

CPP 21: POSTERS Colloids, Nanoparticles and Aggregates

Time: Wednesday 16:00–18:30

Location: Poster A

CPP 21.1 Wed 16:00 Poster A

Tuning the Surface Field at Liquid/Liquid Interfaces: New Wetting Behaviours and Surface Phase Transitions —

•CHRISTIAN BAHR¹, ERFAN KADIVAR², YASUTAKA IWASHITA¹, HOLGER STARK³, and STEPHAN HERMINGHAUS¹ — ¹MPI for Dynamics and Self-Organization, 37073 Göttingen — ²Department of Physics, University of Isfahan, 81746 Isfahan, Iran — ³Institute of Theoretical Physics, Technical University Berlin, 10623 Berlin

We present experimental and theoretical results concerning the ordering and wetting behaviour at interfaces between thermotropic liquid crystals and aqueous phases. The addition of a surfactant to either of the two bulk media provides the interface with an ordering potential which strongly influences the behaviour in the vicinity of the liquid-crystal – isotropic phase transition.

At nematic – isotropic transitions, the observed behavior changes from surface-induced order at higher surfactant concentrations to surface-induced disorder at lower surfactant concentrations. The experimental behavior can be well described within the framework of Landau-de Gennes theory. Current measurements concentrate on the realization of prewetting transitions.

At smectic – isotropic transitions, the variation of the surfactant concentration enables the observation of new surface layering transitions and surface triple points which were predicted by theoretical models but have experimentally not been demonstrated so far.

[1] E. Kadivar, Ch. Bahr, and H. Stark, *Phys. Rev. E* **75**, 061711 (2007); Ch. Bahr, *Phys. Rev. Lett.* **99**, 057801 (2007).

CPP 21.2 Wed 16:00 Poster A

Time resolved fluorescence studies of self-assembling porphyrins —

•JĘDRZEJ SZMYTKOWSKI^{1,3}, CHILLA MALLA REDDY², MIHAELA CARMEN BALABAN³, TEODOR SILVIU BALABAN^{2,3}, and HEINZ KALT^{1,3} — ¹Karlsruhe Institute of Technology (KIT), Universität Karlsruhe (TH), Institute of Applied Physics, Karlsruhe, Germany — ²Karlsruhe Institute of Technology (KIT), Forschungszentrum Karlsruhe, Institute of Nanotechnology, Karlsruhe, Germany — ³Center for Functional Nanostructures (CFN), Karlsruhe, Germany

There is a great interest in biomimetic antenna systems, which can be used in hybrid solar cells. The self-assembly causes an increase in the harvesting of sunlight in such structures. In order to find novel artificial self-assembling compounds, we have studied the time resolved luminescence of several new diacetyl zinc porphyrins as well as push-pull porphyrins having an electron withdrawing group and an electron donating group directly grafted onto the porphyrin macrocycle and the data have been analyzed using decay associated spectra (DAS). The results show the formation of molecular aggregates in the investigated systems.

CPP 21.3 Wed 16:00 Poster A

Self-assembly driven pattern formation of dendron-like macromolecules on a structured surface —

•MARTA BALBÁS-GAMBRA, ERWIN FREY, and THOMAS FRANOSCH — Arnold Sommerfeld Center for Theoretical Physics and Center for NanoScience, Ludwig-Maximilians Universität, München

Dendron-like macromolecules have been observed to self-assemble into a broad variety of patterns on top of graphite surfaces. We have developed a theoretical model to understand the nature of this assembly and explored the phase behavior as a function of temperature and density. The interaction between the macromolecules is described by an interaction-site model, which largely simplifies the complexity and reduces the model to a few points representing both the aromatic rings and carbonated chains of the molecule. The attraction between chains of different molecules is accounted for by a short ranged potential (Lennard-Jones), whereas the strong repulsion of the aromatic rings is encoded in a hard-sphere interaction. Suitable order parameters are introduced to describe the ensuing ordered phases and corresponding patterns. The phase behavior is explored employing extensive Monte-Carlo simulations.

CPP 21.4 Wed 16:00 Poster A

Influence of self assembled monolayers on local structuring of silicon —

•HARALD GRAAF, THOMAS BAUMGÄRTEL, and CHRISTIAN VON BORCZYKOWSKI — Center of Nanostructured Materials and

Analytics, TU Chemnitz, 09107 Chemnitz, Germany

The local anodic oxidation of hydrogen-terminated silicon by an atomic force microscope under ambient conditions is an established method for the preparation of silicon oxide nanostructures. The kinetics of this process have been studied in detail by several groups and the influence of humidity, applied electric field, shape of the cantilever and exposure time respectively tip velocity has been developed.

We will discuss here the influence of two organic alkenes with different headgroups (CH₃ and COOCH₃) covalently bond to silicon surfaces. Both monolayers showed similar trends in the influence of the oxidation e.g. higher threshold voltage compared to hydrogen terminated silicon. A decreasing hydrophobic character of the monolayer is accompanied by a broadening and flattening of the formed oxide structure. More hydrophilic surfaces led also to a lower increase in threshold voltage with increasing tip velocity.

CPP 21.5 Wed 16:00 Poster A

Polyelectrolyte coating of tubular J-aggregates investigated by cryo-TEM —

•OMAR AL-KHATIB¹, DÖRTHE M. EISELE², JÜRGEN P. RABE², CHRISTOPH BÖTTCHER³, and STEFAN KIRSTEIN² — ¹MPI-Golm, Inst. für Kolloid- und Grenzflächenforschung, Wissenschaftspark Golm, 14424 Potsdam — ²HU-Berlin, Inst. für Physik, Newtonstr. 15, 12489 Berlin — ³FU-Berlin, Forschungszentrum für Elektronenmikroskopie, Fabekstr. 36a, 14195 Berlin

Amphiphilic carbocyanine dyes are able to form tubular J-aggregates in aqueous solutions by a self-assembly process [1]. The wall of the tubular aggregates is formed by a dye bilayer that encloses the hydrophobic alkyl chains and exposes negative surface charges to the water. The charged surface is utilized to adsorb oppositely charged polyelectrolytes in order to cover the aggregates by the polymer and gain mechanical stabilization and further functionalization. The addition of various polycations such as poly(diallyldimethylammonium chloride) (PDAC) and poly(allylamine hydrochloride) (PAH) was investigated by optical spectroscopy and cryogenic transmission electron microscopy (cryo-TEM). It is found that the relative concentration of the polyelectrolyte is a critical parameter for precipitation of the structures. This and other solvent conditions and their influence on the spectra and structure are discussed.

[1]S.Kirstein, S. Dähne, *International Journal of Photoenergy*, Volume 2006, Article ID 20363, 1-21

CPP 21.6 Wed 16:00 Poster A

Dissipative Structure Formation in Surfactant Films —

•PETER C. SEITZ and MOTOMU TANAKA — Physikalisch Chemisches Institut, INF 253, 69120 Heidelberg, Universität Heidelberg

We study the formation of dissipative microstructures in composite ultrathin surfactant films. Dissipation occurs at the three phase contact line during Langmuir-Blodgett transfer onto a solid substrate of lipid/lipopolymer films. Structures are stripe like and continuous over several cm, limited only by substrate size. Stripe to stripe distance is precisely controlled by transfer speed from several μm to below optical resolution.

The onset of the meniscus is observed using imaging ellipsometry. This allows the determination of the microscopic contact angle as well as the discrimination between domains in lateral direction. Data is analyzed using Off-Null ellipsometry and repeating null ellipsometry conditions giving access to Å scale resolution over a μm range. The close relation between the contact angle and the draining process during transfer allows a hydrodynamic modelling and thus a deeper insight to the nucleation leading to stripe patterns.

CPP 21.7 Wed 16:00 Poster A

Self-assembly and multi-compartment micellar hydrogel formation of amphiphilic di- and triblock copolymers containing fluorophilic blocks —

•RUZHA IVANOVA¹, TUNE BONNÉ¹, KELL MORTENSEN², KLAUS PRANZAS³, THOMAS KOMENDA⁴, KARIN LÜDTKE⁴, RAINER JORDAN⁴, and CHRISTINE PAPADAKIS¹ — ¹Physikdepartment E13, TU München, 85747 Garching — ²Risø National Laboratory, Roskilde, Denmark — ³GKSS, Geesthacht — ⁴Department Chemie, TU München, 85747 Garching

The self-assembly of novel amphiphilic poly(2-oxazoline) di- and triblock copolymers containing hydrophilic and fluorophilic and/or

lipophilic blocks in aqueous solutions was studied. Small-angle neutron scattering together with contrast matching was used to study the size and the shape of the micelles as well as the effect of the copolymer concentration and the length of the hydrophilic block on the structure. In addition, transmission electron microscopy was used to visualize the micelles. The diblock copolymers aggregate into core-shell micelles. The micelles formed by the lipophilic-hydrophilic copolymers are spherical, whereas those formed by the hydrophilic-fluorophilic copolymers are slightly elongated. The triblock copolymers aggregate into micelles, and at higher concentrations, hydrogels are formed. We could show that the scattering curves of the hydrogels can be described by a coexistence of spherical lipophilic and elongated fluorophilic micellar cores linked by the hydrophilic blocks. Thus the studied poly(2-oxazoline) copolymers have large practical potential as multi-compartment vehicle systems in e.g. medicine or cosmetics.

CPP 21.8 Wed 16:00 Poster A

Molecular Self-Organisation of Fréchet-Dendrons Probed by STM — C. ROHR¹, K. GRUBER¹, M. MALAREK², L. J. SCHERER², C. E. HOUSECROFT², E. C. CONSTABLE², and •B. A. HERMANN¹ — ¹Dept. of Physics / CeNS, LMU Munich and WMI, Walther-Meissner-Str. 8, 85748 Garching, Germany — ²Dept. of Chemistry, Uni. of Basel, Spitalstrasse 51, 4056 Basel, Switzerland

Self-organised molecular layers provide a promising route to constructing new (switchable) nanodevices and optimising nanosensors. The design of suitable molecules involves the control of structure and stabilisation on the surface as well as the control of chemical functionality. The synthesis of molecules bearing functionality and at the same time exhibiting excellent self-organization properties is tedious and time consuming. Hence, the search for a potentially universal "adapter", that can control the self-organisation and stabilisation on a particular type of surface, is a worthwhile challenge. High-resolution nanoscale imaging using scanning tunnelling microscopy (STM) provides the means to significantly advance such studies. How powerfully Fréchet-dendrons can affect various central components (catalytic, switchable, redox-active) on a graphite surface is addressed by analysing self-organised monolayers of nine different molecules, each containing at least one first or second-generation Fréchet-type dendron. The arrangement of the molecules in the monolayer on the surface can further be influenced by small structural changes of the Fréchet-type dendron.

CPP 21.9 Wed 16:00 Poster A

To be or not to be - included? Heterogeneous Molecular Structures Probed by STM — K. GRUBER¹, C. ROHR¹, M. MALAREK², L. J. SCHERER², C. E. HOUSECROFT², E. C. CONSTABLE², and •B. A. HERMANN¹ — ¹Dept. of Physics / CeNS, LMU Munich and WMI, Walther-Meissner-Str. 8, 85748 Garching, Germany — ²Dept. of Chemistry, Uni. of Basel, Spitalstrasse 51, 4056 Basel, Switzerland

Complex molecular structures, e.g. as are apparent in supramolecular chemistry, typically assemble through interactions mediated by weak intermolecular forces. Weak refers here to an interaction lower in strength than a covalent bond. Especially heterogeneous assemblies are of growing interest for biological and chemical processes as well as for technical applications and provide important contribution to the design of nanodevices such as small molecular machines. All heterogeneous assemblies presented in this poster are based on weak interactions of smaller inclusion molecules with Fréchet-dendrons. While adamantane could be successfully incorporated into existing patterns (host-guest structures), heterogeneous assemblies with the inclusion compound coronene resulted in the formation of a new (polymorph) molecular arrangement. The new polymorph pattern could further be influenced by employing two other molecules of slightly modified chemical structure, benzoperylene and benzopyrene, missing two and four carbon atoms, respectively. This work impressively demonstrates the versatility of the Fréchet-dendrons, allowing a high degree of control of heterogeneous structures and presents a first step towards controlled multilayer, multicomponent self-organization of complex systems.

CPP 21.10 Wed 16:00 Poster A

The influence of nano fillers on the dynamics of a PEP-Silsesquioxane composite - a NSE study — •KLAUS NUSSER¹, GERALD JOHANNES SCHNEIDER², WIM PYCKHOUT-HINTZEN², ANDREAS WISCHNEWSKI², LUTZ WILLNER², and DIETER RICHTER² — ¹Institut für Physik, Universität Regensburg, 93040 Regensburg — ²Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich

Elastomer-filler composite materials are technically very important and widely used, because the addition of active fillers to the polymers

significantly enhances the properties of the resulting blend material and helps to optimize its employment in distinct applications. Up to now mainly a reinforcing effect of the filler was observed. New results by Mackay et al., however, report a decrease in viscosity by the addition of nano-particles of a characteristic size. The impact of this effect is investigated by means of a mixture of polyethylene-propylene (PEP) with silsesquioxane. The silsesquioxane nano particles have a characteristic diameter, which can very well be compared to the tube diameter of the PEP melt within the reptation model. The changes of the dynamics after the addition of this nano-filler are investigated and supposed to give more insight into the mechanisms of interaction in polymer-filler nano composites. First results from neutron spin echo measurements at the ILL are presented.

CPP 21.11 Wed 16:00 Poster A

The role of interfaces in photoluminescence intermittency — •CORNELIUS KRASSELT, JÖRG SCHUSTER, HARALD GRAAF, and CHRISTIAN VON BORCZYKOWSKI — TU Chemnitz, Institut für Physik, 09107 Chemnitz

Fluorescence intermittency characterized by a broad distribution of on- and off-periods, the so called power law blinking, has recently attracted great scientific interest since it appears to be a common feature of individual emitters [1]. Meanwhile it is generally accepted, that intermittency is due to the emission and trapping of charges. However, the physical nature of this charge trapping process is still unresolved and thus matter of debate. Even the most advanced available theoretical model, the diffusion controlled electron transfer model by Tang and Marcus (see references in[1]) will account for a few but not all experimental observations [1].

One of the most obvious findings is the omnipresence of interfaces in all of the observations of power law blinking reported so far, since usually various silicon oxide substrates are used as sample substrate or emitters are embedded in polymers in order to immobilize it. We show now very recent results of blinking in the presence of silicon dioxide surfaces which obviously modifies the blinking statistics. Since organic layers are known, to saturate interface related charge trapping centers on silicon oxides we conclude that those interface states play a key role for the blinking processes.

[1] F. Cichos, C. von Borczykowski, M. Orrit: *Curr. Op. Colloid Interface Science* 12 (2007), 272

CPP 21.12 Wed 16:00 Poster A

Colloidal Adsorbate Structures on Quasicrystalline Light Fields — JULES MIKHAEL, •LAURENT HELDEN, and CLEMENS BECHINGER — 2. Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany.

Quasicrystals are unusual materials since they exhibit no periodic structure but retain true long range order. Spontaneous formation of quasicrystals is typically only observed in rather complex metal alloys, for instance i-AlPdMn or d-AlNiCo, and strongly depends on the specific chemical composition. One way for forming monoatomic quasicrystalline structures is to use the surface of the quasicrystals as templates for adsorbed monolayers. Here we report a real space investigation of the phase behavior of micron-sized colloidal particles adsorbed onto a quasicrystalline decagonal substrate created by interfering five laser beams. For intermediate substrate strength a remarkably stable phase is found revealing likewise crystalline and quasicrystalline characteristics. It can be described by the Archimedean (3.3.3.4.4) tiling which is intersected by double rows of triangular tiles arranged in a Fibonacci sequence. The results on this model system open a route to identify the primordial parameters for the formation of pseudomorphic monoatomic quasicrystals.

CPP 21.13 Wed 16:00 Poster A

Metal salt-nanoparticle formation in supercritical water investigated by molecular dynamics simulation — •NORBERT LÜMMEN and BJØRN KVAMME — University in Bergen, Institute for Physics and Technology, Allégaten 55, N-5007 Bergen, Norway

Nanoparticle formation of FeCl₂ and MnCl₂ from single ions in water at supercritical conditions was investigated by molecular dynamics (MD) simulations. The water-water interaction was modelled by the rigid SPC/E water model while the water-ion and ion-ion interaction was treated by a combination of Coulomb and Lennard-Jones potentials. The temperature was controlled by a heat bath thermostat using the Nosé-Hoover mechanism. The system density was chosen to match a system pressure around 25 MPa. Simulations at different heat bath temperature and system density were carried out while keeping the

water to ion ratio constant.

Our results show that initial particle formation takes place within a few tens of picoseconds after the jump from ambient to supercritical conditions. Nucleation, surface growth and growth by cluster-cluster-collisions is observed. We present results on the time development of distributions of cluster sizes, cluster compositions, and cluster temperatures as well as radial distribution functions and nucleation rates.

CPP 21.14 Wed 16:00 Poster A

Low-dimensional nanoparticle chains formed via a dewetting water layer — ●LEONID GOVOR¹, GÜNTER REITER², GOTTFRIED H. BAUER¹, and JÜRGEN PARISI¹ — ¹Institute of Physics, University of Oldenburg, D-26111 Oldenburg, Germany — ²Institut de Chemie des Surfaces et Interfaces, CNRS, 68057 Mulhouse Cedex, France

We report on self-assembly of nanoparticles (diameter 6 nm) into low-dimensional close-packed arrays. This was achieved on substrates coated with a nitrocellulose (NC) thin layer by spreading of a hexane solution containing nanoparticles, hexadecylamine, and water. In a first step, the solution film transforms into a bilayer containing a hexane layer located onto a water film. The hexane layer dewets the water layer and the latter dewets the NC covered substrate. Dewetting of the water layer leads to the formation of water droplets. Finally, the particles follow the motion of the contact line of the dewetting water layer and thus assemble into close-packed arrays at the periphery of the water droplets.

CPP 21.15 Wed 16:00 Poster A

The microSAXS/WAXS beamline at PETRA III — ●STEPHAN V. ROTH, RALPH DÖHRMANN, RAINER GEHRKE, ULRICH HAHN, HORST SCHULTE-SCHREPPING, MICHAEL LOHMANN, HEINZ GRAAFSMA, RALF RÖHLSBERGER, HERMANN FRANZ, and EDGAR WECKERT — HASYLAB at DESY, Notkestr. 85, D-22607 Hamburg, Germany

Due to its outstanding brilliance, the third generation synchrotron radiation (SR) source PETRA III at DESY, being currently under construction, offers ideal conditions for combining micro- and nanofocused x-ray beams with small- and wide-angle x-ray scattering (SAXS/WAXS). From mid 2009 on, the microfocusSAXS/WAXS beamline P03 will be operational at PETRA III. The beamline layout combines high resolution in both real and reciprocal space with beam sizes ranging from 40 μm to 100 nm. The low divergence offered by the high-β undulator allows for installing ultraSAXS geometries in combination with such small beams. We present the detailed layout of the μSAXS/WAXS beamline [1]. Strong emphasis is put on the future improvements of the various experimental scanning techniques, such as nano- and microbeam GISAXS [2], nanoWAXS [3] and micro/nanoSAXS tomography [4].

[1] S.V. Roth et al., HASYLAB Annual report 2007 (2007)

[2] S.V. Roth et al., Appl. Phys. Lett 88, 021910 (2006), ibid. 91, 091915 (2007)

[3] S.V. Roth et al., Macromolecules 36, 1585 (2003)

[4] C. Schroer et al., Appl. Phys. Lett. 88, 164102 (2006)

CPP 21.16 Wed 16:00 Poster A

Microstructured surfaces for templating colloidal particle assembly — ●MELANIE PRETZL¹, ANNE HORN¹, ARNAUD CHICHE¹, UTE ZETTEL¹, ALEXANDRA SCHWEIKART¹, CONGHUA LU², and ANDREAS FERY¹ — ¹Department of Physical Chemistry, University Bayreuth, 95440 Bayreuth — ²Max Planck Institute of Colloids and Surfaces, Wissenschaftspark Golm, 14476 Potsdam

Surfaces with patterned assemblies of colloidal particles are of interest for various tasks like controlling wetting, optical properties (optical bandgap materials), electronic properties (wire formation) or combinatorial chemistry (catalytic activity of Particles, Synthesis in hollow capsules). We present two complementary approaches for creating such surfaces which are complementary. Chemical patterning can be achieved by means of microcontact printing. We apply this technique to create surfaces which are patterned in their charge density and show that in this way the immobilization of charged Microcapsules and Micro-balloons (gas filled microcapsules) can be directed. These entities can serve as micro-reactors or sensors. Controlled wrinkling offers an alternate approach with which periodic, topographically structured surfaces can be created. We demonstrate that these surfaces, when dipped into colloidal suspensions, direct particle adsorption. The wrinkling approach is lithography free and periods as low as 150 nm can be achieved, such that assembly of nanoparticles is feasible. We show first examples of ordered assemblies of gold nanoparticles and viruses that were created using this approach and discuss their potential.

CPP 21.17 Wed 16:00 Poster A

Structural Anisotropies in Filled Elastomers — ●GERALD JOHANNES SCHNEIDER¹ and DIETMAR GÖRITZ² — ¹Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich — ²Institut für Physik, Universität Regensburg, 93040 Regensburg

Nano composites consisting of an elastomer and a filler such as silica play a major role in our daily life. In general the macroscopic properties of the composite material depend on the type of silica, the filler content, and the silanization, i. e. on the interaction between the surface of the filler and the polymer matrix. Possibly a dependence on the direction of an applied external force can be found. Thus, in order to understand the macroscopic properties an investigation of the filler structure at a length scale of a few nanometers is of great interest. Scattering methods, in particular small angle X-ray scattering experiments are very suitable to study the structure and potential anisotropies of silica at the nanoscale. In our contribution we show the influence of the elastomer, the silane and the filler content on the anisotropy of the silica. We found a systematic increase of the anisotropy with increasing filler content. The influence of the silane is weak and the dependence on the elastomer is negligible.

CPP 21.18 Wed 16:00 Poster A

Evaluation of USAXS data obtained from colloidal crystals in latex films — ●RAINER GEHRKE — HASYLAB at DESY, Notkestrasse 85, D-22607 Hamburg, Germany

Compressed films of spherical core-shell particles with a rigid thermoplastic core (polystyrene) and a soft elastomeric shell (polymethyl methacrylate-polyethylacrylate) show a regular arrangement of the spheres. Close to the film surface the particles are ordered in an fcc lattice with the (111) net-planes parallel to the surface while in the bulk crystal-like domains with no preferred orientation are formed. USAXS measurement were performed by varying the angle between the incident beam and the surface normal stepwise from 0 degree (perpendicular incidence) to almost 90 degrees (grazing incidence) using 0.15 nm wavelength and a two-dimensional detector. Data evaluation allows separation of the scattering contributions from bulk and crystal-like top and bottom layers. The fraction of crystal-like ordered material can be estimated as well as the quality of its spatial and orientational ordering.

CPP 21.19 Wed 16:00 Poster A

The solvation energy of non-trivially shaped objects in simple liquids: testing morphology by integral equations — ●FLORIAN PESTH and MARTIN OETTEL — Institute of Physics, Johannes Gutenberg-University, 55099 Mainz

For a given solvent, the grand potential in a finite volume in general depends in a complex way on the shape of the container, or alternatively, the solvation energy of a large solute depends in a similarly complex way on the shape of the molecule. A morphological theorem states [1], that if some physical restrictions are imposed on the container or the solute, the grand potential depends on only four quantities, namely the volume, the surface area, the integrated mean curvature and the Euler characteristic of the container or the solute. On the other hand, one may calculate solvation free energies microscopically by combining integral equation methods with density functional theory. In a first test, we compare the insertion free energies from the morphological and the microscopic route for dumbbell-shaped objects with special attention to line contributions arising from the curvature terms. This appears to be relevant for applications of this morphological theorem to the configuration dependent solvation energy of macromolecules [2].

[1] P.-M. König, R. Roth, and K. R. Mecke, Phys. Rev. Lett. 93, 160601 (2004)

[2] R. Roth, Y. Harano, and M. Kinoshita, Phys. Rev. Lett. 97, 078101 (2006)

CPP 21.20 Wed 16:00 Poster A

Influence of temperature and pH on thermoresponsive PNIPAM films — ●ANNA BURMISTROVA¹, MATTHIAS KARG¹, THOMAS HELLWEG², and REGINE VON KLITZING¹ — ¹TU Berlin, Institut für Chemie, Stranski-Laboratorium, Str. d. 17. Juni 124, 10623 Berlin, Germany — ²Universität Bayreuth, Physikalische Chemie 2, Universitätsstr. 30, 95440 Bayreuth, Germany

During the last decades microgels made of N-isopropylacrylamide (NI-PAM) have attracted much interest and were studied by several techniques like microscopy and light scattering. These polymer particles

show a thermoresponsive behaviour and can be classified as "smart" materials. By copolymerisation with organic acids such as acrylic acid (AAc) the temperature of the volume phase transition as well as the swelling ratio can be influenced. Moreover charged copolymers are more sensitive to changes in pH and ionic strength. Depending on the way of preparation one can achieve particles with rather low polydispersities which makes them more interesting for applications like surface coatings and sensor design. Characterisation of coated surfaces with poly-NIPAM-co-AAc microgels has been done using Atomic Force Microscopy (AFM) and ellipsometry. While AFM allows to obtain information about the particle size and arrangement, ellipsometry focuses on the overall film thickness. In order to study the films under various conditions such as temperature and solvent composition we employed liquid cells which allowed to study the surfaces under solution. The results show that the way of preparation and external stimuli like pH and temperature influences strongly the structure of the films.

CPP 21.21 Wed 16:00 Poster A

NMR Investigation of the Aggregation of Dye Molecules — RICHARD SZOPKO, KLAUS HUBER, and •CLAUDIA SCHMIDT — Department Chemie, Universität Paderborn, Warburger Str. 100, 33098 Paderborn, Germany

The azodyes "Rot 2G" (red) and "Gelb GA" (yellow) are anionic direct dyes. A mixture of these dyes is used to produce orange hued paper. However, in the presence of alkaline-earth ions, such as Mg^{2+} , aggregates are formed, which interfere with the dyeing process. Time-resolved static light scattering, observed within 15–20 minutes after mixing the two dye solutions, has shown the formation of short aggregates with a contour length of 250–300 nm in the presence of Na_2SO_4 , whereas substituting Na^+ ions with Mg^{2+} ions leads to a nearly tenfold increase of the contour length [1]. NMR spectroscopy revealed that even in dilute aqueous solutions of the pure dye Gelb GA aggregation occurs. The aggregation as a function of temperature and concentration has been investigated using high resolution NMR measurements of proton chemical shifts and pulsed gradient stimulated echo diffusion experiments.

[1] S. E. Inglés, A. Katzenstein, W. Schlenker, K. Huber, *Langmuir*, 16, 3010 (2000).

CPP 21.22 Wed 16:00 Poster A

decontamination with sugar surfactant based bicontinuous microemulsions — •STEFAN WELLERT¹, THOMAS HELLWEG¹, CHRISTIAN GROETSCH², MICHAEL DOLLE², HANS-JUERGEN ALTMANN², and ANDRE RICHARDT² — ¹University Bayreuth, PCI, Universitaetsstrasse 30, D-95440 Bayreuth — ²Bundeswehr Scientific Institute (NBC-Protection), Humboldtstr, D-29633 Munster

Bicontinuous microemulsions are continuously connected interwoven domains of oil and water. In a fishlike phase diagram, this type of microemulsion structure is located in the single phase region, very close to the fishtail point, where the three-, two- and one phase region meet.

Bicontinuous microemulsions are formed by the highest amounts of oil and water and the lowest necessary amount of surfactant. We study the bicontinuous region of a quaternary system water/rapeseed methyl ester/sugar surfactant/pentanol, which is environmental compatible and hence, a promising candidate for a modern decontamination medium.

We present results from studies of the phase behavior of quaternary systems. Moreover, the influence of an additional active component like oxidizing agents and enzymes is discussed.

CPP 21.23 Wed 16:00 Poster A

Mixture of polymers and dilute colloids — •MARYAM NADERIAN and MATTHIAS FUCHS — University of Konstanz

Equilibrium structure and thermodynamics of a mixture of non-adsorbing polymers and dispersed particles in *Protein Limit*, where the Proteins are much larger than colloids, are very interesting. Employing a macromolecular liquid state approach leads to an integral equation method (PRISM) for polyatomic fluids, applicable for any polymer to colloid size ratio. Ideal polymers are described using a Gaussian form factor. By numerical solution of the Ornstein-Zernike equation we investigate thermodynamic and structural properties and thermodynamic consistency for the infinitely dilute regime.

CPP 21.24 Wed 16:00 Poster A

Plasma Electrochemistry in Ionic Liquids: Deposition of Copper-Nanoparticles — •MAREIKE BRETTHOLLE¹, OLIVER

HÖFFT¹, SEBASTIAN MATHES², SHERIF ZEIN EL ABEDIN¹, and FRANK ENDRES¹ — ¹Institut für Metallurgie, TU Clausthal, 38678 Clausthal-Zellerfeld, Germany — ²Institut für Physik und Physikalische Technologien, TU Clausthal, 38678 Clausthal-Zellerfeld, Germany

Ionic liquids are a highly interesting group of solvents for electrochemical processes - mainly due to the combination of their high electrical conductivity, their electrochemical stability and their ability to dissolve a wide range of compounds [1]. Due to their low vapour pressure low pressure plasmas can easily be applied. The idea is to use the free electrons of the plasma to reduce the dissolved metal atoms in the liquid and generate this way the metal particles. In ionic liquids this principle was utilized recently by Meiss et al. [2]. Here we present our results using an argon plasma as electrode for the electrochemical deposition of copper nanoparticles (5-100 nm) from a Cu solution in 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)amide [BMP]Tf₂N and 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)amide [EMIm]Tf₂N. XPS, REM, EDX and Dynamic light scattering (DLS) were used to characterise the particles. [1] F. Endres, S. Zein El Abedin, *Phys. Chem. Chem. Phys.*, 8 (2006) 2101; [2] S. A. Meiss, M. Rohnke, L. Kienle, S. Zein El Abedin, F. Endres and Jürgen Janek, *Chem. Phys. Chem.*, 8 (2007) 50

CPP 21.25 Wed 16:00 Poster A

Stimuli-sensitive micelles from amphiphilic diblock copolymers — •KORDELIA TROLL¹, AMIT KULKARNI¹, CHRISTINE M. PAPADAKIS¹, WEINAN WANG¹, PETER MÜLLER-BUSCHBAUM¹, ACHILLE M. BIVIGOU KOUMBA², and ANDRÉ LASCHEWSKY² — ¹Physikdepartment E13, TU München — ²Institut für Chemie, Universität Potsdam

Amphiphilic diblock copolymers from a hydrophilic, thermosensitive block, poly(N-isopropyl acrylamide) (PNIPAM), and a hydrophobic block, polystyrene, are expected to form micelles in aqueous solution, which are swollen below the lower critical solution temperature (LCST) and collapsed above. We focus on the conformational change of the micellar shell as a function of temperature and the PNIPAM volume fraction.

Two diblock copolymers with different PNIPAM volume fractions were studied at low polymer concentrations in aqueous solution. The temperature behavior was investigated using microcalorimetry and dynamic light scattering. The polymer with a high PNIPAM volume fraction (0.80) form micelles and show a reversible collapse at the expected LCST of ~31°C. The spherical shape of the micelles was confirmed using TEM. The polymer with the low PNIPAM volume fraction (0.29) could not directly be dissolved in water. Aqueous solutions were therefore prepared via dialysis from organic solvents. The size of the aggregates was found to depend strongly on the organic solvent, and no collapse could be detected.

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Nanorod-coated PNIPAM microgels: thermoresponsive optical properties — •MATTHIAS KARG¹, ISABEL PASTORIZA-SANTOS², JORGE PÉREZ-JUSTE², LUIS M. LIZ-MARZÁN², and THOMAS HELLWEG³ — ¹TU Berlin, Stranski-Laboratorium, Strasse des 17. Juni 124, 10623 Berlin, Germany — ²Universidad de Vigo, Grupo de Química Física, 36310 Vigo, Spain — ³Universität Bayreuth, Physikalische Chemie I, Universitätsstrasse 30, 95440 Bayreuth

Highly-charged, thermoresponsive poly-(N-isopropylacrylamide) microgels were covered with polyelectrolyte-coated gold nanorods [1]. The surface coverage of these hybrid particles was varied by changing the ratio of nanorods to microgel and determined from electron microscopy images. Temperature dependent UV-VIS measurements were done to investigate the optical behavior during the collapse of the microgel core. The results show red-shifts of the longitudinal plasmon band due to increasing electronic interactions between the gold nanorods when the polymer cores decrease in size. Further observed effects are an increase in the band width and a decrease of the amplitude of the longitudinal band. These properties strongly depend on the surface coverage and are therefore tuneable, which makes them interesting for applications such as optical filters. [1] M. Karg, I. Pastoriza-Santos, J. Pérez-Juste, T. Hellweg, L. M. Liz-Marzán, *Small*, 2007, 3, 1222-1229

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Hydrodynamics in colloidal suspensions: From highly charged to electrostatically screened particles — •FABIAN WESTERMEIER¹, TINA AUTENRIETH¹, CHRISTIAN GUTT¹, AYMERIC ROBERT², and GERHARD GRÜBEL¹ — ¹HASYLAB/DESY, Hamburg, Ger-

many — ²SLAC/Stanford University, Menlo Park, USA

We studied the dynamic behaviour of charge-stabilised colloidal suspensions. For these systems the direct particle interactions, for which the experimental data can be described by the RMSA model, are well understood. For the indirect particle interactions which are mediated by the solvent and described by the hydrodynamic function several theories have been developed and experimentally tested within the last years, but there is no universally valid theoretical model that is applicable over the whole range of volume fractions.

Therefore we undertook a systematic study where the interaction strength between the particles was altered by varying both the volume fraction of the colloids and the concentration of added electrolyte screening the electrostatic interactions. The combined use of dynamic light scattering (DLS), Small Angle X-ray Scattering (SAXS) and X-ray Photon Correlation Spectroscopy (XPCS) allowed us the determination of the hydrodynamic function free from any modeling.

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From gas-liquid to liquid crystalline phase behavior via anisotropic attraction: A computer simulation study — ●WENZE OUYANG and REINHARD HENTSCHE — Bergische Universität Wuppertal

The phase behavior of a continuum molecular model for self-assembling semiflexible equilibrium polymers is studied via Monte Carlo simulation and molecular dynamics. We investigate the transfer from ordinary gas-liquid coexistence to the appearance of liquid crystallinity driven by excluded volume interaction between rodlike aggregates. The

transfer between the two types of phase behavior is governed by a tunable anisotropic attractive interaction between monomer particles. The relation to dipolar fluid models, which are also known to form reversible chains, is discussed.

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Geometric Order Parameters for Point Patterns — ●SEBASTIAN BITTNER and KLAUS MECKE — Institut für Theoretische Physik Universität Erlangen-Nürnberg, Staudtstrasse 7, 91058 Erlangen, Germany

Higher correlations are important to characterise hexatic phases in colloidal systems or non-Gaussian fluctuations in fluids beyond the two-point structure function. A hybrid technique of two-point correlation functions and Minkowski functions of point patterns offer the possibility to measure higher correlations in a statistically robust way.

The geometrical idea of the morphological technique is simple: a ring of outer radius R and inner radius $r < R$ is attached at each point of the pattern, which will overlap mutually. The morphology of the coverage is then analysed geometrically for all reasonable values of r and R by measuring its area, boundary length and Euler characteristic. For $r = 0$ one recovers the standard Minkowski functions of point patterns whereas for $r \rightarrow R$ the measures reduce to the two-point characteristics.

We present an algorithm for computing the morphological functions of the coverage and snapshots from visualisations of the rings. Finally, we apply this hybrid method on various point patterns in physics and biology, e.g. on colloidal configurations.