

## CPP 18: Poster: Polymer Dynamics

Time: Tuesday 18:15–20:15

Location: Poster C

CPP 18.1 Tue 18:15 Poster C

**Transport of Polyelectrolytes in Rotational and Pulsed-DC Electric Fields in Confining Cylindrical Geometries** — SORIN NEDELUCU<sup>1</sup> and •JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz Institute of Polymer Research Dresden e.V., Hohe Strasse 6, D-01069 Dresden, Germany — <sup>2</sup>Technische Universität Dresden, Institute of Theoretical Physics, Zellescher Weg 17, D-01069 Dresden, Germany

We consider molecular dynamics simulations of the electrophoretic motion of charged polymers in a confining straight cylinder under the influence of an electric field which has a time-independent component orientated along the axis of the cylinder and a component perpendicular to the symmetry axis which rotates with constant angular velocity. The fluid is modeled explicitly, and also the co-ions, counterions and the charged polymer monomers. At moderate applied electric field in the axial direction, and nearly complete separation of the positive from the negative free charges, the electrophoretic velocities of the charged polymer chains in a narrow window of rotational frequencies are found to depend strongly on hydrodynamic friction effects related to changes in the frontal cross-section area and extension due to axial and centrifugal forces. We also investigate electrophoresis in cylinders with a periodic variation (or modulation) of the diameter. In these modulated geometries, the charged polymer chains can be separated only at low fields. At large fields we observe separation effects in modulated geometries if a pulsed electric field is applied. We propose scaling arguments to explain the observed behavior.

CPP 18.2 Tue 18:15 Poster C

**Behavior of AB-Diblock-Copolymer chains under the influence of external Stimuli - An AFM Study** — •KIRSTEN DAMMERTZ, ANNE-MARIE SAIER, MASOUD AMIRKHANI, MARTIN MUELLER, and OTHMAR MARTI — Institute of Experimental Physics, Ulm University

Concerning the constantly growing demand of advanced materials with special characteristics on nanoscale, e.g. reconfigurable nanowires, the properties and interactions of various polymers adsorbed on surfaces are still a research topic of major interest. Several methods to initiate conformational changes and reorientations are described in literature by different authors. Vapors or 2D pressure can be used to induce a collapse/decollapse cycle of single polymer chains in consequence of a coadsorption process, electric fields can be applied to align the molecules just as well as to change the surface properties of the substrate. Although the mechanisms of these observations are often analyzed, the basic driving forces are still not well understood.

In this work, novel effects of externally stimulated linear- and AB-block-copolymer chains interacting with several surfaces are presented. The molecules gain unexpectedly high mobility and show conformational changes under specific conditions and the presence of an external electric field. Varying from single molecule chains to thin polymer films, the underlying physical effects are systematically investigated and discussed.

CPP 18.3 Tue 18:15 Poster C

**IPMCs as a artificial muscle** — •PARISA BAKHTIARPOUR, MASOUD AMIRKHANI, and OTHMAR MARTI — Institute of Experimental Physics, Ulm University, Albert-Einstein-Allee 11, 89081 Ulm, Germany

IPMCs (Ionic Polymer Metal Composite) are classified as EAPs (electro active polymers), that their properties change by electrical stimulation. The shape and size of these polymers alter when electrical voltage apply to their opposite interfaces. In additional, IPMCs bending can produce electrical signal in back movement. By patterning the metal electrodes during the IPMCs sample fabrication, movement with multiple degree of freedom is possible. The performance of IPMC can be control and monitor with several sensing methods such as surface resistivity connected in bridge configuration.

In this research, we developed Simultaneous actuating and sensing methods for IPMCs sample. We consider the sample as variable resistance which displacement of sample could be detected by proper electrical circuit design. The benefit of this method is reducing the noise and also possibility of measurement for each part of patterned sample independently.

CPP 18.4 Tue 18:15 Poster C

**Annealing Effects of Thin Polymer Films and Single Chains of Poly(methyl methacrylate) on Various Substrates** — •DANIEL GEIGER, KIRSTEN DAMMERTZ, MASOUD AMIRKHANI, and OTHMAR MARTI — Institute of Experimental Physics, Ulm University

As previously stated by Guiselin [1], polymer solutions can form an irreversible adsorbed, brush-like layer on a solid interface. Napolitano and Wübbenhorst [2] concluded that the contradictory reports, concerning the dynamics of thin films, are possibly due to the formation of an irreversible adsorbed layer. Therefore, the properties of thin films are strongly dependent of the sample history, in particular of the annealing time and temperature.

The investigation of the influence of different substrates (e. g. silicon and mica) on the formation of the irreversible adsorbed layer is one of the main goals of this work, as well as the study of the temperature dependence of the irreversible adsorbed layer growth process. Furthermore, we study the behavior of single molecules on solid substrates after annealing.

[1] O. Guiselin, Irreversible Adsorption of a Concentrated Polymer Solution, *Europhys. Lett.*, 17, 225-230, 1992

[2] S. Napolitano, M. Wübbenhorst, The lifetime of the deviations from bulk behaviour in polymers confined at the nanoscale, *Nat Commun*, 2, 260, 2011

CPP 18.5 Tue 18:15 Poster C

**Analysis of polymer flow in nanopores with time-resolved SAXS** — •MANUELA LUKAS and BERND STÜHN — Experimental Condensed Matter Physics, TU Darmstadt, Germany

The flow of polymers due to capillary pressure in nanopores is investigated. Polycarbonate samples are irradiated with swift heavy ions, treated with UV light and etched in NaOH solution. The nanopores are aligned strictly parallel and examined by Small-Angle X-ray Scattering (SAXS). To observe the filling behavior, time resolved SAXS measurements are performed at different temperatures.

Polydimethylsiloxane was chosen with different molecular weights. With different radii of gyration and various pore diameters a wide range of  $R_g/D$  is considered.

The filling process is shown by the steady decrease in scattering intensity with time. The whole scattering curves are fitted at every time step. It is thus possible to analyse change of intensity and form factor with time.

The intensity variation with time follows the Lucas-Washburn equation. The  $\sqrt{t}$ -dependency of the filling height is reproduced well throughout the whole filling process.

The current aim is to determine the factors that influence flow behavior in nanopores.

CPP 18.6 Tue 18:15 Poster C

**Oxidation dependent magnetism in Polyvinylferrocene-b-Poly-2-Vinylpyridine diblock copolymer** — •HAIKO DIDZOLEIT<sup>1</sup>, MARKUS GALLET<sup>2</sup>, JOHANNES ELBERT<sup>2</sup>, MATTHIAS REHAHN<sup>2</sup>, and BERND STÜHN<sup>1</sup> — <sup>1</sup>TU Darmstadt, Experimental Condensed Matter Physics — <sup>2</sup>TU Darmstadt, Ernst-Berl-Institut für Technische und Makromolekulare Chemie

Switching of conformation triggered by an external stimulus is a desired ability of a variety of polymers. In focus of our research is the ferrocene containing diblock copolymer polyvinylferrocene-b-poly-2-vinylpyridine (PVFc-P2VP) with molecular weights between 8000 and 16000 g/mol<sup>-1</sup> synthesized via sequential living anionic polymerization. The first block is a hydrophilic pyridine based polymer while the second part consists of a hydrophobic polymer containing a ferrocene moiety. This moiety has a strong influence on the properties such as magnetism, dynamic and solubility. SQUID measurements reveal that the magnetic susceptibility of the polymer can be changed by an oxidation agent from diamagnetic to paramagnetic. This effect depends on the characteristics of the polymer such as oxidation ratio and chain length. Furthermore the oxidation effects the conformational structure of the diblock copolymer which we investigate using X-Ray diffraction. The amphiphilic property enables the polymer to be analyzed as a monolayer on solid substrates as well as dissolved on a liquid surface, this gives the opportunity to change polymer conformation dependent on the mean molecular area. Results from the X-Ray reflectometry

reveal a dependency of the layer thickness regarding oxidation.

CPP 18.7 Tue 18:15 Poster C

**Entropic DNA segregation in bacteria** — ●ELENA MININA and AXEL ARNOLD — Institute for Computational Physics, University of Stuttgart, Allmandring 3, 70569, Stuttgart, Germany

Cell division is a complex process consisting of two main parts - DNA replication and segregation. In all higher organisms, both parts involve active mechanisms. In particular, the mechanism for segregation is too complex to be employed by primitive bacteria like *Escherichia coli*. During replication DNA of the mother cell is copied into two daughter strands, which segregate, i.e. move towards opposite sides of the rod-shaped cell. It was previously shown that the segregation can be driven by entropy only, without need for an active mechanism [A. Arnold and S. Jun, Phys. Rev. E 76 (2007)]. The time scale for this entropic segregation is much faster than simple diffusion, and sufficient to explain DNA segregation in primitive bacteria. However, there is barrier towards entropic segregation, which has to be overcome by diffusion and would be a major obstacle towards purely entropic segregation.

In the present study we use MD simulations in order to investigate the influence of finite replication speed on the segregation. We model the replication by unzipping of two initially cross-linked, ladder-like strands, and compare to a more realistic model, where a second strand is added gradually. Our results show that the finite replication speed allows to overcome the induction time, which is only an artifact of spontaneous segregation. Without the need for induction, entropic segregation is indeed a promising candidate to explain bacterial DNA segregation without active mechanisms.

CPP 18.8 Tue 18:15 Poster C

**Passive and active microrheology of a polymer melt studied by molecular dynamics simulation** — ●ANJA KUHNHOLD and WOLFGANG PAUL — Institut fuer Physik, Martin-Luther-Universitaet, 06099 Halle

The rheology of polymer melts can be observed from the behaviour of suspended particles (microrheology). Therefore MD simulations of a bead-spring polymer melt model including one or two nanoscopic particles are carried out. Passive microrheology yields linear response properties of the polymer melt by looking at the thermal motion of the nanoparticles. From the mean square displacement of the nanoparticles the complex modulus  $G^*(\omega)$  of the melt is determined by using a generalized Stokes-Einstein equation. Results for one- and two-particle microrheology are compared. Furthermore the nonlinear response of the polymer melt is investigated by applying forces to the melt. Here a nanoparticle-oscillator is used; i.e. two nanoparticles are connected by a harmonic potential and the compressed oscillator is put into the polymer melt. The resulting oscillation of the nanoparticles is studied for different melt temperatures and different spring constants.

CPP 18.9 Tue 18:15 Poster C

**Growth process of monodisperse cylindrical polymer micelles measured by SAXS, DLS and TEM** — ●CHRISTINA LEDERLE<sup>1</sup>, JOHANNES ELBERT<sup>2</sup>, MARKUS GALLET<sup>2</sup>, MATTHIAS REHAHN<sup>2</sup>, and BERND STÜHN<sup>1</sup> — <sup>1</sup>Experimental Condensed Matters Physics, TU Darmstadt, Germany — <sup>2</sup>Makromolekulare Chemie, TU Darmstadt, Germany

Cylindrical micelles are grown on the basis of seeds formed by aggregates of the block copolymer polyferrocenylsilane-b-poly(dimethylsiloxane) (PFS-b-PDMS) in hexane (selective for the second block). The seeds were produced by 4 hours sonication. Adding a second block copolymer (Polyisoprene-b-PFS) in Tetrahydrofuran (good solvent for both blocks) to these seeds cylindrical micelles are grown. Their length depends on the addition of a specified amount of PI-b-PFS in THF.

We study these aggregates with Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM). TEM - pictures show a big length difference between PFS-b-PDMS seeds after applied 4 hours sonication (40 - 60 nm) and grown cylinders (200 nm - 1000 nm). Diffusion coefficients, measured by DLS, decrease with increasing addition of further chains. Furthermore we observe the growth process via measured intensity in light scattering experiments, started from seeds and added PI-b-PFS in solution during the measurement. The intensity increases until a plateau appears after days.

We plan to orientate those grown cylinders in solution via application of an electric field and measure its effect by SAXS.

CPP 18.10 Tue 18:15 Poster C

**Neutron Scattering and Simulations on Polymers confined in Silica Nanopores** — ●MATTHIAS MUTHMANN, REINER ZORN, and DIETER RICHTER — Jülich Centre for Neutron Science JCNS and Institute for Complex Systems ICS Forschungszentrum Jülich GmbH, Germany

We will present neutron scattering experiments on confined polymers. The confinement was realized by nanoporous silica. It consists of silica particles ( $\varnothing$  approx.  $2\mu\text{m}$ ) that are covered by hexagonal pores with a diameter of approximately 5nm. These pores channel through the whole particle and can be filled with the polymer. A neutron backscattering measurement has been performed at the SPHERES instrument and a complementary time of flight experiment at the TOFTOF instrument. Both are located at the FRM2 reactor in Munich. We discovered a significant slowdown of the local dynamics of the confined polymer. To investigate the chain dynamics, we did a the measurement at the neutron spin echo spectrometer at Oak Ridge National Laboratory. The experiment yielded a slowdown of the dynamics of the whole chain.

The spectra obtained from our neutron scattering experiments have been compared to the results from atomistic simulations. We created a system of polymer chains, confined in a silica nanopore, similar to the system of our experiments. For this purpose, we used the commercial software Discover by Accelrys. The simulations yielded trajectory files of the simulated polymer chains. These trajectories then allowed a comparison to experimental results.

CPP 18.11 Tue 18:15 Poster C

**A Detailed Study on Heterogeneous Dynamics in Polymers Close to Tg by SM Techniques** — ●SUBHASIS ADHIKARI, MARKUS SELMKE, and FRANK CICHOS — Inst. of Expt. Physics I, University of Leipzig, Germany

The temperature dependent rotational dynamics of a single perylene dimide (PDI)dye molecule in Poly (methyl acrylate)(PMA) and in poly (vinyl acetate) (PVAc) have been studied. The autocorrelation of linear dichroism (LD) of a single PDI molecule is stretched exponential. The dynamics of a single probe molecule is temporally heterogeneous. The rotational times and stretching exponents are widely distributed. All SM results are discussed using a simple model of dynamical heterogeneity based on a Gaussian distribution of activation energies. SM average rotational times follow Debye - Stokes - Einstein (DSE) law for polymer viscosity. Dielectric measurements shows that probe rotation may or may not couple to segmental motion. Probe with different size follow same temperature dependence as predicted from DSE law.

Detailed information on heterogeneous dynamics is further expected from an extension of two - point nanorheology to single molecule optical studies based on fluorescence resonance energy transfer (FRET). We have therefore synthesized bi - labeled (Alexa 488 and Alexa 594) polystyrene polymer. Lifetime and intensity based smFRET are reported.

CPP 18.12 Tue 18:15 Poster C

**Study of PEG loaded Nonionic Microemulsions using DLS** — ●PHILIPP GRAMLICH, ANDREAS BISCHOF, ANDREAS WEBER, and BERND STÜHN — Experimental Condensed Matter Physics, TU Darmstadt

We study the behaviour of polymer loaded nonionic w/o microemulsions in droplet phase using dynamic light scattering methods. The microemulsions are water-C12E4-octane mixtures with different concentrations of PEG 1500. We keep a steady relation  $\omega = 10$  between water molecules per surfactant molecules as well as a constant volume fraction  $\phi = 0.1$  of water plus surfactant to total volume while varying the polymer content. Experiments are performed in a temperature range from 10 to 70 degrees Celsius. Coefficients of translational and rotational diffusion are measured and used to compute hydrodynamic radii. Special attention is given to the possible change between droplets and lamellar/bicontinuous structures in the proximity of phase transitions. Additionally we performed SANS and SAXS as well as transmissional and dielectric measurements.

The addition of PEG 1500 strongly affects the hydrodynamic radii extracted by DLS. Furthermore the hydrodynamic radii differ greatly for different temperatures which cannot be explained solely by a change of viscosity for any of the components.

CPP 18.13 Tue 18:15 Poster C

**Novel thermoresponsive polymers in various architectures** — ●KONSTANTINOS KYRIAKOS<sup>1</sup>, SARAH OTTINGER<sup>1</sup>, ANNA

MIASNIKOVA<sup>2</sup>, ANDRÉ LASCHEWSKY<sup>2</sup>, PETER MÜLLER-BUSCHBAUM<sup>1</sup>, and CHRISTINE M. PAPADAKIS<sup>1</sup> — <sup>1</sup>TU München, Physikdepartment, Physik weicher Materie, Garching — <sup>2</sup>Universität Potsdam, Fakultät für Chemie, Potsdam-Golm

Amphiphilic copolymers with a thermoresponsive block have attracted interest, mainly because of their ability to self-assemble into micelles with a thermoresponsive shell in water. Poly(methoxy diethyleneglycol acrylate) (PMDEGA) is a new thermoresponsive polymer, which exhibits critical temperatures in the range 35-45 °C.

We report here on fluorescence correlation spectroscopy (FCS) experiments on various PMDEGA-PS systems, focusing on the effect of the different molecular architectures. We studied a P(S-*b*-MDEGA) diblock, a P(S-*b*-MDEGA-*b*-S) triblock and a (P(MDEGA-*b*-S))<sub>3</sub> three-arm star copolymer. Information about the critical micelle concentration (CMC) and the hydrodynamic radius ( $r_H$ ) were obtained. In agreement with our previous results [1], we observe a strong dependence of the different chain architectures on the CMC of the studied systems. Moreover, the  $r_H$  of the micelles varied with chain architectures.

[1] A. Miasnikova, A. Laschewsky, C.M. Papadakis, P. Müller-Buschbaum, et al., *Langmuir* (2012), 28, 4479

CPP 18.14 Tue 18:15 Poster C

**Cononsolvency of PNIPAM in water/methanol mixed solutions** — ●KONSTANTINOS KYRIAKOS<sup>1</sup>, MARTINE PHILIPP<sup>1</sup>, JOSEPH ADELSBERGER<sup>1</sup>, SEBASTIAN JAKSCH<sup>1</sup>, ANNA MIASNIKOVA<sup>2</sup>, ANDRÉ LASCHEWSKY<sup>2</sup>, ISABELLE GRILLO<sup>3</sup>, PETER MÜLLER-BUSCHBAUM<sup>1</sup>, and CHRISTINE M. PAPADAKIS<sup>1</sup> — <sup>1</sup>TU München, Physikdepartment, Physik weicher Materie, Garching — <sup>2</sup>Universität Potsdam, Fakultät für Chemie, Potsdam-Golm — <sup>3</sup>Institut Laue-Langevin, Grenoble, France

Thermoresponsive polymer poly(N-isopropyl acrylamide) (PNIPAM) exhibits a lower critical solution temperature (LCST) of 32 °C in aqueous solution. Upon the addition of a second polar solvent, e.g. methanol, a miscibility gap appears, which is termed as cononsolvency. Diblock copolymers consisting of a long PNIPAM block and a short polystyrene block, e.g. P(S-*b*-NIPAM), form micelles with a thermoresponsive shell [1].

We report here on a stopped-flow experiment with time-resolved SANS on an aqueous solution of a PNIPAM homopolymer or a P(S-*b*-NIPAM) diblock copolymer to which methanol was added. This resulted in a collapse transition of the linear chains or the micellar shell, respectively, and on the subsequent aggregation. For both systems the aggregation path and the final size of the formed aggregates depend on the mixing ratio. Interestingly, the size of the formed aggregates is much bigger for the homopolymer compared to the diblock copolymer.

[1] J. Adelsberger, A. Laschewsky, P. Müller-Buschbaum, C.M. Papadakis et al., *Colloid Polym. Sci.* 2011, 289, 711

CPP 18.15 Tue 18:15 Poster C

**Synthesis and dynamic studies of H-bonded double networks** — ●BARBARA GOLD, WIM PYCKHOUT-HINTZEN, CLAAS HÖVELMANN, JÜRGEN ALLGAIER, ANA BRAS, ANDREAS WISCHNEWSKI, and DIETER RICHTER — Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-1) & Institute of Complex Systems (ICS-1), 52425 Jülich

In the framework of a recently granted EU project on SelfHealing Innovative Elastomers (SHINE) newly developed elastomers containing both permanent and/or transient crosslinks in different concentrations in rubbers will be investigated by different measurement methods.

The chemical concept of SHINE involves two types of linkages in the molecular structure of the self-healing elastomers: strong covalent bonds that do not undergo reversible changes to provide strength and rigidity to the material and transient bonds that thermodynamically can be broken. Re-combination of the broken segments will result in the novel self-healing properties.

We present the synthesis of our model network, which consists of monodisperse polydienes (PI) where the backbone and extremities are modified with H-bonding active groups. Furthermore first results of rheological experiments will be shown to get a basic impression of how chain dynamics change due to the networking process and will be influenced of thus permanent and transient crosslinks with respect to self-healing mechanism.

CPP 18.16 Tue 18:15 Poster C

**POCLMD: A Flexible GPU Accelerated Molecular Dynamics Code** — ●CHUANFU LUO<sup>1</sup> and JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz-

Institut für Polymerforschung Dresden, Germany — <sup>2</sup>Technische Universität Dresden, Germany

Recently, general-purpose computing on Graphics Processing Units (GPU) or coprocessor cards becomes a trend in high performance computing. Many newly built super-computers are equipped with powerful GPUs or coprocessors. Currently, several companies provide high performance accelerating cards and all of them support the open standard OpenCL programming. The code writing in OpenCL can run on multiple-core CPUs, GPUs, and coprocessors without any changes. POCLMD is designed to be a fast, flexible and easy-to-use MD code, which is programmed in Python and OpenCL through Py-OpenCL [1]. The kernel code written in OpenCL is compiled and loaded on the fly during the running, thus the executing kernel of POCLMD is very small and efficient. Benefited by the powerful template programming of Python, POCLMD can support an easy and flexible way to add some custom potentials without asking users to modify the codes. The first benchmark of LJ liquids shows that the performance of POCLMD can catch up 90% of HOOMD-blue [2] (the fastest CUDA based MD code) on the same NVIDIA's GPUs. The best performance is achieved on an AMD's HD7970 card, on which POCLMD runs over 80 times faster than LAMMPS on a single core Q6600 CPU (2.4GHz). [1] <http://mathematician.de/software/pyopencl> [2] <http://codeblue.umich.edu/hoomd-blue/>

CPP 18.17 Tue 18:15 Poster C

**Molecular Dynamics and Conductivity of Solid Polymer Electrolytes based on Poly(butylene)oxide and LiClO<sub>4</sub>** — ●BERNHARD HOPFENMÜLLER<sup>1</sup>, GERALD SCHNEIDER<sup>1</sup>, JÜRGEN ALLGAIER<sup>2</sup>, REINER ZORN<sup>2</sup>, and DIETER RICHTER<sup>2</sup> — <sup>1</sup>Jülich Center for Neutron Science JCNS, Forschungszentrum Jülich GmbH, Outstation at FRM II, Lichtenbergstr.1, 85747 Garching — <sup>2</sup>Institute of Complex Systems (ICS-1) and Jülich Center for Neutron Science (JCNS), Forschungszentrum Jülich GmbH, 52425 Jülich

Solid polymer electrolytes play a crucial role in our daily life, e.g. as polymer-based batteries. Such systems are build up of mixtures containing a polymer and a salt. The charge carrier mobility and therefore the conductivity is inherently coupled with the molecular dynamics of the polymer itself. Addition of salt changes the stiffness of a polymer and hence again the conductivity is affected. The most simple and therefore much studied systems are based on poly(ethylene)oxide. This polymer crystallizes at ambient temperature. Though solid polymer electrolytes based on it have a reduced conductivity in solid state. Therefore we wanted to study systems based on poly(butylene)oxide (PBO) and lithium perchlorate (LiClO<sub>4</sub>). PBO has an additional side-group that prevents crystallization at all temperatures. Dielectric spectroscopy allows to study both, conductivity and molecular dynamics with the same technique. In our presentation we want to show results of dielectric spectroscopy on solid PBO electrolytes with different salt contents. We want to demonstrate that the the conductivity and the molecular dynamics are mainly coupled by the segmental dynamics.

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**Dielectric spectroscopy on polymer loaded microemulsions based on C12E4** — ●ANDREAS BISCHOF, ANDREAS WEBER, CHRISTINA LEDERLE, and BERND STÜHN — Experimental Condensed Matter Physics, TU Darmstadt

We study the droplet phase of pure and polymer loaded nonionic w/o microemulsions composed of the surfactant C12E4 by the combination of different experimental methods, e.g. light transmission, dielectric spectroscopy and SAXS.

For different droplet sizes and concentrations the phase behaviour and structure are well understood. It is known that the addition of a polymer to a microemulsion may change structure and dynamic of the droplets. For an investigation of the effect on dynamics we compare the dielectric spectra of the pure microemulsion and of microemulsions loaded with the water soluble PEG. We found several relaxations, varying in relaxation time and strength, depending on the structural and dynamical changes and applied temperature.

Further we observe a strong effect of system composition and polymer concentration on the stability of the droplet phase. We will discuss the dielectric relaxations in pure and polymer loaded systems.

CPP 18.19 Tue 18:15 Poster C

**The Jülich Neutron Spin Echo Spectrometer: Dynamics with Depth Resolution** — ●OXANA IVANOVA<sup>1</sup>, OLAF HOLDERER<sup>1</sup>, and MICHAEL MONKENBUSCH<sup>2</sup> — <sup>1</sup>Jülich Centre for Neutron Science, Forschungszentrum Jülich, Aussenstelle am FRM II, Garching —

<sup>2</sup>Jülich Centre for Neutron Science, Forschungszentrum Jülich, Jülich, Germany

Neutron spin-echo (NSE) spectroscopy is a neutron scattering technique with the highest energy resolution. It enables investigation of very slow dynamic processes and via scattering vector gives access to the spatial information. The accessible time and length scales are relevant for observation of thermal fluctuations in mesoscopic systems. High energy resolution, low background and good instrumental stability of J-NSE spectrometer at FRM II research reactor in Garching enables the use of grazing incidence technique (GINSES). Along with conventional NSE spectroscopy, GINSES is developed to be used as 'push-button' option to resolve depth dependent near surface dynamics. Scientific applications of J-NSE instrument include dynamics of classical and critical microemulsions, microgels, polymer blends, polymers in solution and different confinement, membranes and so on. Some examples of recent experiments will be presented.

CPP 18.20 Tue 18:15 Poster C

**Huge material transport in azobenzene polymer films induced by highly intense laser light of 534 nm** — ●ZAHRA MOLLA<sup>1</sup>, REGINA ROSENHAUER<sup>2</sup>, JOACHIM STUMPE<sup>2</sup>, and ULLRICH PIETSCH<sup>1</sup> — <sup>1</sup>Universität Siegen, Festkörperphysik, Siegen, Germany — <sup>2</sup>FHI für Angewandte Polymerforschung, Potsdam, Germany

Photochemical polymers undergo permanent trans to cis isomerisation under illumination with UV or visible light. In the past this property has been used to generate surface relief lattices via illumination of thin films of an azobenzene polymer, for example, by an interference pattern of polarized light. For this purpose typically Ar<sup>+</sup> lasers emitting at 488nm with power < 250mW have been used. Meanwhile new lasers, such as disc lasers emitting at 534nm, are available with beam power up to 2W. In order to study light induced nano-movement, a thin film of the photopolymer Holomix5 was irradiated under normal incidence by an expanded beam of the disc laser. The induced change in film height has been probed by He-Ne laser (633nm) under an angle of 30°. Recorded by a photo diode the reflected intensity shows dramatic changes while illumination. The intensity increases immediately by several percent switching the disc laser with power > 500mW on followed by intensity oscillation with time period of few seconds. The intensity drops back to the initial values switching the disc laser off. The number of oscillations depends on laser power. The scattering data are interpreted in terms of Fresnel equations and refer to the creation of a column formed by polymer material with height up to several 100nm and column diameter equal to that of the laser beam.

CPP 18.21 Tue 18:15 Poster C

**Li-dynamics in amorphous PEO electrolytes in supercooled liquid states** — ●JOYJIT CHATTORAJ, DIDDO DIDDENS, and ANDREAS HEUER — Institute of Physical Chemistry, Westfälische Wilhelm Universität Münster, Corrensstr. 28/30, D-48149 Münster, Germany

The effect of ionic liquids on Li-dynamics is investigated via MD simulation in a poly(ethylene oxide) PEO-based polymer electrolyte material containing Li-TFSI salt and MPPY-TFSI ionic liquid (IL) for a vast temperature regime ranging from above the freezing temperature to the vicinity of the glass transition temperature of PEO. Li cations are complexed with ether oxygen atoms and move via continuous bond breaking and making. Three key mechanisms of cation transport in polymer melts had already been identified at temperatures well above the freezing point. These are *M1*: intrachain motion, *M2*: segmental motion and *M3*: interchain motion. In addition, a plasticizing effect of ionic liquid had been noticed by Diddens et al [arXiv:1211.3413]. In this paper we show that the three mechanisms also hold for low temperatures and a simple Rouse model could be applied to explain these mechanisms as done in the case of high temperature polymer melt. The plasticizing effect of ionic liquid diminishes as we find that

the diffusion coefficient of Li tends to collapse for all IL concentrations while approaching the glass transition.

CPP 18.22 Tue 18:15 Poster C

**Rheology of Complex Fluids: Mathematical Modeling** — ●JOSE MANUEL MUNOZ VILLEGAS — Universidad de Guadalajara, Guadalajara, Mexico

In this work is introduced the SMV model. This model mixes Giesekus model and Johnson-Segalman model. Dynamic simulations (shear stress) are showed under steps shear rate. First and second normal stress differences are also showed. This model predicts well steady and unsteady nonlinear flow.

CPP 18.23 Tue 18:15 Poster C

**Dynamic consequences of missing chain ends** — ●SEBASTIAN GOOSSEN, ANA RITA BRÁS, WIM PYCKHOUT-HINTZEN, ANDREAS WISCHNEWSKI, MARGARITA KRUTYEVA, JÜRGEN ALLGAIER, and DIETER RICHTER — Jülich Centre for Neutron Science, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

The dynamics of cyclic polyethylene glycol (PEG) in a melt was studied by neutron spin echo spectroscopy (NSE) and PFG-NMR for three distinct molecular weights. In comparison with their linear analogs the ring polymers showed a significantly faster center of mass diffusion. This turns out to be an explicit violation of the Rouse model for the smallest rings (~1 Me). Slightly bigger rings (~3 Me) fulfill the Rouse behavior perfectly taking into account the different mode structure due to the ring architecture, while linear chains are already slowed down due to the onset of entanglements. For even bigger rings (~5 Me) the Rouse dynamics does not apply anymore. Obviously topological ring-ring-interactions lead to slower dynamics. However, while for linear chains these topological interactions can be described by entanglements, for the rings they are still not fully understood. Further studies dealt with blends of cyclic and linear PEG. Cyclic polymers in a linear matrix are slowed down effectively with increasing chain length of the linear matrix. On the other hand slightly entangled linear chains (~3 Me) in a matrix of cyclic polymers of the same molecular weight diffuse much faster than in a linear environment. This very first molecular weight dependent case study on the dynamics of ring polymers in the melt is compared to recent simulation work.

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**Switching single macromolecules at modified graphene surfaces** — ●CHIEN-LI LEE<sup>1</sup>, DAVID BLÉGER<sup>2</sup>, STEFAN HECHT<sup>2</sup>, and JÜRGEN RABE<sup>1</sup> — <sup>1</sup>Institut für Physik, Humboldt-Universität zu Berlin — <sup>2</sup>Institut für Chemie, Humboldt-Universität zu Berlin

Introducing azobenzene moieties into polymers has recently been shown to allow for optically switching the aggregation behavior of the polymer in solution, which has been attributed to rod-coil transitions [1]. Due to the difficulty of isolating single switchable azobenzene-containing polymers on solid substrates, they were studied so far in aqueous solutions, thin films and bulk materials, thereby reflecting ensemble properties.

Here we present an approach to switch single macromolecules immobilized on a modified graphene surface. A synthetic rigid-rod polymer [1] incorporating azobenzene photoswitches in the backbone was deposited from aqueous solution onto a graphite surface precoated with an oriented monolayer of octadecylamine [2]. Single rod-like polymers aligned by the substrate have been imaged by scanning force microscopy. Photoisomerization back and forth between trans and cis at different wavelengths leads to shrinking and stretching, respectively, as well as some local movements of the macromolecules on the surface.

[1] David Bléger, T. Liebig, R. Thiermann, M. Maskos, J. P. Rabe, and S. Hecht *Angew. Chem. Int. Ed.* 2011, 50, 12559.; [2] N. Severin, I.M. Okhupkin, A.R. Khokhlov, and J.P. Rabe, *Nano Lett.* 2006, 6 1018