

## CPP 36: Poster: (Hydro)gels and Elastomers

Time: Wednesday 16:30–18:30

Location: Poster C

CPP 36.1 Wed 16:30 Poster C

**The distribution of segmental order in polymer networks** — ●MICHAEL LANG<sup>1</sup> and JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz Institut für Polymerforschung Dresden, Hohe Straße 6, 01069 Dresden — <sup>2</sup>Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden

We discuss the distribution function of the segment orientation order parameter in entangled networks. The distribution function is derived from a tube model of polymer entanglements assuming random walk statistics of the tube. Monomer fluctuations along the tube are assumed to follow the phantom model as shown in a previous work [M. Lang, J.-U. Sommer, *Physical Review Letters* 104 (2010) 177801]. The predictions are compared with simulation data of model networks that were created using the bond fluctuation method. The comparison reveals that local fluctuations of the tube statistics do not affect the distribution function as averaged over the full sample. Instead, length fluctuations of the confining tube control the shape of the distribution function. Furthermore, a narrowing of the distribution function is determined, if the cross-linking occurs on the time scale of the relaxation of the network strands. Almost instantaneously cross-linked polydisperse samples do not show this narrowing and are well described by tube length fluctuations that agree to previous work on the dynamics of melts of star polymers.

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**Poly(N-isopropylacrylamide) chains adsorbed on silica nanoparticles: A dielectric study of the phase transition of interfacial pNIPAM** — ●MARIEKE FÜLLBRANDT<sup>1,2</sup>, SARAH T. TURNER<sup>1</sup>, REGINE VON KLITZING<sup>1</sup>, and ANDREAS SCHÖNHALS<sup>2</sup> — <sup>1</sup>Stranski-Laboratorium für Physikalische und Theoretische Chemie, Technische Universität Berlin, Strasse des 17. Juni 124, D-10623 Berlin — <sup>2</sup>BAM Bundesanstalt für Materialforschung und -prüfung, Unter den Eichen 87, D-12205 Berlin

Poly(N-isopropylacrylamide) (pNIPAM) is adsorbed on silica nanoparticles. In bulk phase linear pNIPAM shows a lower critical solution temperature (LCST) at about 32°C. In general the physical properties of constrained polymers differ from those of the bulk phase. Adsorbed pNIPAM on surfaces can have interesting applications in functionalized interfaces with thermosensitive properties. Such applications require fundamental knowledge of the transition behaviour and mobility of adsorbed pNIPAM chains.

Dielectric Relaxation Spectroscopy (DRS) is applied in a frequency range of 10<sup>-1</sup> to 10<sup>6</sup> Hz. By using charges as probes the phase transition of pNIPAM can be monitored by both the temperature dependence of the DC conductivity and the frequency dependence of the complex conductivity spectra [1]. The formation of a Si/pNIPAM core/shell particle where charges are trapped/ blocked at the interface evokes a Maxwell/Wagner/Sillars polarization. For structural information DLS measurements and TEM images are added. [1] M. Füllbrandt, R. von Klitzing and A. Schönhals, *Soft Matter*, 2012, 8, 12116-12123.

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**Kinetics of aggregation in micellar solutions of thermoresponsive triblock copolymers: influence of concentration, start and target temperature** — JOSEPH ADELSBERGER<sup>1</sup>, AMIT KULKARNI<sup>1</sup>, ISABELLE GRILLO<sup>2</sup>, MELISSA SHARP<sup>3</sup>, ACHILLE M. BIVIGOU-KOUMBA<sup>4</sup>, ANDRÉ LASCHEWSKY<sup>4</sup>, PETER MÜLER-BUSCHBAUM<sup>1</sup>, and ●CHRISTINE M. PAPADAKIS<sup>1</sup> — <sup>1</sup>TU München, Physik-Department, Physik weicher Materie, Garching — <sup>2</sup>Institut Laue-Langevin, Grenoble, France — <sup>3</sup>European Spallation Source, Lund, Sweden — <sup>4</sup>Uni Potsdam, Institut für Chemie, Potsdam-Golm

Micellar solutions of thermoresponsive block copolymers respond to a small change of temperature across the cloud point with a strong volume change. We have investigated triblock copolymers having a long poly(N-isopropylacrylamide) (PNIPAM) middle block and two short polystyrene (PS) end blocks. Temperature-resolved SANS with contrast matching revealed the collapse of the micellar shell and the subsequent aggregation [1]. Time-resolved SANS during a temperature jump showed that the process involves a number of steps, such as the formation of small imperfect aggregates, their densification and their growth by attachment of single micelles and finally by coagulation [2].

The time constants depend on polymer concentration, start and target temperature [2].

1. J. Adelsberger, C.M. Papadakis et al., *Macromolecules* **43**, 2490 (2010) and *Colloid Polym. Sci.* **289**, 711 (2011).
2. J. Adelsberger, C.M. Papadakis et al., *Macromol. Rapid Commun.* **33**, 254 (2012) and *Soft Matter*, DOI:10.1039/C2SM27152D

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**Rheological characterization of PDMS-based magnetoelastomers** — ●RUDOLF HASSLACHER<sup>1</sup>, VITOR C. BARROSO<sup>1</sup>, FRANZ HIPTMAIR<sup>2</sup>, ZOLTAN MAJOR<sup>2</sup>, KERSTIN SCHINDLER<sup>3</sup>, CHRISTIAN WOLFRUM<sup>3</sup>, and SABINE HILD<sup>1</sup> — <sup>1</sup>Institute of Polymer Science, Johannes Kepler University of Linz, Altenberger Strasse 69, 4040 Linz, Austria — <sup>2</sup>Institute of Polymer Product Engineering, Johannes Kepler University of Linz, Altenberger Strasse 69, 4040 Linz, Austria — <sup>3</sup>Eckart GmbH, Guentersthal 4, 91235 Hartenstein, Germany

Magnetoelastomers are hybrid materials based on elastomers and magnetic particles. Due to their magnetic features, their mechanical properties and shape can be controlled by external magnetic fields. Applications as mechanical actuators, mechanical dampers or for vibration reduction are conceivable.

Depending on the particle material, size and their distribution and arrangement inside the cured elastomeric matrix, the obtained mechanical properties (and possible applications) can be varied. Ultimately the movement of the particles is heavily dependent on the viscosity of the whole composite.

During this work, the preparation of the magnetoelastomeric material and corresponding rheological characterisation were carried out. The isotropic materials consisted of a crosslinkable polydimethylsiloxane (PDMS) matrix filled with different iron particles (distinguishable by shape and functionalities). The aim is to study the crosslinking behaviour and its dependence on the particle characteristics by means of time resolved rheological measurements.

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**Wetting induced structure formation in elastic porous media** — ●ZRINKA GATTIN, OHLE CLAUSSEN, STEPHAN HERMINGHAUS, and MARTIN BRINKMANN — MPI DS, Am Fassberg 17, 37077 Gottingen, Germany

The interplay between the elasticity of a porous matrix and interfacial stresses can give rise to a wide variety of unexpected phenomena including spontaneous symmetry breaking and pattern formation.

Many properties of a fibre network undergo large changes when exposed to a wetting liquid. The mechanical response of an elastic fibre network, for example, to compression or shear changes noticeably between the dry and the wet state. A number of processes can lead to the formation of liquid domains in a fibre network. This includes phase separation of the ambient fluid, impact of aerosol droplets on fibres, or spontaneous imbibitions of liquid. In all of these cases the elasticity of the elastic matrix in combination with its wetting properties will have an effect on the dynamics of these processes.

Motivated by experiments on the demixing of binary liquids in polymer gels we study the formation and interaction of liquid droplets in a dilute elastic medium. To model the phase separating liquids we use a lattice gas model while the elastic matrix is represented by a network of tethered particles which are interacting with the fluid phases. Here, we present preliminary results on the deformation of the network due to interfacial stresses for different configurations of the liquid domains after demixing. The results of our simulations are compared to predictions of a simple continuum model of the elastic matrix.

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**Dielectric strength and electro-mechanical instability in soft insulating elastomers** — ●STEFAN BEST, MATTHIAS KOLLOSCHKE, and REIMUND GERHARD — ACMP, Institut für Physik und Astronomie, Universität Potsdam, Karl-Liebknecht-Str. 24/25, 14476 Potsdam-Golm, Germany

The dielectric breakdown strength of polymer materials is of particular interest for many technological applications such as cable insulation, polymer capacitors and emerging systems that rely on soft polymers, such as energy harvesting or voltage tunable optics. We present experimental strategies to assess the impact of material properties and

preparation methods on the dielectric breakdown strength of soft insulating polymers. This is studied on un-stretched Elastomers of various material stiffnesses, which can be varied through the preparation methods. Also, the breakdown strength was measured as a function of stretch ratio. The breakdown strength of un-stretched elastomers was found to increase with material stiffness, since breakdown occurs due to an electro-mechanical instability mechanism. Relatively higher breakdown strength was observed on pre-stretched, clamped elastomers. It is found, that very high pre-stretch prevents the electro-mechanical instability such that dielectric breakdown strength becomes independent of stretch ratio and thus the true material breakdown strength is observed. The results are found to compare well with theories in literature.

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**About the elastic nature of the demixing transition of aqueous PNIPAM solutions** — ●MARTINE PHILIPP<sup>1</sup>, ULRICH MÜLLER<sup>2</sup>, RALITSA ALEKSANDROVA<sup>2</sup>, ROLAND SANCTUARY<sup>2</sup>, PETER MÜLLER-BUSCHBAUM<sup>1</sup>, and JAN K. KRÜGER<sup>2</sup> — <sup>1</sup>TU München, Physik-Department, LS Funktionelle Materialien, Garching, Germany — <sup>2</sup>Université du Luxembourg, LPM, Luxembourg, Luxembourg

The demixing transition of aqueous solutions of poly(N-isopropylacrylamide) (PNIPAM) has been widely investigated in basic and applied research. It is of the lower critical solution temperature type. Due to the large volume change accompanying this phase separation, it is denoted as a volume transition. Only few experiments were dedicated to the elastic properties at this transition. However, one hint exists that the longitudinal elastic modulus may be its inverse order parameter susceptibility [1]. Here we discuss the competitive behaviour of mass density and the longitudinal elastic modulus across the demixing transition in dependence of temperature and PNIPAM concentration [2]. Brillouin spectroscopy indeed proves the governing role of the longitudinal elastic modulus for this phase separation

mechanism. Moreover, Brillouin spectra recorded across the phase transition allow following the growth of PNIPAM-rich agglomerates with gel-like mechanical consistency embedded in the liquid PNIPAM-poor phase. This result clearly disproves the widespread opinion that the demixed PNIPAM-rich agglomerates are glassy.

[1] S. Hirotsu, *Phase Transitions* 47, 183 (1994) [2] M. Philipp, U. Müller, R. Aleksandrova et al., *Soft Matter* 8, 11387 (2012)

CPP 36.8 Wed 16:30 Poster C

**Co-non-solvency effect of adsorbed thermo-responsive gel particles** — ●MARCEL RICHTER, MELANIE HUNNENMÖRDER, and REGINE VON KLITZING — TU Berlin

During the last decades microgels made of N-isopropylacrylamide (NI-PAM) have attracted much interest and were studied by several techniques like atomic force microscopy (AFM) and dynamic light scattering (DLS) [1]. These polymer particles show thermo responsive behaviour and can therefore be classified as \*smart\* materials. The Co-non-solvency effect in the different water/ solvent compositions are well investigated for the bulk phase [2, 3] but not at the surface. Those colloidal particles are of great interest as carrier systems and sensors [4]. For this purpose the understanding of such particles in different organic solvent mixtures is necessary. The presented study focuses on the swelling behaviour of PNIPAM and PNIPAM-co-AAA microgels in different water/ solvent compositions. The question will be answered: How much the particles swell from the dry to the liquid state? Furthermore, the particle size in different water/ solvent ratio is investigated. The used solvents are ethanol, iso-propanol and tetrahydrofuran. The size of microgels is determined by Dynamic Light Scattering and Scanning Force Microscopy. [1] K. Kratz, T. Hellweg, W. Eimer, *Polymer* (2001), 42, 6531 [2] B. Saunders et al, *Macromolecules* (1997), 30, 482 [3] Christine Scherzinger et al, *Macromolecules* (2010), 43, 6829 [4] J. Kim, *Angewandte Chemie* (2005), 117, 1357