CPP 30: Complex Fluids, Colloids, Micelles and Vesicles I

Time: Tuesday 14:00–15:30 Location: ZEU/0260

Invited Talk CPP 30.1 Tue 14:00 ZEU/0260

Solvent effects on amphiphile self-assembly in Deep Eutectic Solvents — •Karen Edler — Centre for Analysis and Synthesis, Chemistry Department, Lund University, Sweden

Deep eutectic solvents (DES) are mixtures of hydrogen bond donors and acceptors that form strongly hydrogen-bonded room temperature liquids. These mixtures are straightforward to prepare, using cheap, bioderived components, with lower volatility than most organic solvents, so are potential new green solvents for applications from drug delivery to battery electrolytes. We are interested in micelle templating of inorganic nanomaterials and formulations for delivery of actives, using these versatile solvents.

Changing the H-bonding components and their ratios alters the physicochemical properties of DES, leading to changes in solubility of other species in these solvents. This also alters the self-organisation of surfactants in these mixtures. We have investigated how specific DES components and their molar ratios impact upon solubility and structuring in surfactant solutions, using small angle X-ray and neutron scattering and rheology. Factors such as polarity, the presence of water, and the intermolecular interactions, both between solvent components and with the surfactant headgroups, play a role in the size and morphology of the micelles formed. We aim to develop design rules for novel complex solutions with applications in templating, rheology control and encapsulation using these interesting new solvent systems.

CPP 30.2 Tue 14:30 ZEU/0260

Brick by Brick - Magnetic Particle Transport — •Margaret Rosenberg[1], Jonas Bugase[2], Christian Janzen[2], Rico Huhnstock[2], Arno Ehresmann[2], and Hartmut Löwen[1] — [1]Heinrich-Heine University Düsseldorf, Universitätsstraße 1, 40225 Düsseldorf — [2]Institute of Physics , University of Kassel, 34132 Kassel

Facilitated by advances in particle synthesis, anisotropic and anisometric magnetic micro- and nanoparticles have been intensely studied in recent years, as the particles' lack of symmetry can give rise to unique, tailor-able interactions. However, the modeling of off-equilibrium processes in non-trivial magnetic landscapes is still relatively under-explored. This contribution will seek to understand the ratchet-like transport process of a magnetically coated polymer block ("brick") across a stripe-patterned magnetic surface via a sequence of time-dependent external magnetic fields, from a simulation perspective. In particular, we explore the rotational behavior unlocked by the anisotropic particle shape, and discuss the connection to ongoing experiments.

CPP 30.3 Tue 14:45 ZEU/0260

Role of acids in stabilizing Reverse Micelles: the case of Dodecyl Sulfate — •Qixuan Li and Marialore Sulpizi — Faculty of Physics and Astronomy, Ruhr-University Bochum

The anionic surfactant Sodium dodecyl sulfate (SDS) can form reverse micelles (RMs) in two non-miscible components above the critical micelle concentration [1]. Although the RMs in salt or alkali solution has been investigated in previous studies [2,3], less is known on the working mechanism of acids in SDS RMs. Here, we employ all-atom (AA) and coarse-grained (CG) molecular dynamics to investigate the effects of chloroauric acid (HAuCl4), fluoroboric acid (HBF4) and phosphoric acid (H3PO4) solutions on the stability of the RMs through spontaneous self-assembly in toluene. We find that investigated acids can stabilize micellar structure, particularly H3PO4 due to the stable hydrogen-bonds it forms with the SDS headgroups. In addition, HAuCl4 can significantly influence micelle shape because of its strong polarizability at the water-toluene interface, while HBF4 causes the highest interfacial tension as a result of its significant hydrophilicity. Moreover, scission free energy calculations from CG simulations [4,5] reveal important differences, which along with the viscosity can explain how different acids affect the size of RMs. Our findings can help to rationalize the impact of different acids on the RMs stability and morphology and, in turn, on the metallic nanoparticles synthesis where the RMs are used as nanoreactors.

CPP 30.4 Tue 15:00 ZEU/0260

Microsecond-Resolved Tracking of Ultrasound-Responsive Colloids: From Rigid Silica Probes to Acousto-Responsive Microgels — Parsa Kassaiyan, Regine von Klitzing, and •Amin Rahimzadeh — Technische Universität Darmstadt, Hochschulstrasse 8, 64289 Darmstadt, Germany

Dynamic Light Scattering (DLS) is a powerful tool for characterizing dispersed particles, providing access to their size, size distribution, and dynamical behavior. Here, we integrate high-frequency ultrasound excitation into a conventional DLS setup to resolve the microsecond-scale motion of colloidal particles subjected to intense acoustic fields. This enables simultaneous extraction of particle size and ultrasound-induced oscillation parameters such as vibration frequency, amplitude, and acoustic response, through analysis of the scattered-light intensity correlation function. Compact silica particles serve as robust reference probes: their size remains unaffected by ultrasound, allowing us to map local acoustic energy dissipation by tracking their oscillatory motion at varying distances from the ultrasound source. Building on this reference system, we investigate acousto-responsive PNIPAM microgels. We find that microgels undergo a pronounced ultrasound-induced volume phase transition, shrinking due to rapid dehydration driven by absorption of high-frequency acoustic energy. Our approach thus provides both microsecond-resolved characterization of particle dynamics and a direct pathway to understanding, and exploiting, the acousto-responsiveness of microgels.

CPP 30.5 Tue 15:15 ZEU/0260

Influence of End Groups on the Aggregation of Polymers: A Neutron Scattering Study — •Jonathan Linus Samuel Garthe[1,2], Sylvain Prévost[3], and Matthias Karg[1] — [1]Physical Chemistry of Functional Polymers, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany — [2]Physical Chemistry: Colloids and Nanooptics, Heinrich Heine University Düsseldorf, Düsseldorf, Germany — [3]Large Scale Structures, Institut Laue-Langevin, Grenoble, France

The solution structure of polymers depends strongly on polymer concentration, solvent quality, and molecular weight. Additionally the nature of chemically different terminal groups influences the phase behavior of polymers with strong differences depending on the average chain length. We investigated the solution behavior and the occurrence of micelle-like structures for (semi)-dilute solutions. We synthesized PNIPAM homopolymers that are hydrophobically terminated. Via aminolysis we also cleaved the hydrophobic end groups allowing for direct comparison of the same homopolymers with and without hydrophobic end group. Small-angle neutron scattering was used to study the structure of the polymers in solution. Our studies demonstrated that a subdominant micelle formation occurs for samples with molecular weights below 100 kDa. The aggregation number of these micelles scales inverse with the molecular weight. At low concentrations, these micelles exist as individual structures. Upon increasing the concentration micelles aggregate, leading to a distinct structure factor contribution in the scattering profile.