nanocellulose single-component inks and cell proliferation in 3D-printed scaffolds
2	Eduardo Anaya	Aggregation Induced Emitting Biohybrids for Bioimaging
3	Long Bai	Two-Phase Emulgels for Direct Ink Writing of Skin-Bearing Architectures
4	Dmitrii Fedorov	Analytical ultracentrifugation
5	Elena Gorshkova	CFD modelling of mixing in two phase suspension of lignin and oxygen
6	Marianna Granatier	Chemistry of GVL stability / degradation under pulping conditions
7	Alessandra Griffo	Single Molecule Force Spectroscopy on Recombinant Fusion Proteins
8	Katja Heise	Thermo-responsive cellulose hydrogels by grafting low-molecular-weight polymer chains
9	Heidi Henrickson	Aalto Materials Platform: Advancing cross-disciplinary communication and collaboration
10	Matti Hokkanen	Scanning Droplet Adhesion Microscopy: Towards quantitative understanding of microscale wetting
11	Ville Hynninen	Properties and spinning of a thermoresponsive methlycellulose/cellulose nanocrystal composite gel
12	Leena-Sisko Johansson	XPS experiments customised for celluloses (and soft surfaces in general)
13	Chris Jonkergouw	Towards Multicellular Communities
14	Sofia Julin	DNA Origami Directed 3D Nanoparticle Superlattice via Electrostatic Assembly
15	Pertti Kauranen	Supercapacitors using wood based activated carbon
16	Jukka Ketoja	Enhancing mechanical performance of cellulose materials with designed structural complexity
17	Antti Korpi	Electrostatic self-assembly of multifunctional protein cage cocrystals
18	Tero Kämäräinen	Polyphenol-based colloidal particles from tannic acid
19	Huy Quang Lê	In-depth characterization of the process fractions in γ-valerolactone-based hardwood biorefinery
20	Laura Lemetti	Molecular crowding facilitates assembly of spidroin-like proteins through phase separation
21	Qing Liu	Bio-Based Materials for Heparin Binding
22	Kai Liu	Improving surface-wetting characterization
23	Tia Lohtander	A Modern Menace: Microplastics
24	Johanna Majoinen	Oligosaccaride based block copolymer self-assembly
25	Kaisa Marjamaa	Lytic polysaccharide monooxygenases in oxidatative modification of cellulosic fibres
26	Lahja Martikainen	Strain-stiffening of agarose gels
27	Zhuojun Meng	Water Interactions in Biomaterials Engineering
28	Bo Peng	Synthesis of superparamagnetic cobalt nanocrystal clusters as catalysts for controlled H2 generation
29	Claudia Pigliacelli/ Emilie Ressouche	Self-assembly of halogen bonded polymer-iodinated compounds complexes
30	Geet Raju	Active drops created and driven by electric field
31	Maria Sammalkorpi	Molecular Modelling of Oxidized Cellulose Surfaces
32	Boxuan Shen	DNA and virus -assisted lithography
33	Géza Szilvay	Production of protein polymers in the filamentous fungus *Trichoderma reesei*
34	Tarja Tamminen	Role of oxygen in the AlkOx process
35	Salla Välimäki	Supramolecular Host-Guest Complex For Heparin Binding and Sensing
36	Cunming Yu	Bioinspired Functional Interfaces: from Superwetting of Gas Bubble to its Applications
37	Hang Zhang	Programming hydrogel with classical conditioning algorithm
38	Monika Österberg	Understanding interactions of cellulose nanofibrils and spherical lignin particles

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