CPP 6: Gels, Polymers Networks and Elastomers II

Time: Monday 15:00–16:00 Location: H34

CPP 6.1 Mon 15:00 H34

Scattering data of A_4B_4 model networks reveal structure induced apparent interaction and cross-link repulsion — •Reinhard Scholz and Michael Lang — Leibniz-Institut für Polymerforschung, Hohe Str. 6, 01069 Dresden, Germany

Based on computer simulations, we analyze how different forms of labeling the network components allow to extract complementary structural information from scattering data. The analysis relies upon simulations of hetero-complementary bound four-functional star polymers A_4 and B_4. For optimized contrast between A and B stars, the calculated dynamic scattering intensity resembles A-B block copolymers with an apparent repulsion between both components, accounting for ordering effects due to the complementary coupling scheme. The position of the observed scattering peak is compatible with radius of gyration and end-to-end extension of A-B chains connecting adjacent star centers, providing access to the mesh size of the network. In samples with optimum contrast, the static correlation length Ξ is in the same range but somewhat smaller than the respective correlation length for homogeneously labeled polymers. Choices of the scattering contrast focusing on the star centers or on small regions around these reveal a correlation hole. Accordingly, scattering is suppressed towards small wave vectors, allowing for a decomposition of the observed scattering intensity into a product of the form factor of the labeled star sections and a structure factor describing the distribution of cross-links in space.

CPP 6.2 Mon 15:15 H34

Responsive Microgel Based Membranes — •Thomas Hellweg — Universität Bielefeld, Fak. f. Chemie, Physikalische und Biophysikalische Chemie, Universitätsstr. 25, 33615 Bielefeld

If microgels are made with comonomers which can act as (photo-)crosslinkable secondary crosslinker, they can be deposited in thin layers and subsequently be cross- linked by irradiation [1, 2]. Upon crosslinking freestanding membranes are obtained, which still exhibit the temperature response of the original microgels. The present contribution describes the synthesis and properties of the respective microgels, the membrane formation, and the membrane properties. The thermal response of the obtained 2D materials can be exploited to make gating membranes [3] which modulate ion flow by changing temperature which can be used in electrochemical devices. The resistance is found to steeply increase by up to an order of magnitude at the volume transition of the original microgels. Hence, these freestanding microgel membranes might be useful for building self- regulating fuel cells. Moreover, they can be doped with metal nanoparticles granting them catalytic activity and allowing to use them in flow reactors or microfluidic cells for chemical conversion [4].

[1] M. Dirksen, et al., Langmuir 2022, 38, 638-651.
[2] M. Dirksen, et al., RSC Adv., 2021, 11, 22014.
[3] S. Uredat, et al. , Phys. Chem. Chem. Phys. 2024, 26, 2732-2744
[4] V. Sabadasch, et al., ACS Applied Materials & Interfaces , 2022, 14, 43, 49181.

CPP 6.3 Mon 15:30 H34

Correlation between swelling ability, softness and adhesion of PNIPAM microgels — •Carina Schneider, Kevin Hagmann, Joanne Zimmer, Franziska Braun, and Regine von Klitzing — Departement of Physics, TU Darmstadt, Hochschulstraße 8, 64289, Darmstadt

PNIPAM microgels (poly-N-isopropylacrylamide) are polymeric crosslinked networks with a core-shell structure. Due to their volume phase transition, it is possible to control their swelling and mechanical behavior. However, the concept of softness in these microgels, is highly complex and is not a single, well-defined property. In this study we show that it rather has a multifold characteristic that arises from a combination of several factors, such as their (de-)swelling ability, mechanical properties and adsorption behavior at interfaces. The cross-linker density of the microgels affect their adsorption behavior at interfaces and faceting. For exploring the multifold softness of adsorbed PNIPAM microgels, atomic force microscopy (AFM) is used to directly probe the mechanical and adhesion properties through indentation measurements and related them to their swelling ability. These insights into the microgel behavior could inform the design of next-generation microgels for biomedical applications.

CPP 6.4 Mon 15:45 H34

Deformation and actuation of 3D-printed polymeric microstructures predicted by finite element simulations — •Santiago Gomez Melo and Ulrich Schwarz — Univesität Heidelberg, Heidelberg

Mechanical metamaterials with promising properties can be manufactured via 3D-printing of polymers. Computational modelling, in addition to aiding conceptualization and characterization, opens the gate towards computer rationalized material design. We present two projects to this end. First, we discuss the experimental investigation of 3D-printed tetrahedral polymeric microlattices with X-ray nanotomography. Step-wise loading and image processing allowed us to evaluate the evolution of the displacement fields. Finite element simulations were used to understand the strain accumulation around lattice defects. Second, we demonstrate that the thermomechanical response of printed nematic elastomer microstructures can be controlled via confinement in PDMS-scaffolds. We applied Landau-de Gennes theory combined with nonlinear morphoelasticity to predict the molecular orientation from the scaffold geometry and the actuation upon heating, in excellent agreement with experimental measurements of birefringence patterns.