CPP 20: (Hydro)gels and Elastomers

Time: Wednesday 9:30–11:00 — Location: C 264

CPP 20.1 Wed 9:30 C 264

Kinetics of structural changes in thermoresponsive block-copolymer solutions — Joseph Adelsberger[1], Ezz Metwalli[1], Alexander Diethert[1], Achille M. Bivigou-Koumba[2], André Laschewsky[2], Isabelle Grillo[3], Peter Müller-Buschbaum[1], and •Christine M. Papadakis[1] — [1]TU München, Physikdepartment, Physik weicher Materie, Garching — [2]Universität Potsdam, Institut für Chemie — [3]Institut Laue-Langevin, Grenoble

Thermoresponsive polymers exhibit lower critical solution temperature (LCST) behavior and are of great interest for applications in ultrafiltration, in sensors or in transport/delivery systems.

We have studied triblock copolymers consisting of two hydrophobic polystyrene end blocks and a hydrophilic poly(N-isopropyl acrylamide) middle block. In aqueous solution, they form core-shell micelles or micellar networks [1]. The structural changes occurring after rapid heating above the cloud point were followed using time-resolved small-angle neutron scattering experiments [2]. Both, the polymer concentration and the target temperature were varied. The PNIPAM shell shrinks and releases water very rapidly. The collapsed micelles form small fractal aggregates, which become denser. Their growth first follows the diffusion-limited aggregation, whereas later, the clusters grow by coagulation. Depending on the target temperature, a skin effect is observed at the cluster surface.

[1] J. Adelsberger, C. M. Papadakis et al., Macromolecules 43, 2490 (2010). [2] J. Adelsberger, C.M. Papadakis et al., Macromol. Rapid Commun., accepted.

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Phase transition behaviour of different aqueous poly(N-isopropylacrylamide) systems monitored by dielectric spectroscopy — •Marieke Füllbrandt[1], Regine von Klitzing[2], and Andreas Schönhals[1] — [1]BAM Bundesanstalt für Materialforschung und -prüfung, Unter den Eichen 87, 12205 Berlin — [2]Stranski-Laboratorium für Physikalische und Theoretische Chemie, Technische Universität Berlin, Strasse des 17. Juni 124, 10623 Berlin

Dielectric Relaxation Spectroscopy (DRS) is applied in a broad frequency range at temperatures between 15°C to 50°C to aqueous solutions of linear Poly(N-isopropylacrylamide)(pNIPAM) with different polymer concentrations and to aqueous dispersions of pNIPAM microgels with different crosslinking densities. In aqueous media thermosensitive pNIPAM shows a lower critical solution temperature (LCST) at about 32°C where it changes its properties from hydrophilic to hydrophobic. The phase transition of pNIPAM can be monitored by both the temperature dependence of the DC conductivity and the frequency dependence of the conductivity spectra. The latter one is due to a Maxwell/Wagner/Sillars polarization and can be related to the change in chain or particle structure at the LCST of pNIPAM. The frequency and temperature dependence of the conductivity was investigated in dependence on the polymer concentration for linear pNIPAM and on the crosslinking density for pNIPAM microgels. The dielectric measurements were accompanied by dynamic light scattering (DLS) and zeta potential measurements in order to relate the dielectric data with results obtained by well established methods.

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A comparison of the morphology and thermoresponsive switching behavior in thin films of cyclic and linear poly(N-isopropylacrylamide) — •David Magerl[1], Xing-Ping Qiu[2], Françoise M. Winnik[2], and Peter Müller-Buschbaum[1] — [1]TU München, Physik -Department, LS Funktionelle Materialien, James-Franck-Str. 1, 85748 Garching, Germany — [2]Université de Montréal, Faculty of Pharmacy and Department of Chemistry, CP 6128 Succursale Centre Ville Montréal QC H3C 3J7, Canada

Stimuli-responsive hydrogels are of increasing interest because of their use in a variety of applications such as switches and sensors. Poly(N-isopropylacrylamide) (PNIPAM) is one of the most studied polymers in this context. However, there are only very few studies on cyclic PNIPAM, although this topology is of great interest because of the absence of end-groups, which has a significant impact on the lower critical solution temperature (LCST).

In this study, we compare the properties of spin-coated thin films of cyclic and linear PNIPAM samples with similar molecular weights and a low polydispersity. The film thickness is varied and the films are characterized with x-ray reflectivity and optical microscopy. The swelling behavior of these films, exposed to water vapor, is investigated as a function of film thickness in order to assess the influence of chain topography on the thin film behavior. Additionally, the interface correlation between the surface and the substrate is probed with grazing incidence small-angle x-ray scattering.

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Determination of viscoelastic properties of adsorbed thermo responsive gel particles via AFM tip indentation — •Marcel Richter and Regine von Klitzing — TU Berlin, Straße des 17.Juni 124, 10623 Berlin

During the last decades microgels made of N-isopropylacrylamide (NIPAM) 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. For the later adsorption behaviour of nano- and micro-objects like colloidal particles or cells on top of adsorbed microgel layers the mechanical properties of such microgels are of great interest. Here, the AFM tip indentation method is a suitable method for the determination of the Young's modulus [2]. We synthesised microgel particles with different co-monomers and study the stiffness according to the cross linker and co-monomer amount. The measurements show a tremendous shift in the lower critical solution temperature (LCST) and change in (visco) elasticity. 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] E. K. Dimitriadis et al, Biophysical Journal, (2002), 82, 2798

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Computersimulations of Magnetic Gels — •Rudolf Weeber[1], Sofia Kantorovich[1,2], and Christian Holm[1] — [1]Institute for Computational Physics, University of Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Ural Federal University, Lenin Avenue 51, 620000 Ekaterinburg, Russia

Magnetic gels consist of magnetic nano-particles embedded in a cross-linked polymer network. They have potential applications ranging from medicine to engineering, such as drug release systems and artificial muscles. These applications rely on the combination of the mechanical properties of the polymer network with the ability to modify and control the sample with external magnetic fields due to the embedded magnetic nano-particles.

Today, many aspects of the synthesis of ferrogels are understood and the properties of gels can be characterized and tailored. However, many questions concerning the microstructure and its influence on macroscopic properties of magnetic gels are still open. Here computer simulations can help since they allow to study simplified model systems which focus on certain characteristic features of the material.

In this contribution we present computer models which demonstrate different mechanisms of deformation and changing elastic properties of a ferrogel in an external magnetic field. They help to explain the contradicting findings for the shape change of magnetic gels observed in experiments.

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Polymer Dynamics and Crosslink Density of SBR Nanocomposites Containing Fillers with Different Surface Area — •Anas Mujtaba[1], Melanie Keller[2], Sybill Ilisch[2], Hans-Joachim Radusch[2], Thomas Thurn-Albrecht[1], Kay Saalwächter[1], and Mario Beiner[1] — [1]Faculty of Natural Sciences II, Martin-Luther-University Halle-Wittenberg, Germany — [2]Center of Engineering Sciences, Martin-Luther-University Halle-Wittenberg, Germany

Styrene butadiene rubber (SBR) samples filled with different amounts of silica nanoparticles or mixtures of high-surface silica and low-surface borosilicate particles are investigated by dynamic shear measurements and solid state NMR. Aim is to study the influence of filler surface area on the properties of the SBR composites. Double-quantum NMR data are used to determine crosslink densities. Absolute values for the crosslink densities of SBR composites are calculated using additional

information from shear measurements on unfilled samples. The effective crosslink density of the SBR matrix is slightly decreasing if filler content or filler surface area increases. Shear data show that substituting high- with low-surface area silica at constant volume fraction is not only affecting reinforcement and plateau modulus but also energy dissipation in the plateau range. Glass temperature and frequency temperature position of the main transition α of SBR composite, however, are not much affected. Dynamic strain sweeps in the plateau reveal the contribution of the filler network which breaks at large deformations.