CPP 3: Hydrogels and Microgels

Time: Monday 9:30–10:30 Location: ZEU 255

CPP 3.1 Mon 9:30 ZEU 255

Acousto-responsive poly(N-isopropylacrylamide) microgels — •Amin Rahimzadeh, Atieh Razavi, and Regine von Klitzing — Soft Matter at Interfaces, Department of Physics, Technical University of Darmstadt, Hochschulstraße 8, 64289 Darmstadt, Germany

In this work, we introduce a novel stimulus for Poly(N-isopropylacrylamide), known as PNIPAM, microgels. High-frequency ultrasonic waves provide the required energy for collapsing microgels while the solution temperature maintains below their volume phase transition temperature (VPTT). Ultrasound propagates through the liquid and its energy will be absorbed due to the liquid viscosity. A part of the energy will be absorbed due to the translational relaxation of the liquid molecules leading to the creation of a flow that is called acoustic streaming. Another part of the energy of the waves will be absorbed due to the rotational and vibrational relaxations of the liquid molecules. The former absorption is due to the dynamic viscosity and the latter is due to the bulk viscosity. We show that along with acoustic streaming, the absorbed energy due to the bulk viscosity provides the energy for breaking hydrogen bonds between the microgels and water molecules. The turbidity of the liquid is used as a way to visualize and quantify the energy absorption, by calculating the required energy for making the solution fully turbid. We use image processing to quantify the absorbed energy by the hydrogen bonds and investigate the effects of solution concentrations (0.2 wt.%, 1 wt.% and 5 wt.%), ultrasound amplitude and frequency.

CPP 3.2 Mon 9:45 ZEU 255

Swelling and nanophase separation of amphiphilic star polymer conetworks — •Reinhard Scholz and Michael Lang — Leibniz Institut für Polymerforschung, Hohe Str. 6, 01069 Dresden, Germany

Polymer conetworks consisting of complementary four functional stars coupled via complementary end groups are simulated within the framework of a lattice-based Monte Carlo algorithm. A classification of different stars reveals that the conetworks are dominated by ideal star configurations surrounded by four different bonding partners. In a good solvent, the simulation reproduces analytical scaling relations for swelling, modulus and residual bond orientation [1]. A selective solvent induces a phase separation between a swollen polymer phase and embedded clusters consisting of insoluble polymer stars. Due to the complementary end groups, all elastically active chains cross the phase boundary, so that residual bond orientations correspond either to swollen conformations, collapsed stars, or bonds across the phase boundary with a particularly large component along the interface normal. Calculated pair distributions and scattering functions reveal that the length scale of phase separation depends only weakly on the concentration over a broad range of concentrations, $c^* < c < 6c^*$.

[1] M. Lang, R. Scholz, L. Löser, C. Bunk, N. Fribiczer, S. Seiffert, F. Böhme, and K. Saalwächter, Macromolecules 55, 5997 - 6014 (2022).

CPP 3.3 Mon 10:00 ZEU 255

How topology impacts magnetic and rheological properties of a suspension of magnetic nanogels — •Ivan Novikau[1], Alla Dobroserdova[2], Ekaterina Novak[2], and Sofia Kantorovich[1,2] — [1]University of Vienna, Austria — [2]Ekaterinburg, Russia

Hydrogels are soft materials, that attracted solid interest over the last 6 decades and are widely used in chemical, biomedical, and even civil engineering applications. Today, at the front edge of gels' realm stand out nanogels, often additionally functionalization, for instance, by magnetic nanoparticles.

Given the magnetic nanogels (MNG's) size, typical time and velocity scales involved in their nanofluidics, experimental characterization of the systems is difficult. Here, we use molecular dynamics (MD) simulations in conjunction with the Lattice-Boltzmann (LB) scheme in order to describe how the MNG topology affects the rheological and magnetic properties of their suspensions.

We study in detail how the shape and magnetization of a single MNG are affected by the distribution of crosslinkers: uniform, with a displaced centre of mass, with Gaussian distribution from the centre to the periphery and reverse. The impact of a topology in a combination with an external magnetic field on MNG's viscoelastic and magnetic characteristics of the suspensions is also explored.

CPP 3.4 Mon 10:15 ZEU 255

Incorporation of Hydrophilic Microgels at Water in Oil Emulsion stabilized by Hydrophobic Nanospheres — •Sebastian Stock, Carina Schneider, Luca Mirau, Franziska Braun, and Regine von Klitzing — TU Darmstadt, Darmstadt, Germany

For particle-stabilized emulsions (Pickering emulsions, PEs), the affinity of the particular stabilizers to one or the other liquid decides about the resulting emulsion type - either oil in water (o/w) or water in oil (w/o). Besides specific exceptions, hydrophilic microgel particles (MGs) are only able to stabilize o/w emulsions. However, the w/o emulsion type is preferable in a multitude of applications ranging from the food industry over medicine towards interfacial catalysis. We solved this problem by using well-characterized, hydrophobic, positively charged, spherical silica particles (SNs) and hydrophilic, positively charged PNIPAM MGs to stabilize water in 1-dodecene emulsions simultaneously. Using these thoroughly characterized model particles allows deep insights into the interplay between soft and solid particles at the interface and the structure formation of the PEs. The interaction between different kinds of particles was studied on a Langmuir trough in combination with AFM measurements. The observable structure formation at the interface of the Langmuir Trough could explain the particle assembly at the droplet interfaces in PEs.