

CPP 2: Hydrogels and Microgels

Time: Monday 13:30–14:30

Location: H1

Invited Talk

CPP 2.1 Mon 13:30 H1

On the permeability of dense polymer membranes — ●JOACHIM DZUBIELLA — Institute of Physics, Freiburg University

The permeability of polymers for the selective transport of molecular penetrants (drugs, toxins, reactants, etc.) is a central property in the design of soft functional materials. However, the permeation of dense and hydrated polymer membranes is a complex molecular-level phenomenon, and our understanding of the underlying physicochemical principles is still very limited. Here, I present our recent modeling efforts using coarse-grained as well as atomistic computer simulations in combination with the linear-response solution-diffusion model to understand and quantify the permeability of dense polymer (networks). Our work reveals some universal physical principles, such as strong solute partitioning-diffusion cancellation effects for a wide parameter regime, as well as significant 'chemical' effects (such as solute polarity and shape) which all contribute to the control of permeability. The gained insights enable us to formulate semi-empirical rules and scaling laws to potentially describe and extrapolate the permeability also for other polymer/solute systems.

CPP 2.2 Mon 14:00 H1

Phase behavior of ultra-soft spheres shows stable bcc lattices — ●ANDREA SCOTTI — Institute of Physical Chemistry RWTH Aachen University

The phase behavior of super-soft spheres is explored using solutions of ultra-low crosslinked poly(N-isopropylacrylamide) based microgels as a model system. For these microgels, the effects of the electric charges on their surfaces can be neglected and, therefore, only the role of softness on the phase behavior is investigated. The samples show a liquid-to-crystal transition at higher volume fraction with respect to both hard spheres and stiffer microgels. Furthermore, stable body centered cubic (bcc) crystals are observed in addition to the expected face centered

cubic (fcc) crystals. Small-angle X-ray and neutron scattering with contrast variation allow the characterization of both the microgel-to-microgel distance, and the architecture of single microgels in crowded solutions. The measurements reveal that the stable bcc crystals depend on the interplay between the collapse and the interpenetration of the external shell of the ultra-low crosslinked microgels.

CPP 2.3 Mon 14:15 H1

Co-polymerization of PNIPAM microgels with Dopamine Methacrylamide to increase adhesive properties — ●SANDRA FORG¹, ALEXANDRA KARBACHER¹, REGINE VON KLITZING¹, ZHISHUANG YE², and XUHONG GUO² — ¹Soft Matter at Interfaces (SMI), Technical University of Darmstadt, Germany — ²School of Chemical Engineering, East China University of Science and Technology, China

Microgels are cross-linked polymer particles, which are highly swollen in solvents such as water. One of those microgels is the stimuli-responsive PNIPAM, which undergoes deswelling when heated above its LCST at 32°C. The co-polymerization of PNIPAM is a well-defined technique to design unique microgel systems.

Dopamine methacrylamide (DMA) is a catechol-based monomer, which is main responsible for the adhesive properties of marine organisms. Combining the stimuli-responsiveness of PNIPAM with the adhesive properties of DMA bears a huge potential for biomedicine.

In literature the formation mechanisms of such microgel networks are shown. Furthermore, it is well-known that such catechol-based monomers like DMA have a high radical scavenging ability and thus cross-link the microgel. But, so far, a detailed understanding of the co-polymerization is missing. Therefore, the reaction kinetics of DMA during the microgel synthesis are presented in this work. The built-in DMA was verified by UV-VIS standard addition and NMR spectroscopy. First adhesion tests under water will be presented.