CPP 18: Complex Fluids and Colloids, Micelles and Vesicles (joint session CPP/DY)

Time: Tuesday 11:30–13:00 Location: H38

Invited Talk CPP 18.1 Tue 11:30 H38

How X-rays can reveal waters mysteries — •Katrin Amann-Winkel — Max-Planck-Institut für Polymerforschung, Mainz, Germany — Johannes Gutenberg Universität Mainz, Institut für Physik, Mainz, Germany — Stockholm University, Department of Physics, Stockholm, Sweden

Water is ubiquitous and the most important liquid for life on earth. Although the water molecule is seemingly simple, various macroscopic properties of water are most anomalous, such as the density maximum at 4°C or the divergence of the heat capacity upon cooling. Computer-simulations suggest that the anomalous behaviour of ambient and supercooled water could be explained by a two state model of water. An important role in this ongoing discussion plays the amorphous forms of water [1]. Since the discovery of two distinct amorphous states of ice with different density (high- and low density amorphous ice, HDA and LDA) it has been discussed whether and how this phenomenon of polyamorphism at high pressures is connected to the occurrence of two distinct liquid phases (HDL and LDL). X-ray scattering experiments on both supercooled water [2] and amorphous ice [3] are of major importance for our understanding of water. In my talk I will give an overview on our recent experiments on supercooled water and amorphous ices. [1] K. Amann-Winkel et al., Waters controversial glass transition, Rev. Mod. Phys. 88, (2016) [2] K.H. Kim, et al., SCIENCE 358, 1589 (2017) [3] K.H. Kim, et al., SCIENCE 370, 6519, 978 (2020)

CPP 18.2 Tue 12:00 H38

Electrostatic Shielding Behavior of Keggin Anions in Aqueous Solution — •Thomas Tilger and Regine von Klitzing — Department of Physics, Technische Universität Darmstadt, Darmstadt, 64289, Germany

Natural colloidal dispersions have accompanied mankind in the form of blood or milk ever since. Besides this, artificial systems have gained a significant importance for our daily life during the last decades.

Therefore, it is of special interest to gain an understanding of which interparticle forces govern the stability of colloidal dispersions and how this stability can be tailored. In electrolyte solutions, the classical DLVO theory describes these interactions. Whilst this description provides a good agreement with experimental data for 1:1 electrolytes, larger deviations appear for systems of higher valency. For a detailed examination of the van der Waals and electrostatically dominated regimes, we directly measure the forces between colloidal silica particles in aqueous solutions by the colloidal probe AFM (atomic force microscopy) technique.

Varying the concentration of monovalent salts and acids allows us to demonstrate the transition from the double layer to the van der Waals dominated regime and to determine the pH dependence of the colloidal probes double layer potential. Similar measurements for phosphotungstic (PTA, a 1:3 system) and silicotungstic acid (STA, a 1:4 system) - both nanometer-sized anions of the Keggin type - can still be described with the DLVO theory, but reveal significant deviations between the calculated and measured ionic strengths.

CPP 18.3 Tue 12:15 H38

Influence of the imbibition of colloids through the morphology of porous CNF layers — •Constantin Harder[1,2], Marie Betker[1,3], Alexakis E. Alexakis[3], Andrei Chumakov[1], Benedikt Sochor[1], Elisabeth Erbes[1,4], Marc Gensch[1,2], Qing Chen[1], Calvin Brett[1,3], Jan Rubeck[1], Matthias Schwartzkopf[1], Eva Malmström[3], Daniel Söderberg[3], Peter Müller-Buschbaum[2,5], and Stephan V. Roth[1,3] — [1]DESY, 22607 Hamburg, Germany — [2]TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching, Germany — [3]KTH Royal Institute of Technology, 10044 Stockholm, Sweden — [4]Institute for X-ray Physics, Goettingen University, 37077 Goettingen, Germany — [5]MLZ, TU München, 85748 Garching, Germany

Functionalization of porous materials in terms of optical, chemical, and mechanical properties is readily achieved by applying colloidal layers. Our goal is to functionalize porous cellulose nanofibril (CNF) templates by applying tailored core-shell colloids with specific surface properties. The colloidal layer formation influencing the surface properties can be tuned by the deposition conditions and subsequent annealing. Therefore, we applied colloidal inks (poly(butyl methacrylate) and poly(sobrerol methacrylate) in aqueous dispersion) with different glass transition temperatures T_g as the colloidal layers on the CNF templates. During the deposition, the colloids partially enter the CNF layer to fill the CNF voids and remain on the CNF surface, leading to complex drying processes. The morphology of the mixed CNF / colloidal thin film changes when T_g of the colloids is exceeded.

CPP 18.4 Tue 12:30 H38

Elastic core-shell materials and their deformational behavior — Jannis Kolker[1], •Lukas Fischer[2], Andreas M. Menzel[2], and Hartmut Löwen[1] — [1]Institut für Theoretische Physik II, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany — [2]Institut für Physik, Otto-von-Guericke-Universität Magdeburg, Magdeburg, Germany

Elastic materials consisting of an inner part, a core, and an outer part, a shell, of possibly different material properties can be found from planetary scales down to the colloidal microscale. We here describe a situation amenable to analytical theory, namely the linear elastic deformation of a spherical core-shell system in response to an equatorial load in form of a force line density [1]. The relevance of this setup lies in, e.g., functionalized microgel particles absorbed to fluid-fluid interfaces or macroscopic illustrative show-and-tell objects.

Situations of different elastic properties and sizes of core and shell are analyzed to study their influence on the deformational response of the whole system. For example, tuning the two Poisson ratios allows to adjust the relative degree of oblate or prolate deformations and change in volume between core and shell. Due to the overall spherical shape and the two-component structure, the stress and strain distributions become rather inhomogeneous. Using different core and shell materials in colloidal microgel particles allows for inner functionalization while simultaneously adjusting the outer wetting properties.

[1] J. Kolker, L. Fischer, A. M. Menzel, H. Löwen, *J. Elasticity*, in press.

CPP 18.5 Tue 12:45 H38

Effective Thomas-Fermi screening approach and wetting transition at charge/metal interfaces — •Alexander Schlaich[1,2], Dongliang Jin[1,3], Lyderic Bocquet[4], and Benoit Coasne[1] — [1]Univ. Grenoble Alpes, CNRS, LIPhy, Grenoble, France — [2]Stuttgart Center for Simulation Science, Universität Stuttgart, Germany — [3]Institut fur Theoretische Physik, Technische Universitat Wien, Austria — [4]Laboratoire de Physique de l'Ecole Normale Supérieure, CNRS, Université PSL, Sorbonne Université, Sorbonne Paris Cité, Paris, France

At the nanometer scale the commonly employed image charge approach to obtain the electrostatic interactions close to a metallic interface breaks down due to the finite screening in any real metal. We develop an effective approach that allows dealing with any real metal using the Thomas-Fermi formalism. [1]

We find a microscopic picture based on the Gibbs-Thomson equation for capillary freezing of an ionic liquid. An unprecedented wetting transition is found upon switching the confining medium from insulating to metallic. The wetting behavior at imperfect metals raises new challenging questions on the complex behavior of charged systems in the vicinity or confined within surfaces.

[1] A. Schlaich, D. Jin, L. Bocquet & B. Coasne, Nat. Mater. 1 (2021).