

## CPP 49: P14: Polymer Dynamics

Time: Wednesday 10:00–13:00

Location: Poster A

CPP 49.1 Wed 10:00 Poster A

**Molecular dynamics and charge transport in polyisobutylene-based ionic liquids** — ●FALK FRENZEL<sup>1</sup>, MAKAFUI YAO FOLIKUMAH<sup>2</sup>, MATTHIAS SCHULZ<sup>2</sup>, WOLFGANG BINDER<sup>2</sup>, and FRIEDRICH KREMER<sup>1</sup> — <sup>1</sup>Institute of Experimental Physics I, University of Leipzig, Linnéstr. 5, 04103 Leipzig, Germany — <sup>2</sup>Institute of Chemistry, Martin-Luther-University Halle-Wittenberg, Von-Danckelmann-Platz 4, 06120 Halle (Saale), Germany

Broadband dielectric spectroscopy (BDS) and differential scanning calorimetry (DSC) are employed to study molecular dynamics and charge transport in polyisobutylene(PIB)-based ionic liquids. The latter form a homologous series of polymeric 'Ionic Liquids' containing monovalent and bivalent telechelic PIBs either with N,N,N-triethylammonium as the functional group or 1-methylpyrrolidinium. Three well separated dielectric relaxation processes and a conductivity contribution are obtained. This offers to unravel the interplay between molecular dynamics and charge transport in this novel class of materials.

CPP 49.2 Wed 10:00 Poster A

**Proton Motion in Phosphoric Doped PBI Membranes for HT-PEFC** — ●BERNHARD HOPFENMÜLLER<sup>1</sup>, REINER ZORN<sup>2</sup>, OXANA IVANOVA<sup>1</sup>, OLAF HOLDERER<sup>1</sup>, WIEBKE MAIER<sup>3</sup>, WERNER LEHNERT<sup>3</sup>, MICHAELA ZAMONI<sup>1</sup>, NIINA JALARVO<sup>4</sup>, GEORG EHLERS<sup>5</sup>, and MICHAEL MONKENBUSCH<sup>2</sup> — <sup>1</sup>JCNS Outstation at MLZ, Forschungszentrum Jülich GmbH, Garching, Germany — <sup>2</sup>JCNS-1 & ICS-1, Forschungszentrum Jülich GmbH, Jülich, Germany — <sup>3</sup>IEK-3, Forschungszentrum Jülich GmbH, Jülich, Germany — <sup>4</sup>JCNS-SNS, Forschungszentrum Jülich GmbH, Oak Ridge, USA — <sup>5</sup>SNS, Oak Ridge National Laboratory, Oak Ridge, USA

PBI (poly(2,2\*-(m-phenylene)-5,5\*-bibenzimidazole) membranes with phosphoric acid impregnation are a promising material for high-temperature polymer electrolyte membrane fuel cells (PEMFC). Such membranes tolerate impurities like 1-2% of carbon monoxide produced during operation in PEMFC Systems, show good chemical resistance and high glass transition temperature (about 700\*K). The macroscopic level of such materials is well studied but one still lacks a detailed description of the microscopic dynamics, mainly the diffusion of protons. An excellent technique to study such processes is given by Neutron Scattering. We combined Time-Of-Flight and Backscattering to investigate the temperature and q-dependency of proton-diffusion in the membrane materials.

CPP 49.3 Wed 10:00 Poster A

**Dielectric spectroscopy and DSC on water / PEG mixtures** — ●ALEXANDER MATT, BJÖRN KUTTICH, and BERND STÜHN — Experimental Condensed Matter Physics, TU Darmstadt, Germany

The interplay between water and protein dynamics is an important feature for the functionality of proteins in the human body. The dynamics of polymers in an aqueous environment are a simplified model system for this complex biological situation. Taking a simply structured water soluble polymer instead of a complex protein allows to distinguish between the contributions of the different components to the overall dynamics of the mixture. A well suited method for the investigation of polymer dynamics is dielectric spectroscopy. Measuring in the high frequency range between 200 MHz and 50 GHz both pure water dynamics and also fast polymer dynamics can be investigated as well as their interplay.

In this work we focus on the polymer poly(ethylene glycol) (PEG). Despite its simple structure it shows quite surprising features when dissolved in water, like its hydrophilicity itself for instance. Furthermore, we find that already low polymer concentrations lead to a complete change in the water dynamics measured by dielectric spectroscopy, indicating a long range disturbance of the hydrogen bonding network. These effects are investigated for a broad range of molecular weights, concentrations and temperatures in order to vary systematically monomer and end-group concentration as well as solubility properties. All dielectric investigations are accompanied by calorimetric measurements.

CPP 49.4 Wed 10:00 Poster A

**Examination of medium-ranged interactions through optical tweezing of a droplet in a multiphase ternary mixture**

(PNIPAM/H<sub>2</sub>O/DMSO) — ●MICHAEL ORLISHAUSEN and WERNER KÖHLER — Physikalisches Institut, Universität Bayreuth, Universitätsstr. 30, 95447 Bayreuth

Poly-N-isopropylacrylamide (PNIPAM) in aqueous solution can show a cononsolvency effect when mixed with another solvent. A proper concentration of that solvent can result in the shift from a lower (LCST) to an upper critical solution temperature (UCST). In our case, we chose Dimethylsulfoxid (DMSO) and investigated the resulting ternary system at room temperature, and thus below its UCST, using a light microscope and a laser beam (532 nm) focused through the objective, which was utilized both for optical tweezing and local heating. In an unperturbed state the ternary system the system consists of myriads of droplets in different phase states with diameters of several microns. Due to the high refractive index of DMSO as a pure component, DMSO-rich droplets can be easily tweezed. When a tweezed droplet is forced through the sample by controlling the position of the beam, a correlated network-like response of the interacting droplets near the perturbation occurs on a length scale of at least 10 microns. The motion of such a droplet also leads to a net growth of its size as a result of a more frequent contact with other droplets of similar composition, even when only moving on a circular path near the initial position. When a water soluble absorbing dye is added, the temperature field induced by the laser moves along with the tweezed droplet.

CPP 49.5 Wed 10:00 Poster A

**Diffusion of crystalline lamella in a semicrystalline polymer** — ●MARTIN NEUMANN, STEFAN KRAUSE, CHRISTIAN VON BORCZYKOWSKI, and ROBERT MAGERLE — Fakultät für Naturwissenschaften, Technische Universität Chemnitz, Chemnitz, Germany

During crystallization, elastomeric polypropylene (ePP) with 15 % crystallinity forms isolated ~ 50-nm small crystalline lamella within the amorphous matrix and larger but immobile complexes of crystalline lamella. With Atomic Force Microscopy (AFM) we measured the diffusion of these small lamella in 60 nm thin polymer films at different temperatures and analyzed the diffusion trajectories to extract the diffusion coefficients. The temperature dependence of the data is well described by the Stokes-Einstein-Equation (SEE) and the Williams-Landel-Ferry-Equation (WLF). The size variation of the diffusing crystals led to a broad distribution of diffusion coefficients, which cannot completely be explained by the Stokes-Einstein-Equation (SEE). We identified heterogeneities of the crystal diffusion depending on the distance  $d_C$  between isolated crystals and the larger crystalline lamella. Isolated crystals moved up to 5 times slower when  $d_C$  was smaller than 50 nm. Our interpretation of this result is that there is an amorphous interphase layer around all crystalline lamella, which has an increased viscosity. This could be due to partly crystallized polymer coils, which are not able to diffuse like the completely amorphous ones.

CPP 49.6 Wed 10:00 Poster A

**Comparison between thermal diffusion of a linear-chain polymer and a polymer microgel** — ●BASTIAN PUR<sup>1</sup>, WERNER KÖHLER<sup>1</sup>, KLAUS HUBER<sup>2</sup>, and MARTIN SCHNEIDER<sup>2</sup> — <sup>1</sup>Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth, Germany — <sup>2</sup>Physikalische Chemie, Universität Paderborn, 33098 Paderborn, Germany

In present theories for polymer thermophoresis in dilute solutions there are two theoretical models under discussion: draining coil and nondraining coil, corresponding to the Rouse and the Zimm picture, respectively. In order to discriminate between these models we have started a comparative investigation of a linear-chain polymer and a cross-linked microgel. The linear polymer sample used is poly(methylmethacrylate) (PMMA) and the microgel sample is PMMA, cross-linked with ethylene-glycol-dimethacrylate (EGMA). In either case toluene is used as solvent. By means of transient holographic grating technique we obtained the thermal diffusion coefficient  $D_T$ , the Fickian diffusion coefficient  $D$  and the Soret coefficient  $S_T$  as functions of the polymer concentration  $c$ . We have found that for  $c \rightarrow 0$  the thermophoretic mobility of the linear polymer and the microgel are identical within experimental accuracy. The PMMA microgel shows, however, a significantly faster decay with increasing concentration, which we interpret as a result of the more rapidly increase of the microscopic friction.