

CPP 7: POSTERS Rheology

Time: Monday 16:45–19:00

Location: Poster A

CPP 7.1 Mon 16:45 Poster A

Spatio-temporal behavior of dipolar nano-rods under shear — ●SEBASTIAN HEIDENREICH, SIEGFRIED HESS, and SABINE H. L. KLAPP — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, D-10623

The flow properties of nano-rods are strongly affected by the dynamical behavior of molecular alignment. A theoretical description can be made by an relaxation equation [1] of the order parameter tensor. For plane Couette flow geometry the model leads to a rather complex orientational and flow behavior [2]. Depending on the model parameters and the boundary conditions various flows like shear banding flow can occur. To describe suspensions consisting of dipolar nano-rods that can form clusters with an effective polarization the relaxation equation has to be extended. In [4] the coupling of the orientation and the dipole moment was investigated for the bulk system. The additional dipole moment strongly affects the orientational dynamics. In this contribution we study a spatially inhomogeneous tensor model. In the plane Couette geometry structure emerges in the flow profile not known from the flow behavior of nano-rods without dipole moments. Furthermore, we present the effect of the dipole moment on the start up flow dynamics of shear bands.

[1] S. Hess, *Z. Naturforsch.* **30a**, 728, 1224 (1975)

[2] B. Chakrabarti, M. Das, C. Dasgupta, S. Ramaswamy, and A. K. Sood, *Phys. Rev. Lett.* **92**, 055501, (2004);

[3] S. Grandner, S. Heidenreich, P. Ilg S. H. L. Klapp, and S. Hess; S. Grandner, S. Heidenreich, S. Hess, and S. H. L. Klapp, EPJE in press

CPP 7.2 Mon 16:45 Poster A

Deviation from elongational flow in the capillary breakup of polyethylene oxide solutions — ●RAINER SATTLER and CHRISTIAN WAGNER — Campus, Gebäude E2 6 3.OG, 66041 Saarbrücken

The formation of the beads-on-a-string structure on a thinning thread of an elastic liquid is revisited. This structure occurs as previously shown in consequence of a linear instability. However, the evolution has been examined in more detail to evaluate existing iterative concepts and gain more insight into the processes involved. The reported formation of a solidified polymer thread during the final stages of the breakup could be deduced in-situ in an indirect way compared to the Scanning Electron Microscopy images previously presented. Two independent observations allow for a qualitative and quantitative prediction of it matching the known results.

More insight is given on the evaluation of the linear instability justifying the special Super-Resolution method. Singular occurrences of droplets on the fiber prior to the linear instability are discussed. Finally we put emphasis on the examination of the flow conditions within the liquid column from the formation of the cylindrical thread until the onset of the linear instability, falsifying the assumption of a purely elongational plug flow. We present its scope as well as the transition to a flow containing shear and even flow reversal between surface and core especially during the "breathing" instability of the fringe region presented elsewhere.

CPP 7.3 Mon 16:45 Poster A

Uncommon rheological effects during melting of dibenzylidene sorbitol fiber networks in poly (propylene oxide) — ●MARTIN KÜHNE and CHRISTIAN FRIEDRICH — Freiburger Materialforschungszentrum, Stefan-Meier-Str. 21, 79104 Freiburg

Dibenzylidene sorbitol (DBS) is known to gel organic liquids as well as polymers such as poly (propylene oxide) (PPO) due to its capability of forming semiflexible fibers and corresponding networks. These networks are thermoreversible, which means they are melted by temperature increase and rebuild again during temperature decrease.

We investigated the melting process and related rheological effects of DBS fiber networks in PPO with special regard to temperature rate and deformation. At certain temperature rates and deformations an uncommon rheological behavior was found: Both G' and G'' increase with increasing temperature. We found that this behavior is the result of a temperature gradient within the sample, which causes fragmentation of fibers. The temperature dependent balance between fragmentation and reorganization is responsible for the observed effects. As a consequence, at the lowest rates, the samples do not show such uncommon behavior and now G' depends on temperature with T^{-1} . This

is in accordance to the predictions for the temperature dependence of plateau modulus of a network of semiflexible fibers.

CPP 7.4 Mon 16:45 Poster A

Shear induced brush deformation of soft colloids: Hybrid mesoscale simulations and Rheo-SANS experiments — ●JÖRG STELLBRINK¹, MARISOL RIPOLL¹, ROLAND G. WINKLER¹, GERHARD GOMPPER¹, JAN K.G. DHONT¹, DIETER RICHTER¹, DIMITRIS VLASSOPOULOS², and PETER LINDNER³ — ¹IFF, Forschungszentrum Jülich, D-52425 Jülich — ²IESL-FORTH, Heraklion 71110 Crete, Greece — ³Institute Laue-Langevin, F-38042 Grenoble, France

The deformation of a soft colloid by external shear fields crucially depends on its "degree of softness" and the applied Weissenberg number. ($Wi = \tau_e \dot{\gamma}$, with $\dot{\gamma}$ the applied external shear rate and τ_e the characteristic internal relaxation time of the deformable particle.)

Here we compare results obtained with multiparticle collision dynamics simulations (MPC) and Rheo-SANS experiments for dilute solutions of regular star polymers (the limiting *ultra-soft* colloid). To achieve large Weissenberg numbers we use high M_w polybutadiene (PB) star polymers dispersed in a PB oligomer matrix. We found excellent agreement between theory and experiment with respect to onset and amount of shear induced brush deformation for star polymers with varying functionality f .

Moreover, from MPC simulations we found that with increasing functionality star polymers exhibit a crossover in their flow properties from those of linear polymers to a novel behavior, which resembles the tank-treading motion of elastic capsules [1].

[1] M. Ripoll, R. G. Winkler, and G. Gompper, *Phys. Rev. Letters*, **96**, 188302, (2006).

CPP 7.5 Mon 16:45 Poster A

Interfacial Shear Rheology of Coffee Samples — ●JÖRG LÄUGER and PATRICK HEYER — Anton Paar Germany, Ostfildern, Germany

Coffee is a complex dispersion, which for many coffee drinks is topped by a foam structure of tiny bubbles, e.g. the espresso foam. Interfacial rheology does not probe the foam itself, but measures the adsorption of the amphiphilic ingredients and their network formation at the liquid surface. Higher values of the interfacial properties and a faster film formation are expected to correlate with a better foam stability. Measurements on the film formation process and on the interfacial rheological properties of the final film of coffee samples are presented and discussed. Both oscillatory and rotational test have been performed on films with different coffee concentrations. Different techniques have been used to measure interfacial shear properties. Here we would like to focus on two geometries, which have been used in combination with standard types of rotational rheometers. One is the biconical geometry and the other the De Noüy ring. The aim of the paper is twofold: First, to show that interfacial rheology is a valuable tool to get information on the film formation and therefore the foam stability of coffee, and second, to compare the results obtained by a biconical disc geometry and a Du Nuüy ring.

CPP 7.6 Mon 16:45 Poster A

Wet sand flows better than dry sand — ●JORGE FISCINA and CHRISTIAN WAGNER — Technische Physik, Saarland University, D-66123, Saarbruecken

We investigated the yield stress and the apparent viscosity of sand with and without small amounts of liquid. By pushing the sand through a tube with an enforced Poiseuille like profile we minimize the effect of avalanches and shear localization. We find that the system starts to flow when a critical shear of the order of one particle diameter is exceeded. In contrast to common believe, we observe that the resistance against the flow of wet sand is much smaller than that of dry sand. For the dissipative flow we propose a non-equilibrium state equation for granular fluids.

CPP 7.7 Mon 16:45 Poster A

In-situ investigation of the solid/liquid interface of a block copolymer solution under shear stress with μ -focus GISAXS — ●ANDREAS TIMMANN¹, STEPHAN VOLKHER ROTH¹, STEFFEN FISCHER², and STEPHAN FÖRSTER² — ¹HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany — ²Inst. f. Phys. Chem., Uni HH,

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Block-copolymers are interesting for their ability to self organize in various structures. In dilute solution they form micelles, cylindrical micelles and vesicles. The length scales of these structures ranges from about 5 nm up to several hundred nanometers. Hence such structures are well suited for investigations using small-angle X-ray scattering.

The experiments were performed the beamline BW4 at HASYLAB, Hamburg [1] using the microfocus setup. We present the results of the investigation of a 13 wt.% solution of a poly-(isoprene-block-ethylene oxide) in water. The block degrees of polymerization of the isoprene and the polyethylene oxide were 55 and 170, respectively. The shear stress was applied by a stress-controlled Bohlin CVO rheometer in a plate-plate-geometry with a diameter of 20 mm and a gap of 1 mm. We investigated the interface layer of the solution with the rotor of the shear geometry at different temperatures. From the experiments it is clearly shown that the behavior of bulk and steel-liquid interface in a rheometric cell are quite different from each other.[2]

References:

[1] Roth et al., Rev. Sci. Instrum., 2006, 77, 085106

[2] Timmann et al., Appl. Phys. Lett., accepted

CPP 7.8 Mon 16:45 Poster A

Networks in polypropylene / carbon nanotube composites investigated by simultaneous rheological and electrical measurements — NIKOLAOS KATSIKIS¹, CHRISTIAN TRIEBEL¹, JOACHIM KASCHTA¹, HELMUT MÜNSTEDT¹, ANDREAS FUNK², and WALTER KAMINSKY² — ¹Lehrstuhl für Polymerwerkstoffe, Universität Erlangen-Nürnberg — ²Institut für Technische und Makromolekulare Chemie, Universität Hamburg

Electrical conductivity of polymer composites filled with carbon nanotubes (CNT) can already be reached for concentrations far below 1 vol.%. To achieve such properties, a good distribution of the CNT is essential. This goal is very difficult to reach for polyolefins as their processing in the diluted state, necessary for a good distribution of nanoparticles, is complicated. Polypropylene/CNT composites were developed at the University of Hamburg by using metallocene catalysts. Materials of that kind were investigated by simultaneous measurements of rheological and electrical properties in order to get information on the formation of CNT - networks. For that purpose, a rheometer was equipped with heatable electrodes and a sensitive current measuring system. It was found that the distinct percolation threshold for the electrical conductivity is not reflected in rheological properties which show a more or less continuous change with the volume concentration. A model for an explanation of these findings is presented and discussed.

CPP 7.9 Mon 16:45 Poster A

Surface enrichment in statistical copolymer films — ALEXANDER DIETHERT, EZZELDIN METWALLI ALI, and PETER MÜLLER-BUSCHBAUM — TU München, Physik-Department LS E13, James-Frank-Str. 1, 85747 Garching

A prominent class of pressure sensitive adhesive (PSA) films is based on statistical copolymers. Typically two or three different monomers are combined to balance the different requests of the PSA films. In the presented work we focus on model systems and investigate the dependence on different monomers of the copolymer. With x-ray reflectivity the density profile perpendicular to the PSA surface is probed and enrichment layers are detected. From a model fit the type of monomer enriching at the surface and the thickness of the enrichment layer is detected.

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CPP 7.10 Mon 16:45 Poster A

Evolution of complex defects in cylinder phase of block copolymers: Experiment and Simulations — LARISA TSARKOVA¹, ANDRIANA HORVAT¹, AGUR SEVINK², and ANDREY ZVELINDOVSKY³ — ¹Physikalische Chemie II, Universität Bayreuth, Germany — ²Soft Condensed Matter Group, Leiden Institute of Chemistry, Leiden University, The Netherlands — ³Centre for Materials Science, Department of Physics, Astronomy and Mathematics, University of Central Lancashire, Preston, United Kingdom

We study and classify typical and specific 2D defects which are repeatedly observed in thin films of cylinder-forming block copolymers upon long-term annealing as well as in simulations based on the dynamic self-consistent mean field theory (DSCFT). We demonstrate that pure topological arguments are not sufficient to characterize the stability

and mobility of defects. Instead, specific features of block copolymer materials should be taken into account. In cylinder-forming block copolymers, representative defect configurations provide connectivity of the minority component and indicate the overall morphological evolution under given annealing conditions. The formation of specific non-topological neck-defects is tentatively similar to the initial stages of membranes/vesicles fusion. Lateral propagation velocity of a complex 3T-Junction was measured with in-situ SFM. Comparison with the DSCFT simulations suggests that lateral defect motion is diffusion-driven and indicates weak involvement of the bottom (wetting) layer in the lateral ordering of the structures at the free surface.

CPP 7.11 Mon 16:45 Poster A

Fluids in confinement: Dynamics of Foam Film Thinning — SILKE STÖCKLE¹, RUMEN KRASDEV¹, GEORGI GEORGIEV², and HELMUTH MÖHWALD¹ — ¹Max Planck Institut für Kolloid- und Grenzflächenforschung, 14424 Potsdam/Golm, Deutschland — ²University of Sofia, Department of Biochemistry, Sofia, Bulgaria

The thinning dynamics of foam films have become of interest and we are utilising this as a tool to study the behaviour of liquid in confinement. We show results on the dynamics of thinning of foam films stabilised by Dodecyl-D-Maltoside (C12G2) and by DMPG.

The results show the strong influence of the C12G2 concentration on the film thinning. The films formed from solutions with low surfactant concentration reveal a high speed of film thinning which is much slower above a critical threshold surfactant concentration. The theoretical models describe the thinning process well only down to a certain thickness below which the film thins faster than theory predicts. The discrepancy could be explained by introducing an additional term to the classical DLVO theory which counts for the short range interactions or considering the properties of liquids in confined volumes. The films prepared from the lipid DMPG show complex thinning behaviour at different temperatures. The peculiarities complement well to the changes of the bulk properties of the lipid dispersions at the studied temperatures.

CPP 7.12 Mon 16:45 Poster A

Time evolution of surface relief structures in thin block copolymer films — ANDRIANA HORVAT¹, LARISA TSARKOVA¹, AGUR SEVINK², ANDREY ZVELINDOVSKY³, ROBERT MAGERLE⁴, and ARMIN KNOLL⁵ — ¹Physikalische Chemie II, Universität Bayreuth, Germany — ²Soft Condensed Matter Group, Leiden Institute of Chemistry, Leiden University, The Netherlands — ³Centre for Materials Science, Department of Physics, Astronomy and Mathematics, University of Central Lancashire, Preston, United Kingdom — ⁴Chemische Physik, Technische Universität Chemnitz, Germany — ⁵IBM Research GmbH, Sumerstrasse 4, Rüschlikon, Switzerland

The dynamics of early stage of terrace formation in thin supported films of cylinder forming triblock copolymers was studied both theoretically using self-consistent field theory (DSCFT) and experimentally by *in-situ* scanning force microscopy (SFM). In experiment, an initially flat film of incommensurable thickness was imaged continuously, and the evolution of vertical orientation of cylinders into parallel one, as well as the respective development of thickness gradient (terrace formation) was captured in detail. On the grounds of these experimental observations, the parameters of the computational model $A_3B_{12}A_3$ were determined to match the structures in experiment. Both systems show excellent agreement in details of structural phase transitions and in the dynamics of the step development, suggesting that the underlying transport mechanisms are governed by diffusion.

CPP 7.13 Mon 16:45 Poster A

Depth profiling of lamella-forming block copolymer films using SFM with quasi in-situ etching treatment — EVA MAX, MARKUS HUND, and LARISA TSARKOVA — Physikalische Chemie II, Universität Bayreuth, Germany

State-of-the-art SPMs have limited in-situ sample treatment capabilities. Aggressive treatments like plasma etching or etching in aggressive liquids typically require to remove the sample from the microscope. In consequence, time consuming procedures are needed if the same spot of the sample has to be imaged after the step-wise treatment. We report a first prototype of an SPM setup with quasi in-situ sample treatment capabilities which utilizes a modified commercial SPM (Dimension 3100, Veeco Instruments Inc.) and present recent experiments using this approach. Thin lamella-forming block copolymer films have been subjected to consecutive plasma etching, and the structure depth profile has been reconstructed.

CPP 7.14 Mon 16:45 Poster A

Structure and dynamics within the length scale of the boundary layer — ●MARCO WALZ¹, NICOLE VOSS¹, MAX WOLFF², HARTMUT ZABEL², and ANDREAS MAGERL¹ — ¹Chair for Crystallography and Structural Physics, University of Erlangen-Nürnberg, Staudtstr. 3, 91058 Erlangen — ²Chair for Condensed Matter Physics, Ruhr-University Bochum, Universitätsstr. 150, 44780 Bochum

Shear anomalies may manifest themselves by unusual solid-liquid interface properties. Structural issues can be studied by GISANS and reflectometry which can be tuned to be particularly surface sensitive. In earlier studies by GISANS slightly above the critical angle, we observed a crystalline ordering of micellar solutions depending on the chemical termination of the solid boundary. An extension to smaller angles implying an increased sensitivity to near surface structures shows that the local structure depends on the distance to the interface. In addition a first attempt to access the dynamics in the near surface region by grazing incidence neutron spin echo (GINSE) indicates that also the micellar dynamics in this region is responsive to the chemical potential of the boundary.

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CPP 7.15 Mon 16:45 Poster A

Unusual growth exponent in liquid crystal foams — ●TORSTEN TRITTEL, VICTOR AKSENOV, and RALF STANNARIUS — Otto-von-Guericke-Universität Magdeburg

We investigate foams made from pure thermotropic liquid crystals and observe a new type of scaling behaviour during foam coarsening. 2D foams are prepared in thin cells and studied by digital image analysis. We calculate the temporal evolution of the mean bubble radius $\langle R(t) \rangle$ and find a scaling behaviour with $\langle R(t) \rangle \propto t^\alpha$. In ordinary soap foams, the growth exponents are $\alpha = 1/3$ (wet foams, circular bubbles) and $\alpha = 1/2$ (dry foams, polygonal bubbles), respectively. Our bubbles have a polygonal shape like in a dry foam, but we observe an anomalous growth exponent $\alpha \simeq 0.20$ in the smectic phase. This is not compatible with the classical theories of bubble growth in foams, neither for dry nor for wet foams. In the nematic phase, coalescence dominates the evolution and the foam collapses so fast that one can not determine a steady scaling growth exponent.

CPP 7.16 Mon 16:45 Poster A

Kinetic toy model for crystal plasticity — ●MARKUS HÜTTER¹, MIROSLAV GRMELA², and HANS CHRISTIAN ÖTTINGER¹ — ¹ETH Zürich, Department of Materials, Polymer Physics, CH-8093 Zürich, Switzerland — ²Ecole Polytechnique de Montréal, Montréal, Quebec, Canada H3C 3A7

We propose a kinetic toy model to describe the dynamics of sliding layers as it occurs in the plastic deformation of single crystals, be it of polymeric, colloidal, or metallic nature. As its basic ingredient, the distribution function of relative strains between adjacent crystal layers is introduced with time evolution described by a diffusion equation with periodic boundary conditions. The model highlights the conceptual difference in the dynamics of the elastic and plastic strains, the latter being related to an average hopping rate that captures the evolving reference state. We illustrate the model by calculation of the stress response for both stationary and transient conditions. In order to discuss the physics behind the parameter that drives the plastic flow in the kinetic model, we use nonequilibrium thermodynamics to unify this model with a nonisothermal hydrodynamic description, which renders the set of evolution equations closed. Finally, we examine the relation of the kinetic toy model to macroscopic theories of elasto-viscoplasticity that employ the macroscopic deformation gradient as a fundamental variable.

CPP 7.17 Mon 16:45 Poster A

Single molecule probe diffusion in liquid crystalline films — ●BENJAMIN SCHULZ, JÖRG SCHUSTER, and CHRISTIAN VON BORCZYKOWSKI — TU Chemnitz, Institut für Physik, 09107 Chemnitz

Liquid crystalline materials are widely used in modern displays. Image quality and switching speed of the display cells are critically influenced by details of the arrangement of the mesogenes at the interface. Thus, analytical techniques are required which are able to probe molecular orientation in liquid crystals on a nanoscale. We will present the first study on the use of single fluorescent dye probes which are especially tailored for the analysis of liquid crystalline materials on the single

molecule level. Perylene dyes have been modified such, that the dyes align along the orientation of the mesogenes, and will thus, due to the orientation of their absorption and emission dipoles, probe the local orientation of the liquid crystal.

Diffusion trajectories of such dye probes in thin liquid crystalline films have been tracked by wide field microscopy techniques and analyzed following standard procedures [1]. The use of tailored probe molecules allows us to discriminate between homeotropic and homogeneous alignment of thin liquid crystalline films. By comparing diffusion properties of different dyes with variable alignment strength, details of the orientation of the films will be resolved in future. Here we present the comparison of the diffusion properties of two perylene derivatives, one strongly aligning and one not aligning.

[1] J. Schuster, F. Cichos, C. von Borczyskowski: Eur. Polymer J. 40 (2004), 993

CPP 7.18 Mon 16:45 Poster A

Rupture dynamics of smectic bubbles — ●FRANK MÜLLER and RALF STANNARIUS — Institut für Experimentelle Physik, Otto-von-Guericke Universität, 39106 Magdeburg, Germany

Equilibrium shapes of thin liquid membranes are well understood. On the other hand, when such films undergo fast transitions from a non-equilibrium to an equilibrium state like rupture, different dynamical mechanisms are involved which are in general poorly understood. We study such phenomena experimentally with a fast camera (up to 100.000 fps), using smectic liquid crystal bubbles as model membranes [1]. We observe several unexpected phenomena like 1. a global thickening of the film during rupture, 2. the propagation of mechanical waves, which result in light scattering, 3. an instability of the moving rim that separates the film from the hole and 4. the formation of a brim, which is due to the spherical shape of the film. All these phenomena are strongly dependent on film thickness.

[1] Müller F, Kornek U, and Stannarius R: Experimental study of the bursting of inviscid bubbles, Phys. Rev. E 75 065302(R), 2007

CPP 7.19 Mon 16:45 Poster A

Influences of Added Salt on the Drying Behavior of Polymer Dispersions - Simultaneous Use of Magnetic Resonance Profiling and Diffusing-Wave Spectroscopy — ●ALEXANDER KÖNIG¹, PETER McDONALD², JOSEPH KEDDIE², and DIETHELM JOHANNSMANN¹ — ¹Institute of Physical Chemistry, Clausthal University of Technology, Germany — ²Department of Physics, University of Surrey, UK

Magnetic Resonance Profiling (MRP) was used to measure the non-uniform drying of charge-stabilized polymer dispersions. Drying is sometimes accompanied by packing of particles at the top of the film. In this case, the vertical distribution of free water, $\phi_{wat}(z)$, is strongly asymmetric. It is suspected - but not well investigated - that particle packing and coalescence create a skin. This process should be influenced by the interaction potential between particles (which can be influenced via addition of salt). As a measure of asymmetry, the skewness of the distribution $\phi_{wat}(z)$ was used. The skewness is defined as $m_3/m_2^{3/2}$, where m_i is the i -th moment of the distribution.

Diffusing-Wave Spectroscopy (DWS) probes the translational dynamics in concentrated dispersions. Both techniques were combined in-situ in order to correlate structure and dynamics.

The skewness, as determined with MRP, correlated well with the occurrence of a static scattering component in DWS. Skin formation is stronger in the presence of salt, which is explained by a destabilizing effect of salt onto the interparticle membranes. Comparing different salts, we found that their relative influence onto interparticle coalescence followed the Hofmeister series.

CPP 7.20 Mon 16:45 Poster A

Competition of Phase Separation and Kinetic Arrest in a Binary Mixture with Depletion Attraction — ●ANNA KOZINA¹, PEDRO DIAZ-LEYVA^{1,2}, CHRISTIAN FRIEDRICH^{1,3}, and ECKHARD BARTSCH^{1,2} — ¹Institute of Macromolecular Chemistry, Freiburg University, Germany — ²Department of Physical Chemistry, Freiburg University, Germany — ³Material Research Centre Freiburg, Freiburg University, Germany

Recently it has been shown that the introduction of short-range attractions by the addition of free polymer leads to such effects like melting of a colloidal glass and appearance of a reentrant glass transition [1] ('attractive' glass). The studied colloidal system consists of a binary colloidal mixture of 1:50 cross-linked polystyrene microgel particles in a good solvent. To introduce short-range attraction various amounts

of linear polystyrene were added. A binary mixture was chosen to suppress crystallization and the size ratio $R_{g,polymer}/R_{colloid} \sim 0.08$ should exclude a fluid-fluid phase separation. Nevertheless, when driving the system into the attractive glass, a pronounced waiting time dependence of both density fluctuations and mechanical properties was observed. Using time resolved SLS we found evidence that this behavior is due to a micro phase separation of A and B particles with the concomitant formation of pure crystalline A and crystalline B micro domains. This phenomenon is reminiscent of the fractionation of polydisperse emulsion droplets via depletion attraction [2].

- [1] T. Eckert and E. Bartsch, Phys. Rev. Lett. 89, 125701 (2002)
 [2] J. Bibette, J. Colloid Interf. Sci. 147, 474 (1991)

CPP 7.21 Mon 16:45 Poster A

Network induced relaxation dynamics in colloidal gels. — ●EMANUELA DEL GADO — Polymer Physics, ETH Zürich

In contrast to other systems that show a slow relaxation, such as, e.g., glass-forming liquids, the structure of gels is given by an open network that is thought to be responsible for the unusual dynamical properties of these systems. It would be therefore essential to deeper understand this connection and to be able to tune the mechanical response via the structural features. We investigate the gel formation from the equilibrium sol phase in a simple model that has the characteristics of (colloidal) gel-forming systems at a finite temperature [1]. In the molecular dynamics simulations, at low volume fraction and low temperatures, particles are linked by long-living bonds and form an open percolating network. As a consequence, the dynamics show a non-trivial dependence on the wave-vector: At high wave vectors the relaxation is due to the fast cooperative motion of the branches of the gel network, whereas at low wave vectors the overall rearrangements of the heterogeneous structure produce the relaxation process. We study the lifetime of bonds and nodes of the gel network in order to relate these quantities to the complex relaxation dynamics observed. [1]E. Del Gado and W. Kob, Europhys. Lett. 71, 1032 (2005); Phys. Rev. Lett. 98, 028303 (2007); J. Non-Newt. Fluid Mech. 2007, in press.

CPP 7.22 Mon 16:45 Poster A

Ordnungsverhalten eines A-B Diblockcopolymer in einer (A/B/A-B) Polymermischung aus drei Komponenten — ●VITALIY PIPICH, LUTZ WILNER und DIETMAR SCHWAHN — Institut für Festkörperforschung des Helmholtz Forschungszentrum Jülich

Die Beimischung eines Diblockcopolymer zu einer binären Homopolymermischung führt zu einem komplexen Phasenverhalten [1]. Dies äußert sich in einem verbesserten Mischungsverhalten der beiden Homopolymere, zur Ausbildung einer Mikroemulsionsphase und schließlich zu einer geordneten lamellaren Phase[2]. Parallel beobachtet man in der homogenen Phase verstärkt das Auftreten thermischer Fluktuationen der Zusammensetzung [3]. In diesem Beitrag diskutieren wir den Strukturfaktor des Diblockcopolymer in solch einer A/B/A-B Polymermischung (A und B ist repräsentiert durch Polybutadien und Polystyrol). Solche Messungen sind mit der Neutronenkleinwinkelstreuung möglich, in dem nur ein Block des Diblockcopolymer durch entsprechende Deuterierung "sichtbar" gemacht ist. Theorien im Rahmen der Molekularfeldnäherung postulieren einen Strukturfaktor unabhängig von der Temperatur. Dieser Befund wird für kleine Diblockkonzentrationen bestätigt, stimmt aber nicht für Konzentrationen nahe und oberhalb der Lifschitzlinie. Es zeigt sich weiterhin, dass in diesem Konzentrationsbereich das Diblockcopolymer früher ordnet als das Homopolymer.

- [1]*D. Schwahn, Advances in Polymer Science 183, 1 (2005). [2]*V. Pipich et al. J. Chem. Phys. 123, 124904-1 (2005) [3]*V. Pipich et al. Phys. Rev. Lett. 94, 117801 (2005).

CPP 7.23 Mon 16:45 Poster A

Fluorescence correlation spectroscopy for micro-rheological measurements — ●HUBERT CHEVREAU^{1,2}, HANS-JOSEF BEAUVISAGE¹, and SILKE RATHGEBER¹ — ¹Max-Planck-Institute for Polymer Research, Polymer Physics, 55128 Mainz, Germany. — ²Ecole Polytechnique Universitaire de Lille, 59655 Villeneuve D'Ascq Cedex, France.

To obtain information about the mechanical properties of the samples on microscopic length scales we exploited the capabilities of fluorescence correlation spectroscopy (FCS) to be used for micro-rheological measurements. Micro-rheology by means of FCS looks at the Brownian motion of a fluorescent μm tracer particle embedded in a matrix of which the rheological properties are to be determined. In principle with FCS micro-rheology the material response on micrometer length

scales of a heterogeneous sample can be probed. We used fluorescent, carboxylate-modified colloidal spheres with a diameter of $0.1 \mu\text{m}$ as tracer particles. As a simple test system we have chosen polyethylene oxide (PEO) with varying molecular weights and different concentrations in water solutions in order to change the rheological response from viscous to viscoelastic. We followed different analysis methods to transfer the mean-square center-of-mass displacement to the shear moduli. Results are compared to results obtained from conventional rheological measurements.

CPP 7.24 Mon 16:45 Poster A

Supercooled Water Confined in Reverse Micelles - A Neutron Scattering Study — ●TINKA SPEHR^{1,2}, BERNHARD FRICK², ISABELLE GRILLO², and BERND STÜHN¹ — ¹TU Darmstadt, Deutschland — ²Institut Laue Langevin, Grenoble, Frankreich

Water, the surfactant AOT and oil (toluene or decane) form a stable droplet phase microemulsion over a wide range of compositions. Spherical water droplets surrounded by a mono-layer of AOT are dispersed in oil. The size of the water pool can be varied by changing the molar ratio ω of water to surfactant: radii between a few Å and several nm can be obtained, which makes the droplets an attractive model system for the study of soft confined water. We used neutron time-of-flight (TOF), backscattering (BS) and small angle scattering (SANS) to study the system with a fixed droplet volume fraction $\phi = 0.2$ and ω ranging from 3 to 40. The phase behaviour of the microemulsion was investigated by SANS from 290 to 220 K. The droplet structure is stable down to temperatures T much below the freezing point of bulk water. The smaller the droplets (the smaller ω) the lower T down to which the droplet size is maintained. When reducing T below this phase transition the droplet size shrinks. Freezing of the confined water was observed by BS: the freezing temperature as a function of droplet size follows the same dependence as the phase transition temperature monitored[1]. Inelastic measurements (TOF, BS) show that the supercooled confined water is strongly slowed down compared to bulk water. Rotational and translational dynamics of the water are discussed.

- [1]T Spehr, B Frick, I Grillo, B Stühn (2007), accepted by JPCM

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Statistics and dynamics of blends of linear and ring polymers. — ●MICHAEL LANG^{1,2} and MICHAEL RUBINSTEIN² — ¹Leibniz-Institute for polymer Research, Hohe Str. 6, 01069 Dresden, Germany — ²Department of Chemistry, University of North Carolina, 27599 Chapel Hill, N.C., USA

This work focuses on conformations and dynamics of blends of linear and ring polymers.

Rings in a melt of homo-polymer rings are compressed due to topology, if rings are significantly larger than the entanglement length. Dilute rings with degree of polymerization, N_r , immersed in a melt of linear polymers with degree of polymerization, N_l are almost ideal if $N_l > N_r^{1/2}$ and swell if $N_l < N_r^{1/2}$.

Dynamics of pure ring melts is enhanced as compared to pure linear melts. Thus, minority of linear chains immersed in ring melt experiences enhancement of diffusion and relaxation. On the other hand, minority of long entangled rings immersed in melt of long entangled linear chains gets temporarily trapped. This leads to a clear reduction in diffusion coefficient while keeping relaxation (as determined by half ring relaxation) almost unaffected.

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Micellar crystallization in salted solutions — ●NICOLE VOSS¹, MARCO WALZ¹, MAX WOLFF², HARTMUT ZABEL², and ANDREAS MAGERL¹ — ¹Chair for Crystallography and Structural Physics, University of Erlangen-Nürnberg, Staudtstr. 3, 91058 Erlangen — ²Chair for Condensed Matter Physics, Ruhr-University Bochum, Universitätsstr. 150, 44780 Bochum

Micellar solutions of tri-block copolymers are an excellent model system for the study of crystallization in soft matter, since they have well-known and rich phase diagrams which may be identified through rheometry. The phases can be controlled by varying temperature or polymer concentration. Further, the aggregation and crystallization is highly sensitive to the presence of ions. Through the addition of salt the attraction between hydrocarbon chains and water can be tuned allowing a study of the macromolecule-solvent interaction.

We have studied the influence of CsCl with concentrations up to 1.5 mol/dm^3 on the phase diagram of the tri-block copolymer Pluronic

P123, consisting of a central part of 70 propylene oxide units terminated by two end groups of 20 ethylene oxide units (EO₂₀-PO₇₀-EO₂₀). The salient result of our investigation is a linear shift of all phase lines to lower temperatures under the addition of salt, whereas

the fundamental structural properties of the phases are preserved.

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