

## BP 28: Biopolymers, Biomaterials and Bioinspired Functional Materials (joint session CPP/BP)

Time: Friday 9:30–11:15

Location: H39

### Invited Talk BP 28.1 Fri 9:30 H39

**New biobased material concepts using scattering techniques to elucidate and control nanoscale assembly** — ●DANIEL SÖDERBERG — KTH Royal Institute of Technology, Department of Fibre and Polymer technology, Stockholm, Sweden

Cellulose, the most abundant biopolymer on earth, can be crucial in mitigating fossil-based resources to more sustainable solutions. It is used as an engineering material, e.g. sawn timber, pulp for papermaking or as a polymer as a basis for plastic materials.

Cellulose nanofibres (CNF) constitute the structural component of plants, it is a semi-crystalline, semi-flexible rod-like nanoparticle having cross-sections in the order of 4-5 nm and lengths around one micrometre. Based on technical developments during the last decades, it is today possible to extract the CNF in large quantities, which has promoted significant research efforts aiming at new material concepts and devices based on cellulose.

Small and wide-angle x-ray scattering have been used to understand nanoscale assembly during fibre spinning from a CNF dope using microfluidics, allowing the tuning of the hierarchical structure, resulting in 100% bio-based filaments with exceptional properties. Furthermore, to develop scalable engineering processes, an in-depth understanding of nanoscale diffusion and the effects of nanoparticle interaction in low-concentration crowded systems has been pursued by combining light-scattering, X-ray Photon Correlation Scattering and coarse-grain modelling.

### BP 28.2 Fri 10:00 H39

**A Semisynthetic Superparamagnetic Nanoprobe for Protein Targeting and Manipulation** — ●ANDREAS NEUSCH<sup>1</sup>, IULIA NOVOSELOVA<sup>1</sup>, NIKOLAOS TETOS<sup>2</sup>, MICHAEL FARLE<sup>2</sup>, ULF WIEDLAND<sup>2</sup>, and CORNELIA MONZEL<sup>1</sup> — <sup>1</sup>Heinrich-Heine University Düsseldorf, Germany — <sup>2</sup>University of Duisburg-Essen, Germany

Probing and manipulating biological functions requires tools to target and modify the proteins involved in the respective process. In recent years Magnetogenetics emerged as an approach where magnetic nanoparticles (MNPs) and external magnetic fields are used to realize such manipulation (Lisse et al., *Adv. Mater.*, 29, 1700189 (2017)). The advantages of this combination lies within the deep tissue penetration of magnetic fields and the possibility to apply stimuli on nanoscales leading to spatial redistribution, force application, or heat generation of proteins. However, a precise active perturbation requires MNPs to be monodisperse, biocompatible, tunable with regard to their magnetic properties, as well as exhibiting a modifiable molecular shell (Monzel et al., *Chem. Sci.* 8, 7330-7338 (2017)). Here, we synthesize a bioinspired semisynthetic MNP - Magnetoferritin (MFt) -, which fulfils these demands. MFt is based on the globular iron storage protein complex ferritin that converts iron ions to a ferrihydrite core but can be synthetically loaded with a magnetic iron oxide core (Novoselova et al., *Nanomaterials*, 11, 2267 (2021)). MFt was chemically, physically and magnetically characterized both in vitro and in vivo. We demonstrate how MFt can be used to target proteins on living cells as well as to spatially manipulate MFts in a single cell environment.

### BP 28.3 Fri 10:15 H39

**Bioinspired electrodes for brain wave detection** — ●VÖLKER KÖRSTGENS<sup>1</sup>, GÖKAY ERBİL<sup>1</sup>, ANDREAS ZHENG<sup>1</sup>, HSIN-YIN CHIANG<sup>2</sup>, and PETER MÜLLER-BUSCHBAUM<sup>1</sup> — <sup>1</sup>TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching — <sup>2</sup>Cephalog, 67000 Strasbourg, France

With increasing demands in brain computer interfaces (BCI) measuring biosignals non-invasively becomes more important. Applications like measuring brain waves via electroencephalography (EEG) with dry electrodes remains challenging as for a steady biosignal acquisition adhesion to the skin has to be maintained all the time. We present two different approaches inspired by nature for such electrodes. In our first approach we developed micro-structured dry adhesive electrodes based on polydimethylsiloxane (PDMS) with conductive fillers. The EEG-performance and adhesive properties of these electrodes will be discussed and compared to the concept of mussel-inspired hydrogels we follow in our second approach.

### BP 28.4 Fri 10:30 H39

**Anionically functionalized glycogens efficiently encapsulate cationic peptides** — HANNA ZHUKOUSKAYA<sup>1</sup>, ●PABLO M. BLANCO<sup>2</sup>, ZULFIYA ČERNOCHOVÁ<sup>1</sup>, LUCIE ČTVERÁČKOVÁ<sup>1</sup>, ROMAN STAŇO<sup>3</sup>, EWA PAVLOVA<sup>1</sup>, MIROSLAV VETRÍK<sup>1</sup>, PETER ČERNOCH<sup>1</sup>, MIROSLAV ŠLOUF<sup>1</sup>, MARCELA FILIPOVÁ<sup>1</sup>, MIROSLAV ŠTĚPÁNEK<sup>2</sup>, MARTIN HRUBÝ<sup>1</sup>, PETER KOŠOVAN<sup>2</sup>, and JIŘÍ PÁNEK<sup>1</sup> — <sup>1</sup>Institute of Macromolecular Chemistry, Czech Academy of Sciences, Heyrovského nám. 2, 162 06 Prague 6, Czech Republic — <sup>2</sup>Department of Physical and Macromolecular Chemistry, Faculty of Science, Charles University, Hlavova 8, 128 40 Prague 2, Czech Republic — <sup>3</sup>Faculty of Physics, University of Vienna, Kolingasse 14-16, 1090 Vienna, Austria

We developed and tested novel acid-functionalized glycogen conjugates as supramolecular carriers for efficient encapsulation and inhibition of a model cationic peptide melittin, which is the main component of honeybee venom. Systematic investigation of this model system allowed us not only to test its potential application as honeybee venom antidote but also to assess the role of the degree of substitution and solution pH in the interactions of these anionic carriers with multivalent cationic cargos. Our results demonstrate that the concept of electrostatically driven encapsulation by acid-functionalized glycogens should be applicable not only to the model case of melittin but also to other multivalent cationic biomolecules.

### BP 28.5 Fri 10:45 H39

**Dissipative Assembly: Controlling Changes of Membrane Topology by Reaction Cycles** — ●GREGOR IBBEKEN and MARCUS MÜLLER — Institut für Theoretische Physik, Georg-August Universität, Friedrich-Hund-Platz 1, 37075 Göttingen

Coupling a self-assembling system to a reaction cycle, we go beyond equilibrium self-assembly toward systems that dissipate energy and thus exhibit new, unique features of dynamic self-organization. We consider polymers which can switch between a hydrophilic and an amphiphilic state and in the latter self-assemble to form vesicles in aqueous solution. This can occur either by macromolecular or monomeric reactions. In both cases a precursor reacts with a fuel to a product, which itself can decay back to the precursor. We perform particle-based simulations using a soft, coarse grained model for polymers. For the macromolecular reactions we find two drastically different scenarios depending on the fuel volatility: (i) For high fuel volatility, the coupling of inactivated to activated polymers introduces a length scale which dictates the maximal vesicle size and prevents fusion beyond this. This results in an interplay between the architecture- and the reaction-rate-determined length and time scales. (ii) For less volatile fuel, a fuel gradient arises in the system. This results in the compartments moving within the fuel gradient to approach the source. In doing so the moieties gain material over long times which drastically changes the formation mechanism of the vesicles. Finally, we show that the above reaction mechanism can be mimicked by monomeric reactions by the use of multiple, inhomogeneously distributed fuels.

### BP 28.6 Fri 11:00 H39

**Influence of molecular weight of polycation polydimethyldiallylammonium and carbon nanotube content on the electric conductivity of layer-by-layer films** — ●SVEN NEUBER<sup>1</sup>, ANNEKATRIN SILL<sup>1</sup>, PETER NESTLER<sup>2</sup>, HEIKO AHRENS<sup>1</sup>, and CHRISTIANE A. HELM<sup>1</sup> — <sup>1</sup>University of Greifswald, Institut of Physics, Greifswald, Germany — <sup>2</sup>TÜV NORD EnSys GmbH & Co. KG, Greifswald, Germany

For biological and engineering applications, nm-thin films with high electrical conductivity and tunable sheet resistance are desirable. Multilayers of polydimethyldiallylammonium chloride (PDADMA) with two different molecular weights (322 and 44.3 kDa) and oxidized carbon nanotubes (CNTs) were constructed using the layer-by-layer technique. Both the film thickness and the surface coverage of the CNTs increased linearly with the number of CNT/PDADMA bilayers deposited (dfilm up to 80 nm). Atomic force microscopy images showed a predominantly surface-parallel orientation of CNTs. Ohmic behavior with constant electrical conductivity of each CNT/PDADMA film and conductivity up to  $4 \cdot 10^{-3}$  S/m was found. A change in PDADMA molecular weight by almost a factor of ten does not affect the film

thickness and electrical conductivity, only the film/air roughness is reduced. However, increasing CNT concentration in the deposition dispersion from 0.15 up to 0.25 mg/ml results in an increased thick-

ness of a CNT/PDADMA bilayer (by a factor of three). The increased bilayer thickness is accompanied by a decreased CNT coverage and a decreased electrical conductivity (by a factor of four).