

CPP 49: Colloids and Complex Liquids III

Time: Friday 9:30–12:00

Location: H40

Invited Talk

CPP 49.1 Fri 9:30 H40
Interface-controlled property adjustment in ionic liquid/inorganic hybrid materials — ●ANDREAS TAUBERT — University of Potsdam

Ionic liquids (ILs) have classically been used as solvents, for extraction, and catalysis. Materials synthesis and the adjustment of the properties of IL/inorganic and IL/polymer hybrid materials (ionogels) by tuning the interaction between an IL and the host material have recently attracted growing interest.

The advantage of ILs is that, by virtue of the large number of available IL components, their properties such as ionic conductivity or phase behavior can be adjusted.

Among others, IL-based hybrid materials are attractive candidates, for example, as membranes in fuel cells or batteries, in hybrid magnetic materials, or in multiresponsive materials. In order to understand, control, adapt, and extend the application of ionogels, the parameters controlling the structure, thermodynamics, phase behavior, and transport properties within the ionogels must be known.

The presentation will highlight some recent approaches towards quantification of these and other properties and highlight new developments towards transport of protons and ions in these highly complex nanostructured materials that could be of relevance for, e.g., energy research.

CPP 49.2 Fri 10:00 H40

In situ high pressure XPS for ionic liquid - gas phase reaction studies — ●INGA NIEDERMAIER¹, WEI WEI², CHRISTIAN PAPP¹, CLAUDIA KOLBECK¹, SANDRA KRICK CALDERÓN¹, FLORIAN MAIER¹, PETER SCHULZ², PETER WASSERSCHIED², and HANS-PETER STEINRÜCK¹ — ¹Lehrstuhl für Physikalische Chemie II — ²Lehrstuhl für Chemische Reaktionstechnik, Egerlandstr. 3, 91058 Erlangen

Ionic liquids (ILs) are molten salts composed solely of ions with a melting point below 100 °C and a negligible vapour pressure at room temperature. X-ray photoelectron spectroscopy (XPS) has proven to be a versatile tool for surface investigations of these materials under ultrahigh vacuum conditions (UHV).^[1] It even allows to monitor reactions occurring in the near-surface region of ILs.^[2] We demonstrate to our knowledge the first gas-liquid reaction studies between an IL and a gaseous species by means of *in situ* XPS in the mbar pressure regime. The anion of the IL [Me₂N⁺(CH₂CH₂OH)₂][H₂NCH₂CH₂SO₃⁻] was functionalised with an amine group (H₂N⁻), in analogy to aqueous amine systems for carbon dioxide capture applications. ILs are considered as potential replacements for these aqueous amines due to the extremely low vapour pressure and their typically high thermal stability. Under CO₂ pressures up to 0.9 mbar, *in situ* XPS reveals reaction schemes involving carbamate and ammonium formation via carbamic acid as an intermediate. Supported by the Cluster of Excellence - Engineering of Advanced Materials. 1. H. P. Steinrück, *Phys Chem Chem Phys*, **2012**, 14, 5010 2. I. Niedermaier et al., *Chemphyschem*, **2012**, 13, 1725

CPP 49.3 Fri 10:15 H40

Self Assembly in a Magnetic Room Temperature Ionic Liquid (MRTIL) — ●ANDREAS KLEE¹, SYLVAIN PREVOST^{1,2}, and MICHAEL GRADZIELSKI¹ — ¹Stranski Laboratorium für Physikalische und Theoretische Chemie, TU Berlin, Straße des 17. Juni 124, 10623 Berlin, Germany — ²Helmholtz-Zentrum Berlin für Materialien und Energie, Glienicke Straße 100, 14109 Berlin, Germany

Magnetic room-temperature ionic liquids (MRTIL) are a specific class of RTIL where an ion confers a magnetic susceptibility to the liquid, which in turn exhibits a paramagnetic behavior. The first occurrence of this new class of liquid media was discovered in 2004 [1, 2] based on the organic cation 1-butyl-3-methylimidazolium (bmim⁺) and the anion tetrachloroferrate (FeCl₄⁻). Thanks to the high spin FeCl₄⁻, a small magnet is enough to modify the meniscus of the fluid, and stronger macroscopic effects are visible when the surface tension is reduced. MRTIL can be used as a solvent for self assembly of surfactant systems which leads to structures like micelles, liquid crystals, macro- and microemulsions including magnetic properties [3]. New insights into the nature of self assembly by studying these water-free, aprotic systems are expected. [1] S. Hayashi and H. O. Hamaguchi, *Chem. Lett.*, **33**, 1590-1591, (2004) [2] S. Hayashi et al., *IEEE Trans. Magn.*,

42, 12-14, (2006) [3] A. Klee, S. Prevost, W. Kunz, R. Schweins, K. Kiefer, M. Gradzielski, *Phys. Chem. Chem. Phys.*, **14**, 15355-15360, (2012)

CPP 49.4 Fri 10:30 H40

Magneto-optical measurement of the rotational relaxation of nickel nanorod colloidal dispersions in ac magnetic fields — ●MICHA GRATZ, ANDREAS TSCHÖPE, and RAINER BIRNINGER — Universität des Saarlandes, Saarbrücken, Deutschland

The dynamical magnetic and magneto-optical response of nickel nanorod colloidal dispersions in ac magnetic fields was investigated. The nanorods with an average diameter of ≈ 25 nm and an average length of ≈ 200 nm, were prepared by pulsed electrodeposition of nickel into nanoporous AA0-templates. Dissolution of the alumina layer in dilute NaOH with polyvinylpyrrolidone (PVP) for steric stabilization followed by separation and purification resulted in a stable aqueous dispersion of the nanorods. The microstructure of the nanorods was characterized by electron microscopy and the magnetic properties were obtained from static magnetization measurements and field-dependent optical transmission of linearly polarized light. Furthermore, the rotational relaxation in ac magnetic fields was investigated by ac-magnetization and ac-magneto-optical transmission measurements. The experimental results were analyzed by comparison with numerical solutions of the Fokker-Planck equation of rotational diffusion in ac magnetic fields to derive the characteristic relaxation time of the nanorods.

CPP 49.5 Fri 10:45 H40

Systems of magnetic anisotropic particles: microstructure and macroproperties — ●ELENA PYANZINA¹ and SOFIA KANTOROVICH^{1,2} — ¹Ural Federal University, Lenin av. 51, 620000, Ekaterinburg, Russia — ²Sapienza, University of Rome, Piazza A. Moro 5, 00185, Rome, Italy

Anisotropic particles form the cutting edge of dipolar soft matter research as they correspond completely to the idea of fine tuning and designing new materials with controllable properties. In this contribution we present a theoretical study and computer simulations of the microstructure and macroproperties of magnetic ellipsoids and cylinders. As the first step, the analysis of the possible ground state structures (the most energetically favoured configurations at 0 K) for two and three dimensions is carried out. Then, we propose a method of calculating analytically the pair correlation function for the combination of Gay-Berne and magnetic dipole-dipole potential based on the group integral technique. An extensive comparison of the theoretical model and the results of molecular dynamics simulations for different semi-axes ratios demonstrated a very good agreement for two and three dimensions for both types of the particles. We conclude, that even slight shape anisotropy can lead to the drastic change in the microstructure and, as a result in macroscopic responses of the system. Changing the asphericity of particles and their density both the ground states and the equilibrium room temperature properties can be tuned and effectively controlled.

CPP 49.6 Fri 11:00 H40

Colloidal particles at liquid interfaces — ●JENS HARTING, STEFAN FRIJTERS, and FLORIAN GÜNTHER — Department of Applied Physics, Eindhoven University of Technology, Den Dolech 2, 5600MB Eindhoven

Emulsions stabilized by particles are ubiquitous in the food and cosmetics industry, but our understanding of the influence of microscopic fluid-particle and particle-particle interactions on the macroscopic rheology is still limited. Modern simulation algorithms based on a multi-component lattice Boltzmann model to describe the solvents combined with a molecular dynamics solver for the description of the suspended particles allow to tune the particle size, shape, wettability and surface tensions between the fluids.

We report on the adsorption of spherical or ellipsoidal particles to liquid interfaces and demonstrate the existence of stable and semi-stable equilibrium states. On larger scales, different phases of stabilized emulsions have been found. While Pickering emulsions are already known for more than a century, so-called bicontinuous interfacially jammed emulsion gels (Bijels) where only predicted recently. The particles can

fully arrest domain growth and a transition between both phases can be found by tuning the concentration, contact angle, or fluid ratio. Further, by tuning the particle shape additional geometrical degrees of freedom add additional time scales to the arrest of domain growth.

CPP 49.7 Fri 11:15 H40

SANS study of polymer loaded microemulsions — ●ANDREAS WEBER¹, HENRICH FRIELINGHAUS², and BERND STÜHN¹ — ¹Experimental Condensed Matter Physics, TU Darmstadt, Germany — ²Jülich Centre for Neutron Science, Germany

The interactions between polymers and soft surfactant layers are subject of current research interest. We study these interactions in microemulsions in the droplet phase, where surfactant stabilized droplets of water are dispersed in a matrix of octane. Small angle neutron scattering experiments allowed us to observe directly the effect of a polymer on an anionic or non-ionic surfactant layer. To microemulsion droplets of different sizes composed by either AOT or C₁₂E₄ we added different amounts of the hydrophilic polymer PEG. While matrix and water core of the microemulsion were deuterated, the surfactant and polymer were protonated, thus, allowing us to observe the surfactant shell influenced by the polymer. We observe, as predicted by theory and indirect measurements such as dielectric spectroscopy, that the polymer interacts differently with a nonionic or a anionic surfactant shell: Apart from an increase of polydispersity of the droplets in both cases, in the former case the addition of polymer seems not to affect the surfactant shell. In the latter case, the obtained scattering data show that the anionic surfactant layer is strongly influenced. We develop a model describing the scattering of the polymer inside the polymer loaded droplet and fit it to the data. The obtained results are compared to small angle x-ray scattering, dynamic light scattering and dielectric spectroscopy experiments on this system done in our group.

CPP 49.8 Fri 11:30 H40

Bilayer undulation dynamics in unilamellar phospholipid vesicles: Influence of temperature, cholesterol and trehalose — ●BEATE-ANNETTE BRÜNING¹, SYLVAIN PRÉVOST^{1,2}, RALF STEHLE¹, ROLAND STEITZ¹, PETER FALUS³, BELA FARAGO³, and THOMAS HELLWEG⁴ — ¹Helmholtz Zentrum Berlin, Hahn-Meitner Platz 1, 14109 Berlin, Germany — ²Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany — ³Institut Laue-Langevin, B. P. 156, 38042 Grenoble Cedex 9, France — ⁴Universität Bielefeld, Universitätsstraße 25, 33615 Bielefeld, Germany

We report a combined dynamic light scattering (DLS) and neutron spin-echo (NSE) study on lipid vesicles composed of 1,2-dimyristoyl-sn-glycero-3-phosphatidylcholine (DMPC), respectively under the influence of temperature and the membrane additives cholesterol and trehalose. We study bilayer undulation and bulk diffusion dynamics using neutron spin-echo spectroscopy, on two distinct time scales, namely around 25 ns and 100 ns. Finally, we calculate the respective bilayer bending rigidities κ for all types of lipid vesicles. We observe a bilayer softening around the main phase transition temperature T_m of the single lipid model system, and a bilayer stiffening the more cholesterol is added, whereas the insertion of trehalose hardly changes the bilayer undulations and membrane rigidity κ [1]. We explain our findings on the basis of a free volume available to lipid molecules in the membrane plane, which encounters the most pronounced changes in the acyl chain regime. [1] B. Brüning, S. Prévost, R. Stehle, R. Steitz, P. Falus, B. Farago, T. Hellweg, submitted.

CPP 49.9 Fri 11:45 H40

Shaping of Unilamellar Vesicles by the Admixture of Amphiphilic Copolymer — ●MICHAEL GRADZIELSKI¹, KATHARINA BRESSEL¹, MICHAEL MUTHIG¹, and THEYENCHERI NARAYANAN² — ¹Stranski Laboratorium, Institut für Chemie, Technische Universität Berlin, Berlin, Germany — ²European Synchrotron Radiation Facility (ESRF), Grenoble, France

In our experiments fast formation kinetics was studied by coupling the stopped-flow technique to high-flux SANS/SAXS instruments, allowing to obtain detailed structural information with a time-resolution of 5-50 ms. For the case of forming monodisperse unilamellar vesicles takes place in a way purely governed by diffusion and proceeds via a disk-like intermediate state. Further aging processes can be observed which are related to the stability of the vesicles. The structural progression of such systems can be modelled by simulations which allow to understand the aging processes in terms simple coalescence processes. Based on the detailed knowledge of the formation process it was then possible to manipulate it by the admixture of amphiphilic copolymers. By doing so systematic control over the vesicle size can be exercised and in addition the presence of the copolymer enhances the vesicle stability largely.

In summary, based on knowing the pathway of the formation of the unilamellar vesicles it can be controlled by the presence of the copolymers and thereby shaping of vesicles occurs in a systematic fashion.