BP 9: Biomaterials, Biopolymers and Bioinspired Functional Materials II (joint session CPP/BP)

Time: Monday 17:00–18:00 Location: H46

BP 9.1 Mon 17:00 H46

Polymer Assisted Condensation and Heterochromatin — •Jens-Uwe Sommer — Leibniz-Institut für Polymerforschung Dresden (IPF), Hohe Straße 6, 01069 Dresden, Germany — TU Dresden, Insitut für Theoretische Physik, Zellescher Weg 17, D-01069 Dresden, Germany

Many biomolecular condensates are formed through the co-condensation of proteins and polynucleotides. In most cases, the proteins that constitute the majority of the condensate exhibit a miscibility gap in aqueous solution at elevated concentrations in vitro. Recently, we published the theory of Polymer-Assisted Condensation (PAC), which predicts the formation of the condensate within the polymer's volume of gyration, where interactions with the three-dimensional conformation of the polymer trigger the phase transition of the protein component [1]. A key feature of these liquid condensates is their robustness against changes in parameters, as well as the dominant role played by the condensation free energy of the protein component. The formation and properties of heterochromatin, a genetically silenced region of eukaryotic chromosomes, can be explained by PAC, which resolves several issues present in previously published theories. Recently, we developed a field-theoretic approach to PAC to better understand the adsorption and desorption scenarios of heterochromatin at the nuclear lamina.

[1] J.-U. Sommer, H. Merlitz, and H. Schießel, Macromolecules 55, 4841 (2022); L. Haugk, H. Merlitz, and J.-U. Sommer, Macromolecules 57, 9476 (2024)

BP 9.2 Mon 17:15 H46

How specific binding induces sol-gel transitions and liquid-liquid phase separation in RNA/protein solutions: Coarse-grained simulations versus Semenov-Rubinstein Theory — •Xinxiang Chen, Jude Ann Vishnu, Pol Besenius, Julian König, and Friederike Schmid — Johannes Gutenberg-University, Mainz, Germany

Liquid-liquid phase separation plays a central role in cellular organization, including RNA splicing. RNA-protein interactions are crucial to these processes. A key factor in controlling the phase behavior of RNA-protein systems is the sequence of binding and neutral domains. Using molecular dynamics simulations, we investigate phase transitions in RNA-protein solutions that are driven solely by specific binding interactions. The model omits nonspecific interactions including electrostatic interactions. We show that specific binding interactions induce a percolation transition with double reentrant behavior without phase separation, if the neutral linker size is long. Comparing our results with the two-component Rubinstein-Semenov theory, we find that the theory qualitatively reproduces the phase diagram of the percolation transition and the impact of the neutral domains. Phase separation is observed when reducing the neutral linker size in an asymmetric system, resulting in a closed-loop phase diagram. We also study the effect of modulating the sequence and find that blockiness of sticker sites introduces microstructure in the dense liquid phase. These insights enhance our understanding of how specific binding and domain arrangement regulates condensate formation in RNA-protein systems.

BP 9.3 Mon 17:30 H46

Model particles to study interaction of microplastic particles — •Kai Gossen, Andreas Fery, and Günter Auernhammer — IPF Dresden, Dresden, Germany

Microplastic in the environment is typically coated by natural organic matter forming an ecocorona. We present an approach to model ecocorona on particles with well-defined polymers, synthetic and derived from natural polymers. Polystyrene particles were coated with fluorescent polyelectrolyte multilayer systems, PS(Chitosan/Hyaluronic acid) and PS(Poly(dimethyldiallylammonium chloride) /Polystyrene sulfonate) by the layer-by-layer method. Systems with 2, 4 and 6 bilayers were synthesized. The second layers were fluorescently labelled with SNARF conjugated dextran.

It was found that zeta potentials of the PS(Chi/HS)2/4/6 systems assume values (-20 mV to -35 mV) that are similar to those of PS-ecocorona particles (-40 mV to -5 mV). The pH-dependent fluorescence of particle suspensions and individual particles were measured at pH values between pH 3 and pH 8. A well measurable pH dependence between pH 4.5 and 8 for the PS(Chi/HS) systems and the PS(PDADMAC/PSS) system could be measured. The system could serve to selectively study effects of surface properties of ecocorona coated particles such as surface stiffness or zeta potential.

BP 9.4 Mon 17:45 H46

Microgels for Enhanced Adsorption of Endothelial Cells on Artificial Networks — •Souraj Mandal[1], Anna Fritschen[2], Alina Filatova[3], and Regine von Klitzing[1] — [1]Soft Matter at Interfaces, Department of Physics, Technical University of Darmstadt, Darmstadt 64289, Germany — [2]BioMedical Printing Technology, Department of Mechanical Engineering, Technical University of Darmstadt, 64289 Darmstadt, Germany — [3]Stem Cell and Developmental Biology, Technical University of Darmstadt, 64287 Darmstadt, Germany

Three-dimensional cellular models hold great promise for drug testing, but their success relies on maintaining a controlled supply of oxygen and nutrients. Artificial vascular networks aim to mimic blood vessel functions, yet ensuring robust endothelial cell (EC) attachment remains a significant challenge. In this study, we designed a mediator between artificial network surfaces and ECs using Poly(N-isopropylacrylamide) (PNIPAM) microgels (MGs) that remain mechanically stable in nutrient solutions. Charged MGs were synthesized and tested for adhesion on plasma-treated model surfaces. The microgel-coated substrates were exposed to cell static culture media and under defined flow. Atomic force microscopy (AFM) confirmed stable adhesion of MG particles before and after exposure. Initial experiments explored EC attachment on positively and negatively charged MG surfaces, followed by mechanical property characterization. The MG coatings were biofunctionalized with integrin-recognized ligands to enhance EC adhesion and proliferation further.