

CPP 11 POSTER Disperse Polymer Systems

Time: Tuesday 17:00–19:00

Room: P3

CPP 11.1 Tue 17:00 P3

Raman characterization of polypropylene-clay nanocomposites — ●GOLNARA NIKOLAEVA¹, KIRILL PROKHOROV¹, PAVEL PASHININ¹, VIKTOR GERASIN², and EVGENI ANTIPOV² — ¹A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, 38 Vavilov St., 119991 Moscow, Russia — ²A.V. Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, 29 Leninsky Pr., 119991 Moscow, Russia

We studied nanocomposites made of isotactic polypropylene (PP) and natural montmorillonite modified with a quaternary ammonium salt. The mass content of the clay in the composites varied from 1.5 to 20 percents. The production technology was melt-blending at 200°C and subsequent quenching in water. X-ray analysis of the composites revealed intercalation of polymer macromolecules in the clay interlayer space. The modulus of elasticity of the composites was higher than that of the neat PP and reached its maximum value at 1.5 percents of the clay content.

Raman spectra of the composites were measured with laser excitation at 472.7 nm. At this excitation wavelength, we observed a strong band of luminescence, the intensity of which increased with the increase in the clay content. However, the 2600–3100 cm⁻¹ frequency range of the Raman spectra contained intense lines that can be used for detailed characterization of the composite structure. In particular, when studying the behavior of the intensity of the A-symmetry line at 2963 cm⁻¹, we concluded that the orientation ability of the macromolecules during uniaxial drawing of the samples decreases with the increase of the clay content.

CPP 11.2 Tue 17:00 P3

Clay Dispersions — ●HENRICH FRIELINGHAUS¹, HELEN HERMES², WIM PYCKHOUT-HINTZEN¹, and DIETER RICHTER¹ — ¹Forschungszentrum Jülich GmbH, Institut für Festkörperforschung, 52425 Jülich, Germany — ²Physik der weichen Materie, IPkM, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany

Dispersions of montmorillonite clay particles in water are investigated by small angle neutron scattering. This method measures structures in the range of several 10 Å up to several 1000 Å. Complementary x-ray scattering experiments at intermediate angles complete the structural studies at shorter distances. Many dispersions showed a small fraction of tactoids, i.e. stacks of single platelets. A new developed model for small angle neutron scattering successfully describes the disc-like behaviour of the single platelets coexisting with a small fraction of tactoids. This model is about to be applied also for polymer-clay nanocomposites, since the distribution function of the stacking can be varied.

CPP 11.3 Tue 17:00 P3

Confined Polymers in Microemulsions — ●SIMONA MACCARONE, HENRICH FRIELINGHAUS, JÜRGEN ALLGAIER, and DIETER RICHTER — Forschungszentrum Jülich GmbH, Institut für Festkörperforschung, 52425 Jülich, Germany

It has been established that amphiphilic diblock copolymers increase the efficiency of surfactants in microemulsions (polymer boosting effect). These studies always considered large oil and water domains of size d compared to the typical polymer size R_g . Thus the confinement parameter R_g/d was small in these first studies. The ongoing studies of this paper consider medium and higher confinement, where small angle neutron scattering measurements reveal a new behaviour, which can be compared to computer simulations by T. Auth. The theory predicts an enhanced sensitivity of the polymer at medium confinement and a reversed behaviour at larger confinement. The higher sensitivity at medium confinement is only slightly visible experimentally, whereas the reversed behaviour (anti-boosting) is clearly present. These results are interesting for applications and interpretations of biological membranes.

CPP 11.4 Tue 17:00 P3

New Sticker Polymers as Efficiency Boosters in Microemulsions — ●MARTIN BRODECK, GAETANO MANGIAPIA, HENRICH FRIELINGHAUS, CHRISTIAN FRANK, JÜRGEN ALLGAIER, and DIETER RICHTER — Forschungszentrum Jülich GmbH, Institut für Festkörperforschung, 52425 Jülich, Germany

Amphiphilic diblock copolymers have been established to enhance the efficiency of surfactants dramatically (polymer boosting effect). The focus of the present paper focuses on sticker polymers with just a small

oil-soluble block. Even though the amphiphilicity of these polymers is rather low, they act as efficiency boosters as effectively as diblock copolymers. The microscopic structure of the domains is measured in small angle neutron scattering studies and compared with the macroscopic phase behaviour. Latest measurements involve sticker polymers with a higher functionality (larger arm number) and are compared to the simple sticker polymers. A theory by T. Auth and G. Gompper predicts a stronger sensitivity of the polymer effect with higher functionality. Ongoing work is aimed at four-functional sticker polymers.

CPP 11.5 Tue 17:00 P3

Assembly of SiO₂ nanoparticles into the interstitial sites of ordered polymethylmethacrylate beads — ●SIMONE HERTH — Rensselaer Nanotechnology Center, Rensselaer Polytechnic Institute, Troy, NY, USA

For nanocomposite materials, their optical, magnetic, and electrical properties could be improved by placing the nanoparticles equidistant to one another or by decreasing the width of the interparticle distance distribution. One attempt to achieve this special arrangement is the assembly of nanoparticles into the interstitial sites of an ordered lattice of uniform polymer beads, such as polymethylmethacrylate (PMMA), by centrifugation. Due to the different densities of PMMA and SiO₂, the PMMA would normally always settle down on top of the SiO₂ nanoparticles during the centrifugation process. For that reason, the SiO₂ nanoparticles were linked with the PMMA beads by a silane linker prior to centrifugation. Scanning electron micrographs of the dried pellets revealed a short range order of the PMMA beads, a good dispersion of SiO₂ nanoparticles, and a good adhesion of the SiO₂ nanoparticles to the PMMA beads.

CPP 11.6 Tue 17:00 P3

Magnetic particles in supported polymer nano-structures — ●M.M. ABUL KASHEM¹, S.V. ROTH², and P. MÜLLER-BUSCHBAUM¹ — ¹TU München, Physik-Department E13, James-Frank-Str. 1, D-85747 Garching, Germany — ²HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany

Polymer nano-structures with incorporated magnetic particles mark a new class of composite materials. Composite structures are formed from a P(S-b-I) matrix and a magnetic filler (metal oxide). The great potential of these composites derives from the substantial modification of the thermal, mechanical and electrical characteristics of polymers which results when the polymer is combined with a filler. The polymer nano-structures, acting as a template, enable a completely new arrangement of the particles which is inaccessible with common magnetic materials. The controlled incorporation of the particles results from the presence of a hairy polymer layer covering the magnetic particles. On top of solid supports the polymer layers including particles are prepared by spin-coating. The nano-structures are created by additional preparation steps by an interplay of dewetting and micro-phase separation. Within this self-assembly process the polymer matrix as well as the magnetic particles are ordered. The resulting structures are presented.

CPP 11.7 Tue 17:00 P3

Microbeam-GISAXS investigation of flow induced structures — ●E. BAUER¹, S.V. ROTH², and P. MÜLLER-BUSCHBAUM¹ — ¹TU München, Physik-Department E13, James-Frank-Str. 1, D-85747 Garching, Germany — ²HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany

Flow in nanoscale geometries is of importance in many areas as for example in chip production, printing techniques and bio-medical sensing devices. While on a local scale the surface structure is nicely pictured by AFM, scattering is usually applied to obtain a mean statistical information. With grazing incidence small-angle x-ray scattering (GISAXS) a length regime comparable to AFM is addressed. A local scattering information becomes accessible by combining GISAXS with a micron sized x-ray beam and scanning of the sample relative to the beam. We demonstrate the actual possibilities of this technique by locally probing the influence of selected boundary conditions on the movement of liquid fronts to reach a deeper understanding of the influence of the selected boundaries on flow at different lengths scales. In the presented example a blend solution (PS:PBr(0.34)S = 1:9) in toluene was deposited as a drop on top of a polyimide-coated substrate.

CPP 11.8 Tue 17:00 P3

Aggregation of block copolymers and surfactants studied by fluorescence correlation spectroscopy. — ●H. ZETTL¹, M. RUPPEL², M. BURKHARDT², A.H.E. MÜLLER², and G. KRAUSCH¹ — ¹Physikalische Chemie II, Universität Bayreuth, 95440 Bayreuth — ²Makromolekulare Chemie II, Universität Bayreuth, 95440 Bayreuth

In recent years new block copolymers with very low critical aggregation concentrations (*cac*) have been synthesized. With classical techniques like light scattering and conductivity the exact determination of these *cac*'s becomes increasingly difficult. Fluorescence correlation spectroscopy (FCS) allows to analyse the diffusion behaviour of single dye molecules to study the aggregation processes of polymers and low molecular weight surfactants. We show aggregation studies starting from well investigated surfactant systems up to complex block copolymers in aqueous solutions and organic solvents.

CPP 11.9 Tue 17:00 P3

Dynamics of the miscible blend PEO / PMMA — ●KATARZYNA NIEDZWIEDZ, ANDREAS WISCHNEWSKI, MICHAEL MONKENBUSCH, LUTZ WILLNER, and DIETER RICHTER — Institute for Solid State Research, Research Center Juelich, Germany

In spite of intensive studies on binary polymer systems it is still impossible to predict the properties of a blend system on basis of what is known about the behaviour of each component of the mixture. Although it is well known that the dynamics of each component is affected by blending, the dynamic miscibility and in particular the question whether or not there exists a corresponding length scale is still matter of strong controversy. Of particular interest are blends where the dynamics of the pure components is well separated in time, i.e. with a very different glass transition temperature *T_g* of the pure components. We present a series of neutron spin echo and neutron backscattering data of the miscible polymer blend poly(ethylene oxide) (PEO, *T_g* = 200 K) / polymethylmethacrylat (PMMA, *T_g* = 400 K). At temperatures below the *T_g* of PMMA, the PEO component is still mobile but shows a strong difference in the segmental pair- and self-correlation functions, i.e. in the collective and self motion, respectively. An explanation for these surprising results will be presented.

CPP 11.10 Tue 17:00 P3

Nanostructure of copolymers of ethylene and 5-ethylidene-2-norbornene and aluminum/polyethylene composites study by very cold neutrons scattering — ●SERGEY KUZNETSOV¹, YURI LAPUSHKIN¹, ANDREY UDOVENKO¹, IRINA MESHKOVA², VITALII GRINEV², LEV RASPOPOV², ALEKSANDR SHCHEGOLIKHIN², ELENA KISELEVA², OLGA KUDINOVA², LIUDMILA NOVOKSHONOVA², and ANATOLII SHELAGIN³ — ¹Lebedev Physics Institute, Moscow, Russian Federation — ²Semenov Chemical Physics Institute, Moscow, Russian Federation — ³Moscow Physics Technical Institute, Moscow, Russian Federation

Very cold neutron (VCN) scattering was used to control the nanostructure of copolymers of ethylene and 5-ethylidene-2-norbornene (E/EN) and polymer nanocomposites. The technology of E/EN copolymerization was developed to obtain the heat-resistant materials with high glass transition temperature and increased transparency. Supermolecular structure (SMS) of the E/EN copolymers with different EN concentrations was investigated. It was shown that EN concentration growth lead to decrease the co-polymer crystallinity. We didn't see the VCN scattering on the E/EN copolymer nanostructure at EN concentration in copolymer >30 molar %. VCN scattering was also used to control the agglomeration of Al particles in Al/PE nanocomposites obtained by polymerization filling method. The dimensions of Al particles were determined. The macro-properties of Al/PE composites with various dimensions and concentrations of Al particles were compared.

CPP 11.11 Tue 17:00 P3

Conformational properties of dendritic block copolymer of first generation — ●MARIOS KOSMAS — Chemistry Department, University of Ioannina, Greece

Our previous works on linear and star polymers are extended to dendritic block copolymer chains of an extra generation and two different species. On the ends of a star of *f_a* branches of molecular weight *N_a* each, which constitute the inner region of the dendrimer the new generation is built. This outer generation consists of *f_a* new stars each one of *f_b* branches having totally *f_af_b* branches eachone having a molecular weight *N_b*. Working at the critical dimensionality *d*=4 above which

polymer chains behave ideally we determine the radius of gyration of the dendritic block copolymer and average angles between the branches, in an effort to see the effects of the two different molecular weights, the two different number of branches and the rest characteristics of the chain and the solvent, on the conformational behavior of the macromolecule. Two macroscopic properties are analysed. The positions of the end groups which determine the activity of the macromolecule and the empty spaces inside the chain which make the macromolecule a good carrier of smaller species.

CPP 11.12 Tue 17:00 P3

Polyethylene-terephthalate ferroelectrets: Foam preparation and piezoelectric properties — ●MICHAEL WEGENER, WERNER WIRGES, AXEL MELLINGER, OLENA VORONINA, and REIMUND GERHARD-MULTHAUPT — University of Potsdam, Department of Physics, Am Neuen Palais 10, D-14469 Potsdam, Germany

Novel cellular polyethylene-terephthalate (PETP) films have been prepared and investigated as alternative ferroelectrets. Ferroelectrets are polymer-air composites with a cellular structure and with electrically charged void surfaces where charges of opposite polarity form large macroscopic dipoles [1]. The change of void (and thus dipole) sizes during application of mechanical stress generates a piezoelectric activity of several hundred pC/N as demonstrated on polypropylene foams [1] and as recently reported for PETP foams [2], a second ferroelectret material.

Here, we describe several methods for foam preparation, such as voiding during treatment in supercritical carbon dioxide or during stretching of filler-loaded polymer sheets as well as procedures for foam-structure optimisation, such as stretching and inflation. Furthermore, we describe charging procedures for charging of void surfaces. Finally, we discuss the piezoelectric and elastic properties of the new ferroelectret materials.

[1] M. Wegener and S. Bauer, Microstorms in cellular polymers: A route to soft piezoelectric transducer materials with engineered macroscopic-dipoles, *ChemPhysChem* 6, 1014-1025 (2005).

[2] M. Wegener, W. Wirges, and R. Gerhard-Multhaupt, Piezoelectric polyethylene terephthalate (PETP) foams - Specifically designed and prepared ferroelectret films, *Adv. Eng. Mat.*, accepted for publication.

CPP 11.13 Tue 17:00 P3

Interface fluctuations, membrane elasticity and renormalization effects in microemulsions — ●OLAF HOLDERER, HENRICH FRIELINGHAUS, DMYTRO BYELOV, MICHAEL MONKENBUSCH, JÜRGEN ALLGAIER, and DIETER RICHTER — Institut für Festkörperforschung, Forschungszentrum Jülich GmbH, D-52425 Jülich

Neutron spin echo (NSE) spectroscopy is a well-suited method for studying the dynamic properties of microemulsions, consisting of oil, water and a surfactant. Here, the focus is set to bicontinuous microemulsions, having equal amounts of water and oil and varying surfactant concentration. The dynamic properties of the surfactant membrane are tuned by the addition of diblock copolymers or homopolymers. Structural parameters as the characteristic distance or correlation length in bicontinuous microemulsions are obtained by small angle neutron scattering (SANS). The renormalized bending modulus is obtained from the SANS experiments by matching the Gaussian random fields theory with a Ginzburg-Landau approach. NSE experiments are evaluated by numerically integrating *S*(*q*,*t*) from the Zilman-Granek theory, where the bending modulus is the only free fitting parameter. It is shown that the analysis of the dynamics gives a direct access to the "bare" membrane bending modulus *κ*, which is compared to the renormalized one as obtained from SANS. The difference between the two ways of determining *κ* is the renormalization factor, as predicted by theory.

CPP 11.14 Tue 17:00 P3

Rigid Amorphous Fraction of Semicrystalline Polymers and Polymer Nanocomposites — ●ANDREAS WURM, ALBERT SARGSYAN, and CHRISTOPH SCHICK — University of Rostock, Institute of Physics, Universitätsplatz 3, 18051 Rostock, Germany

For semicrystalline polymers the observed relaxation strength at glass transition is often significantly smaller than expected from the non-crystalline fraction. This observation leads to the introduction of a rigid amorphous fraction (RAF) which does not contribute to the heat of fusion or X-ray crystallinity nor to the relaxation strength at glass transition. The RAF is non-crystalline and in a glassy state above the common glass transition temperature.

From heat capacity the temperature and time dependence of the RAF can be obtained. For PC, PHB and sPP it is possible to study the creation

and disappearance of the RAF in situ during isothermal crystallization and on stepwise melting.

A RAF can be detected for polymer nano-composites too. The amount and the thermal stability of the RAF in such systems will also be discussed.

CPP 11.15 Tue 17:00 P3

Multicompartment micellar gels of amphiphilic poly(2-oxazoline) triblock copolymers — ●C.M. PAPANAKIS¹, R. IVANOVA¹, T. BONNÉ¹, K. PRANZAS², K. MORTENSEN³, K. LÜDTKE⁴, T. KOMENDA⁴, and R. JORDAN⁴ — ¹Physikdepartment E13, Technische Universität München, James-Frank-Str. 1, D-85747 Garching — ²Institut für Werkstofforschung, GKSS, Geesthacht — ³Danish Polymer Centre, Risø National Laboratory, Roskilde, Denmark — ⁴Lehrstuhl für Makromolekulare Stoffe, Chemiedepartment, Technische Universität München, 85 747 Garching

Amphiphilic triblock copolymers are widely used as gel formers, e.g. in cosmetics. Poly(2-oxazoline) block copolymers constitute a new and versatile system and are promising candidates for the formation of micellar gels with chemically different types of micelles. This may be achieved by using triblock copolymers with blocks containing lipophilic, hydrophilic and fluorophilic side groups. Using small-angle neutron scattering with contrast matching, we could show that diblock copolymers with lipophilic and fluorophilic blocks and the same hydrophilic block do not form common micelles in aqueous solution. The cores of the micelles formed by copolymers with lipophilic blocks are spherical, whereas the ones from fluorophilic blocks are short cylinders, which is possibly due to the steric demands of the fluorophilic side chains forcing the polymer backbone to stretch. Triblock copolymers form gels above 10 wt-%. Their scattering can be described by a coexistence of spherical, lipophilic and elliptical, fluorophilic micellar cores, which are linked by the hydrophilic blocks. Thus, the system forms a multicompartment gel.

CPP 11.16 Tue 17:00 P3

Tuning the microstructure of polymer-metal nanocomposites prepared by pulsed laser deposition — ●JOHANNA RÖDER, JÖRG FAUPEL, and HANS-ULRICH KREBS — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

Nowadays polymer-metal nanocomposites have a wide range of applications. For instance metal clusters embedded in polymers possess interesting optical properties. Heading towards such new materials with tailored properties, it is important to understand and influence their microstructure. Here the samples were prepared in a one-step process by pulsed laser deposition, using poly (methyl methacrylate) (PMMA) as matrix. The embedded clusters were mainly characterized by TEM. The effects of polymer-cross-linking on the growth of Ag will be presented and discussed, as well as the microstructural changes after deposition of nucleation seeds in the form of less diffusing metals like Nb and Cu. The consequences of the different microstructures on the optical properties are shown.

CPP 11.17 Tue 17:00 P3

In-situ Monitoring of Pressure-Induced Aggregation of beta-Lactoglobulin — ●ALBERT BAARS¹, LESZEK KULISIEWICZ¹, RONALD GEBHARDT², WOLFGANG DOSTER², and ANTONIO DELGADO¹ — ¹Technische Universität München, Lehrstuhl für Fluidmechanik und Prozessautomation, D-85350 Freising — ²Technische Universität München, Physikdepartment E13, D-85747 Garching

At pressures up to 1 GPa, bovine beta-Lactoglobulin (B-Lg) in aqueous solution can undergo reversible and irreversible conformational changes, which lead to altered interactions between the dissolved protein molecules. This work investigates the impact of pressures up to 600 MPa on aqueous B-Lg solution by an in-situ rolling ball viscosimeter and by in-situ dynamic light scattering for mass fractions up to 6 % at 20 °C and pH 7. Between 0.1 and 100 MPa, the results reveal negligible changes in relative viscosity while in the range of 100 - 350 MPa the viscosity rises up to the twice of the initial value. At higher pressures only a slight increase appears. These findings can be deduced from aggregation of monomers and dimers to oligomers. Between 100 and 300 MPa an increase in hydrodynamic radius from 1.8 to 7.4 nm has been observed. In literature it is known that pressures higher than 100 MPa induces conformational changes of B-Lg protein. These lead to a reduction of negative surface charge due to the exposure of hydrophobic tryptophan residues to the solvent. In addition, the SH group from Cys 121 moves to the protein surface. This enables aggregation by formation

of hydrophobic and disulfide bonds. After pressure release, the latter are retained leading to an irreversible increase in relative viscosity.

CPP 11.18 Tue 17:00 P3

Suspensions with plastic flow behavior - relation between shear stress and first normal stress difference — ●DIMITER HADJISTAMOV — DECE GmbH, Helvetierstr.15, CH-4125 Riehen

Model suspensions with plastic flow behavior were rheologically investigated. The shear stress and simultaneously the first normal stress difference were measured during stressing experiments and following that a stress relaxation. We compared the flow and normal stress curves. The flow curve of a system with plastic flow behavior shows one or more yield stress regions, where the shear stress does not change with the shear rate. The shear stress rises continuously after the yield stress region with the shear rate. We found that the normal stress curve also exhibits a yield section - the yield normal stress region. The first normal stress decreases (contrary to the shear stress) at first after the yield normal stress region. The decrease of the normal stress can lead to negative values for the normal force. After them, the normal stress increases with the shear rate. It was established that it is possible to draw conclusion from the ratio between shear stress and normal stress about the strengthening of the structure of a suspension with plastic flow behavior.

CPP 11.19 Tue 17:00 P3

The diblock copolymer as an external field in A/B/A-B polymer mixtures — ●VITALIY PIPICH, DIETMAR SCHWAHN, and LUTZ WILLNER — Forschungszentrum Jülich GmbH, Institut für Festkörperforschung, Jülich, Germany

Ordering transitions in an A/B/A-B polymer mixture have been examined by small angle neutron scattering. The homopolymer blend PB/PS of critical composition was mixed with an increasing amount of the symmetric diblock copolymer PB-PS [PB and PS being polybutadiene and polystyrene, respectively] [1]. By deuteration of individual components we got blends with two scattering contrasts: (i) "bulk" contrast by deuteration the PB homopolymer and the PB-block of the copolymer, and (ii) "block" contrast, when only the PS-block was protonated. In particular for case (ii) we observed large-scale density fluctuations of the copolymer following a Q^{-3} scaling behavior. These density fluctuations were independent of temperature within the 3D-Ising ($\Phi_{DB} < 0.05$) and Brasovskii universality class ($\Phi_{DB} > 0.2$). However, within the Lifshitz universality class, e.g. $0.05 < \Phi_{DB} < 0.3$, the density fluctuations of the copolymer increased with decreasing temperature. Between $0.09 < \Phi_{DB} < 0.3$ the ordering of the copolymer occurred prior to the ordering of the homopolymers. So in a limited copolymer range a pre-ordered copolymer structure seemingly served as a template for the polymeric microemulsion and lamellar phase.

[1] V. Pipich, D. Schwahn, J. Chem. Phys. 123, 124904 (2005).

CPP 11.20 Tue 17:00 P3

Drying of polymer dispersions during film formation monitored via beam bending — ●KERSTIN VON DER EHE and DIETHELM JOHANNSMANN — Institute of Physical Chemistry, Clausthal University of Technology, Arnold-Sommerfeld-Strasse 4, 38678 Clausthal-Zellerfeld

Film formation from aqueous polymer dispersions takes place in several steps including loss of water, compactification of particles, and polymer interdiffusion. In the process, large in-plane stresses develop, which may induce cracking of the dry film. Large stresses are often encountered when the coating to be formed has a high mechanical modulus.

This work deals with polymer dispersions prepared via mini-emulsion polymerization. Mini-emulsion polymerization offers a good synthetic flexibility. In particular, nanocomposites can be created. By variation of surfactant concentration and time of sonication we obtain dispersions with different particle sizes. We work with dispersions of PBuMA, PMMA and poly(BuMA-co-MMA) with different solid contents.

For analyzing the behavior of the dispersions throughout film formation in regard to internal stresses we use a cantilever technique. [1] The films are prepared and dried on a flexible substrate fixed at one end. Bending of the substrate under stress is detected by a laser beam which is deflected from the free end of the substrate. With these experiments we find a dependence of the deflection on material parameters. The results are discussed in the frame of recent theoretical models of the film formation. [2]

References: [1] C. Peterson, C. Heldmann, D. Johannsmann, Langmuir 1999, 15, 7745 [2] A.F. Routh, W.B. Russel, Langmuir 1999, 15, 7762

CPP 11.21 Tue 17:00 P3

Melts of Reactively Compatibilized Blends of Polyamide 6 and Styrenic Polymers: Linear Viscoelasticity and Fractional Calculus — ●CHRISTIAN SAILER and ULRICH A. HANDGE — Institute of Polymers, Department of Materials, ETH Zürich, CH-8093 Zürich

In this study, we investigated the linear viscoelastic properties of reactively compatibilized blends of polyamide 6 and styrenic polymers in the molten state. Two blend systems were considered, i.e. blends of polyamide 6 (PA6) and acrylonitrile-styrene (SAN-K) and blends of PA6 and acrylonitrile-butadiene-styrene (ABS-K) which consisted of SAN-K and 10 wt.% of rubber particles. The compatibilizing agent was added to SAN-K and ABS-K and was capable of reacting with the amine end groups of PA6 in situ during melt blending. In linear viscoelastic shear oscillations we observed a complex low frequency dependence of the dynamic moduli for all blends. In contrast to the pure components the slopes of the $G'(\omega)$ and $G''(\omega)$ curves in the double-logarithmic plot were decreasing with decreasing frequency and the moduli exceeded the values of the components in the range of low frequencies. We analyzed the data by applying fractional differential models [1, 2]. Our analysis revealed that the data can be fitted by the model well over the whole frequency range.

[1] Chr. Friedrich, J. Non-Newtonian Fluid Mech., **46** (1993) 307.

[2] H. Schiessel and A. Blumen, J. Phys. A: Math. Gen., **26** (1993) 5057.

CPP 11.22 Tue 17:00 P3

Influence of pre-history and shear flow on the frequency dependent conductivity of carbon nanotube-filled polymers — ●INGO ALIG¹, SERGEJ M. DUDKIN¹, DIRK LELLINGER¹, SVEN PEGEL², and PETRA PÖTSCHKE² — ¹Deutsches Kunststoff-Institut, Schlossgartenstr. 6, D-64289 Darmstadt — ²Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Str. 6, D-01069 Dresden

The influence of pre-history and shear response on AC conductivity of polymer-dispersed multi-walled carbon nanotubes (MWNT) are presented. Different composites of amorphous and crystalline polymers filled with different amounts of MWNT are investigated. The measurements are performed in a plate-plate geometry which allows simultaneous measurements of electrical and rheological properties. The conductivity spectra are recorded under non-isothermal conditions (melting, annealing, crystallization) and during isothermal relaxation after application of a steady state shear field. The measurements exhibit extraordinary changes in dielectric properties depending on mixing conditions, thermal history and/or external flow. Particularly, the changes in conductivity after transient shear indicate long-term relaxations in the conductive network formed by the nanotubes. The changes in AC conductivity are related to changes in (i) tube-polymer-tube interaction and (ii) tube orientation. The conductivity/permittivity spectra are discussed in the frame of percolation theory. In addition to the laboratory experiments, we will present results from in-line conductivity measurements during extrusion.

/1/ P.Pötschke, S.M. Dudkin, I. Alig, Polymer 44 (2003) 5023-5030

CPP 11.23 Tue 17:00 P3

Voiding - a way to increase the piezoelectric activity of polyamide 11 - films? — ●ALEXANDER KREMMER, WERNER WIRGES, PETER FRÜBING, and REIMUND GERHARD-MULTHAUPT — Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam

After quenching from the melt and cold drawing polyamide 11 (PA11) - films form ferroelectric domains. The ferroelectric domains are oriented in the field direction by poling above the coercive field (75 MV/m) and the polymer becomes piezo- and pyroelectric. A remanent polarization of 50 mC/m² and a piezoelectric d_{33} coefficient of 4 pC/N are obtained. At room temperature the piezoelectric effect is relatively small compared with other ferroelectric polymers, however, it shows a better thermal stability. The orientation in the ferroelectric domains can be destroyed only through melting above 185 °C. The small piezoelectric effect is related to the high elastic modulus (2 GPa). Experiments are presented, which were performed in order to reduce the elastic modulus by voiding with supercritical CO₂. First the gas is dissolved in the polymer under high pressure (150 bar). Then the films are annealed at 170 °C in order to expand the gas rapidly and to stabilise the voids before the gas diffuses out of the film. The piezo- and pyroelectric properties are investigated.

CPP 11.24 Tue 17:00 P3

Investigation on the Molecular Mobility and Gas Transport Properties of Polymer/POSS Hybrid Materials — ●NING HAO, MARTIN BÖHNING, OLE HÖLCK, HARALD GOERING, and ANDREAS SCHÖNHALS — Bundesanstalt für Materialforschung, Unter den Eichen 87, D-12205 Berlin

Polymer based hybrid materials are prepared by blending polyhedral oligomeric silsesquioxanes (POSS) into different polymer matrices via a solution / film casting route. POSS can be regarded as a molecular silica nanoparticle. The property structure relationships of these nanocomposites are investigated by dielectric spectroscopy and gas transport measurements. As a main result POSS can be mixed homogeneously on a molecular level into the polymer matrix up to a limited concentration which depends on the organic substituents of the POSS component and the polymer matrix as well. For higher concentrations of POSS a phase separated structure with a POSS rich phase is observed. This structure influences strongly the gas transport properties of the nanocomposite materials

CPP 11.25 Tue 17:00 P3

Physical characterization of organometallic block copolymers: poly(styrene-b-ferrocenyldimethylsilane) / homo- polymer blends — ●JIANJUN XU^{1,2}, VASILIOS BELLAS¹, INGO ALIG², and MATTHIAS REHAHN^{1,2} — ¹Institut für Makromolekulare Chemie, TU Darmstadt, Petersenstr. 22, D-64287 Darmstadt — ²Deutsches Kunststoff-Institut, Schlossgartenstr. 6, D-64289 Darmstadt

Due to inclusion of iron atom in the chain extraordinary electrical, optical and magnetic properties are expected for polyferrocenyldimethylsilane copolymers. We focus here on polyferrocenyldimethylsilane (PFDMS) and polystyrene (PS) diblock copolymer, in which PFDMS is semi-crystalline and PS is amorphous. Synchrotron (SAXS, WAXS), rheological, DSC and dielectric experiments are combined to study phase structure, order-disorder and order-order transitions as well as crystallization of the PFDMS phase. From generalized phase diagram one can conclude that our system is in the weak segregation limit. Synchrotron X-ray experiments show spherical, cylindrical and lamellar morphologies in diblock copolymers blended with the homo polymers (PFDMS or PS) by varying the composition. The DSC experiments indicate the existence of confined crystalline structures. Dielectric relaxation experiments have been performed on doped and undoped samples in order to study conductivity in the organometallic block and polarization effects.

CPP 11.26 Tue 17:00 P3

Forces on driven colloids in polymer solutions — ●MATTHIAS KRÜGER^{1,2}, MARKUS RAUSCHER^{1,2}, and SIEGFRIED DIETRICH^{1,2} — ¹Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — ²Institut für Theoretische und Angewandte Physik, Pfaffenwaldring 57, 70569 Stuttgart

Dynamic density functional theory (DDFT) is a dynamic extension of the very successful equilibrium DFT to systems close to equilibrium. It allows to describe the collective dynamics of interacting Brownian particles at the microscopic level in terms of an evolution equation for the particle density. We extend the DDFT to include the effect of solvent flow. In Particular, we study the case of colloids driven through a polymer solution.

We observe accumulation of polymers in front of a driven colloid which gives rise to a friction additionally to the usual Stokes friction. We relate this friction to the diffusivity of a colloid in a polymer solution. We also compare our results to recent experiments measuring the force on a driven colloid in a polymer solution. Between two colloids moving side by side or behind each other, we find repulsive and attractive polymer induced interactions respectively.

CPP 11.27 Tue 17:00 P3

Dielectric heating of Inverse miniemulsions: size dependence on the absorption of microwave radiation — ●J TSUW¹, F KREMER¹, C HOLTZE², M ANTONIETTI³, R SIVARAMAKRISHNAN⁴, and K.D KRAMER⁴ — ¹Institute for Experimental Physics I, University of Leipzig, Linnéstraße 5, 04103, Leipzig, Germany — ²Experimental Soft Condensed Matter Group, 40 Oxford Street, Harvard University, Cambridge, MA 02138, U.S.A — ³Max Planck Institute of Colloids and Interfaces, Department of Colloid Chemistry, D-14424 Potsdam, Germany — ⁴Department of Physics, Free University of Berlin, Arnimallee, Berlin Dahlem, Germany

The absorption of microwave radiation in aqueous NaCl droplets is

analyzed in the frequency range 1MHz to 4GHz. The droplets were dispersed in a continuous oil medium characterized by a dielectric constant of 2.0 and a loss of less than 0.1. All miniemulsions investigated showed one dielectric loss peak, whose intensity and frequency position varied depending on the droplet size. The analysis of data is discussed in the context of Maxwell-Wagner polarization mechanism. The information obtained from this study not only allows the simple adjustment of heating rates (for example in microwave enhanced chemical reactions) by structural control in multiphase emulsions and dispersions, but also is relevant for the discussion of health impacts in high frequency telecommunication devices. References (1) J. Tsui et al. Dielectric heating of Inverse miniemulsions: size dependence on the absorption of microwave radiation (in preparation)

CPP 11.28 Tue 17:00 P3

Phase structures of oil continuous microemulsions towards new decontamination media — ●S. WELLERT¹, H. IMHOF¹, T. HELLWEG¹, M. DOLLE², H.-J. ALTMANN², and A. RICHARDT² — ¹TU Berlin, Stranski-Lab., Strasse des 17. Juni 112, D-10623 Berlin — ²Armed Forces Scientific Institute for Protection Tech., P.O.Box 1142, D-29623 Munster

Removal of chemical warfare agents from coated metal surfaces is an important issue in civil protection. In this purpose the German army uses a macroemulsion based on the technical surfactant Marlowet IHF in mixture with water, perchlorethylene and hypochlorite. Inherently, macroemulsions are unstable and therefore the formation of a microemulsion with the same surfactant is desirable. Microemulsions are macroscopically homogeneous and thermodynamically stable mixtures of water, oil and surfactants and exhibit various unique properties interesting for decontamination applications. Mixtures of water, perchlorethylene, hypochlorite, the emulsifier Marlowet IHF and the cosurfactant 2-propanol are under investigation in order to form oil continuous microemulsions. We present the phase behavior of the four-component system as well as different cuts through the phase tetrahedron containing stable one phase regions. Alternatively we used AOT instead of the established emulsifier. The identified stable one-phase regions were studied by dynamic light scattering to get knowledge about the formed microstructures of these microemulsions.

CPP 11.29 Tue 17:00 P3

Architectural influence on deformation and fracture properties of S-S/B-S triblock copolymers — ●ULRIKE STAUDINGER^{1,2}, BHABANI K. SATAPATHY^{1,2}, ROLAND WEIDISCH^{1,2}, ANDREAS JANKE², and KONRAD KNOLL³ — ¹Institute of Materials Science and Technology, Friedrich-Schiller-University Jena, Löbdergraben 32, D-07743 Jena, Germany — ²Leibniz-Institut für Polymerforschung Dresden, Hohe Str. 6, 01069 Dresden, Germany — ³BASF-AG, 67056 Ludwigshafen, Germany

The influence of molecular architecture on the deformation and fracture behaviour of triblock copolymers with two PS end blocks and random S/B middle block has been studied and the results have been correlated with their morphology. A triblock copolymer with short PS outer blocks and a S/B ratio of 1:1 in the middle block exhibits a wormlike structure and shows elastomeric behaviour. Increasing the soft phase content in the middle block to a S/B ratio of 1:2 results in an increased interaction parameter and thus to enhanced phase separation. The morphology changes into a lamellae structure leading to a distinct increase in strain, yield stress and Young's modulus. Increasing the PS outer block content up to 18 wt.-% also leads to lamellar morphology and a change to thermoplastic behaviour could be observed. The fracture toughness was evaluated using essential work of fracture method based on concepts of the Post-Yield Fracture Mechanics. With increasing PS content in the outer blocks the resistance against crack propagation increases. The fracture toughness is strongly increased in case of triblock copolymers with lamellae structure when compared to that of wormlike structure.

CPP 11.30 Tue 17:00 P3

Flow NMR of dispersed systems — ●ULRICH SCHELER and FRANK BAGUSAT — Leibniz Institute of Polymer Research Dresden, Hohe Strasse 6, D-01069 Dresden, Germany

Polymers and dispersions often exhibit non-Newtonian flow behaviour. The detailed investigation of this behaviour requires detailed and localized information, which is efficiently derived from a combination of NMR imaging and pulsed field gradient NMR, providing localized flow information. This is utilized to check the validity of assumption on the flow profile for the data analysis. NMR provides information on the fluid phase as opposed to most other methods. In addition to information

on density of the fluid phase (signal intensity), flow direction and velocity contrast in the fluid phase is generated by NMR parameters like relaxation times. This enables the selective investigation of different components in the fluid phase. Experiments are performed in Couette cell in a high-field NMR spectrometer. Variations of the inner cylinder permit the investigation of effects of local high shear. Examples are shown for a silica in water dispersion and oil in water emulsion.

CPP 11.31 Tue 17:00 P3

Self assembly in mixtures of surfactant and amphiphilic Poly(*p*-phenylenes): Rodlike structures — ●THOMAS HELLWEG¹, TOBIAS FÜTTERER¹, GERHARD FINDENEGG¹, and DIETER SCHLÜTER² — ¹TU Berlin, Stranski-Lab. (ER 1), Strasse des 17. Juni 112, 10623 Berlin — ²ETH Zürich

2,5-disubstituted poly(*p*-phenylenes) with one nonpolar substituent R1 and one polar substituent R2 on each monomeric unit represent an interesting class of amphiphiles in which the border between the hydrophilic and hydrophobic part of the molecule runs along its stiff backbone. We have studied the self-assembly of a poly(*p*-phenylene) oligomer, PP_{*n*} (*n*=12), with substituents R1= C₁₂H₂₅ and R2= -CH₂(OC₂H₄)₃OCH₃ in the pure state and in aqueous surfactant solutions, using light scattering, and SANS. This compound is soluble in aqueous solutions of nonionic surfactants such as e.g. C₈E₄, where it forms elongated stiff aggregates (contour length ca. 500 nm, diameter 5.5 nm). The ratio polymer to surfactant was found to be 1:3 in the mixed structures using SANS [1]. Dynamic light scattering data from the aqueous PP₁₂-C₈E₄ solution can be modelled by an intermediate scattering function for rod-like particle dynamics [2].

[1] T. Fütterer, Th. Hellweg, G. H. Findenegg, J. Frahn, and A. D. Schlüter; *Macromolecules* **38** (2005) 7451.

[2] T. Fütterer, Th. Hellweg and G. H. Findenegg; in: *Mesoscale Phenomena in Fluid Systems*, F. Case and P. Alexandridis (Hrsg.), ACS Symposium Series No. 861, (2003).

CPP 11.32 Tue 17:00 P3

Influence of molecular weight on rheological properties of linear symmetric S-(S/B)-S triblock copolymers — ●MAHENDRA THUNGA¹, ULRIKE STAUDINGER^{1,2}, BHABANI K. SATAPATHY^{1,2}, ROLAND WEIDISCH^{1,2}, and KONRAD KNOLL³ — ¹Leibniz Institute of Polymer Research, Hohe Str. 6, 01069 Dresden, Germany — ²Institute of Materials Science and Technology, Friedrich-Schiller-University Jena, Löbdergraben 32, 07743 Jena, Germany — ³BASF AG, D-67056 Ludwigshafen, Germany

The influence of molecular weight on morphology, rheology and mechanical properties of a symmetric linear S-S/B-S type triblock copolymer has been studied. The morphology reveals that the size of dispersed PS (hard) phase is narrowed down with the increase in molecular weight from 110 to 156 kg/mol. On further increasing the molecular weight to 200 kg/mol phase separation is observed with the formation of lamellar morphology. The rheological studies reveal that storage modulus and complex viscosity are strongly influenced by their relative molecular weights. An increase in molecular weight leads to an extended rubbery plateau and the terminal region is narrowed down. A transition from Newtonian to non-Newtonian flow in the low frequency regime could be observed with the increase in molecular weight along with an increase in the order-disorder transition temperature. DMA and DSC measurements reveal that the increase in the molecular weight from 165 to 200 kg/mol has led to two distinct transition points for PS rich phase and PB rich phase due to the macrophase separation.

CPP 11.33 Tue 17:00 P3

Thermal Patterning of a Critical Polymer Blend — ●ALBERT VOIT, ALEXEI KREKHOV, WOLFGANG ENGE, LORENZ KRAMER, and WERNER KÖHLER — Universität Bayreuth

The influence of inhomogeneous temperature fields on the demixing of a critical polymer blend has been investigated with the aim to control the spinodal demixing morphology. We have employed a focused laser beam to write spatial composition patterns into layers of the critical polymer blend poly(dimethylsiloxane)/poly(ethylmethyl siloxane) (PDMS/PEMS, Mw = 16.4/22.8 kg/mol) both in the one and in the two-phase region a few degrees above and below the critical temperature. Due to the critical divergence of the Soret coefficient, moderate temperature gradients are sufficient to induce composition modulations of large amplitude. In the two-phase regime the spinodal demixing pattern can be locally manipulated in a controlled way and the time evolution of

various patterns can be studied. 2D-simulations based on a modified Cahn-Hilliard equation are able to reproduce the essential spatial and temporal features observed in the experiments.

CPP 11.34 Tue 17:00 P3

Studies on the Interphase in PP-Glass Composites — ●HANNA M. BRODOWSKY and EDITH MÄDER — Leibniz-Institut für Polymerforschung Dresden, Hohe Str. 6, D-01069 Dresden

In composites, the interface between the components is essential for improving the mechanical properties. By using a suitable sizing (surface modification) of the fiber, the interface may be varied, e.g. by suppressing or promoting heterogeneous nucleation of a thermoplastic matrix. In the latter case, a three dimensional transcrystallized $\{\Delta q\}$ interphase $\{\Delta q\}$ with properties differing from those of the bulk matrix is formed.

Polypropylene-glass fiber composites with a number of different sizings and different PP chain lengths are prepared as single fiber model composites. These are studied in quasistatic or cyclic load tests. Static tests permit insights in the interfacial characteristics such as fracture energy release rate, shear strength and modulus. Cyclic tests on these model composites can be used to study the nature of dissipative processes and the damage behaviour. An AFM characterisation of the pulled out fibers provides supplementary information. Additionally, the dynamic behavior of bulk composites is characterized.

CPP 11.35 Tue 17:00 P3

Structure and dynamics of electrostatically interacting magnetic colloidal suspensions by means of static and dynamic x-ray scattering — ●TINA AUTENRIETH¹, JOACHIM WAGNER², AYMERIC ROBERT³, and GERHARD GRÜBEL¹ — ¹HASYLAB at DESY, Notkestrasse 85, 22607 Hamburg — ²Universität des Saarlandes, Saarbrücken — ³ESRF, Grenoble, France

A model system for complex liquids with dipolar interactions has been synthesized [1]. The particles consist of a magnetic cobalt ferrite core embedded in a silica shell and have a narrow size distribution. They interact due to the charged silica surface via a screened Coulomb potential in addition to the magnetic dipole-dipole interaction of the core. The colloidal suspension is strongly opaque and thus cannot be probed by visible light scattering techniques. Therefore both, the static and dynamic behaviour of such a concentrated, liquid-like ordered dipolar suspension are studied by means of Small Angle X-ray Scattering and X-ray Photon Correlation Spectroscopy without and in the presence of an external magnetic field [2]. The dynamics was probed over the Q-range of the static structure factor and shows even without magnetic field strong deviations from the Stokes-Einstein behaviour that can not be explained by the De-Gennes narrowing. The observed behaviour has to be attributed to indirect hydrodynamic interactions which are mediated by the suspending medium [3]. However, the hydrodynamic behaviour cannot be described by any of the available models for colloidal hydrodynamics. [1] T. Autenrieth et al., AOC 18, 520 (2004) [2] J. Wagner et al., JMMM 289, 54 (2005) [3] A. Robert et al., JCP 122, 084761 (2005)

CPP 11.36 Tue 17:00 P3

Free volume from positron lifetime spectroscopy and mechanical properties of EPDM rubber/SiO₂ nanocomposites — ●JAN KRUSE¹, RODRIGO LIMA DE MIRANDA¹, KLAUS RÄTZKE¹, MATTHIAS ADLER², DIRK W. SCHUBERT², and FRANZ FAUPEL¹ — ¹Lehrstuhl für Materialverbunde, Universität Kiel — ²Freudenberg Forschungsdienste KG, Weinheim

The addition of inorganic particles to a polymer matrix has a long tradition in polymer engineering. Decreasing their size to nanometre dimensions provides a high specific interaction surface and the possibility of a fine dispersion of the particles. In gas sealing applications, the particles might act as a permeation barrier by blocking diffusion paths (tortuosity). We have investigated EPDM rubber with up to 23 wt% nonfunctionalised SiO₂ nanoparticles. Positron annihilation lifetime spectroscopy (PALS) is a powerful tool to determine free volume from size dependent ortho-positronium lifetime. PALS shows just a slight decrease in free volume element size, but a linear decrease in free volume concentration (from o-Ps intensity) with filler amount. Dynamic mechanical thermal analysis (DMTA) was employed to observe the increase in elastic and damping modulus as well as the respective transition temperature.

CPP 11.37 Tue 17:00 P3

On the way to nano-porous polymer foams — ●FRANCISCO CAMACHO-GONZALEZ, JOHANN G. LEONHARTSBERGER, MARIO DANSACHMUELLER, SIMONA BAUER-GOGONEA, and SIEGFRIED BAUER — Soft Matter Physics, Johannes Kepler University, Altenberger Str. 69, A-4040 Linz, Austria

Electromechanical effects in polymers, like piezoelectricity and electrostriction are employed in transducers and photonics. With the formation of micron-sized voids, soft cellular polymers with huge piezoelectric effects and ferroelectric-like behavior were developed. Micron-sized voids are advantageous for transducer applications, but they prevent the materials to be used in photonics. For photonics applications it might be interesting to have soft polymers with voids in the submicron region. Amorphous polymers and elastomers were foamed under supercritical conditions of CO₂ at different temperatures. Transmission electron microscope (TEM) images show the formation of nano-voided structures in the polymer matrix when samples are saturated under optimal conditions. Saturation at higher temperatures lead to larger voids (in the micrometer range). Samples treated at lower temperatures show not much change in the matrix structure.

CPP 11.38 Tue 17:00 P3

Viscoelasticity of pericellular matrix gels — ●HEIKE BOEHM, CHRISTIAN H.J. SCHMITZ, RALF P. RICHTER, JOACHIM P. SPATZ, and JENNIFER E. CURTIS — Max-Planck-Institute for Metals Research, Department New Materials & Biosystems, and University of Heidelberg, Department of Biophysical Chemistry, Heisenbergstr. 3, D-70569 Stuttgart

Many mammalian cells surround themselves with a pericellular matrix (PCM), a highly hydrated polymer network connected to the cell membrane. The mechanical properties of the PCM are essential for cell proliferation and migration. The most vital component of this polymer network is hyaluronan, a long, unbranched polysaccharide. The viscoelasticity of the PCM is dynamically adjusted by the cell through the addition of glycoproteins called hyaladherins which crosslink or bind to the hyaluronan creating a stiffer network. The effect of most hyaladherins on hyaluronan networks has not yet been measured because the proteins are only available in such small volumes that established rheological techniques cannot be used. To bypass this difficulty, we perform one and two-point microrheological measurements by following the Brownian motion of embedded passivated particles in 20 μ l volumes. This technique enables the characterization of the shear modulus of well-defined hyaluronan networks, and the quantification of the effect of various hyaladherins for the first time. The results can subsequently be compared with measurements of the PCM on a living cell.

CPP 11.39 Tue 17:00 P3

Polymer-Induced Transient Networks in Water-in-Oil Microemulsions Studied by Dynamic Light Scattering — ●THOMAS BLOCHOWICZ, CHRISTOPH GÖGELEIN, and BERND STÜHN — Institute of Solid State Physics, TU-Darmstadt, 64289 Darmstadt

We study water-in-oil microemulsions, i.e. dispersions of water droplets coated with a monolayer of surfactant in a continuous oil phase. Of particular interest for the present work is the system consisting of water, n-decane and the anionic surfactant AOT. On addition of the amphiphilic triblock copolymer PEO(polyethylenoxide)-PI(polyisoprene)-PEO a transient network is formed. The dynamics of concentration fluctuations consisting of the translational diffusion of the droplets and the relaxation of the network are monitored with photon correlation spectroscopy. We mainly focus on the variation of the dynamic behavior as a function of two different parameters, namely the number of polymer molecules per droplet Z and the droplet volume fraction ϕ , which can be taken as a measure for the inter droplet distance. With increasing polymer content the dynamics of the system slows down and three different relaxation processes may be distinguished. We discuss the origin of the different relaxation modes. In particular it turns out that the intermediate relaxation mode may be suppressed by index matching the oil matrix and the PI block and that the network formation sensitively depends on the interdroplet distance.

CPP 11.40 Tue 17:00 P3

Diffusion of Block-Copolymer Micelles Close to the Water-Oil Interface — ●ANTONIO STOCO¹, STERGIOS PISPAS² und REINHARD SIGEL¹ — ¹Max-Planck-Institut of Colloids and Interfaces, D-14476 Golm — ²National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, 11635 Athens, Greece

The interaction of block copolymer micelles in water with a brush composed of the same block copolymer at the water-oil interface is investigated. For a concentration above the critical micelle concentration, the block copolymers adsorbed to interfaces coexists with block copolymer micelles in solution. Close to the interface, a modification of the micelle diffusion compared to the bulk behavior is expected because of changed friction and possible exchange processes. We built up an apparatus for light scattering with evanescent wave illumination of a liquid-liquid interface. In this special geometry, only a thin layer at the interface is illuminated, allowing for dynamic light scattering measurements close to the interface. In addition, ellipsometry measurements within the same apparatus give access to the interface profile. First results on polyisoprene-block-polyethyleneoxide polymers at to the water-dodecane interface are discussed.

CPP 11.41 Tue 17:00 P3

Tailoring the structure of hybrid organic-inorganic tetra and polyfunctional alco-oxo-titanium clusters in polystyrene —

●SONDES TRABELSI^{1,2}, GIULIA FORNASIERI^{3,4}, LAURENCE ROZES³, ANDREAS JANKE¹, AXEL MENSCH⁵, CLÉMENT SANCHEZ³, and MANFRED STAMM¹ — ¹Leibniz Institut für Polymerforschung Dresden e.V., Hohe Strasse 6, 01069 Dresden, Germany — ²Forschungszentrum Karlsruhe GmbH, Institute für Synchrotronstrahlung, ANKA, Hermann-von-Helmholtz-Platz 1, 76344 Karlsruhe, Germany — ³Laboratoire de Chimie de la Matière Condensée, UMR CNRS 7574, — ⁴Laboratoire de Chimie Inorganique, Institut de Chimie Moléculaire et des Matériaux d'Orsay (ICMMO), Bat 420 Université Paris-Sud 11, 91405 Orsay Cedex, France — ⁵Technische Universität, Dresden, Institut für Werkstoffwissenschaft, Helmholtzstraße 7, 01062 Dresden, Germany

Two types of Ti16O16(OEt)32-x(OPhCH=CH2)x cluster have been synthesized with different numbers of styrenic functional groups (i.e. tetra (x = 4) and poly (x = 16)) introduced on the surface of the cluster s core. Investigations combining small angle X-ray scattering (SAXS), transmission electro microscopy (TEM) and energy-filtering transmission electron microscopy (EFTEM) lead to a better understanding about the influence of the functionality s number on the structure of the hybrid nanomaterials. Compared to the tetra functional clusters the poly functional clusters were good dispersed in the hybrid even at very high content between 5 wt% and 10 wt%. Independently of the number of functionalities, three structural levels. The size of the aggregates has been reduced significantly by increasing the number of styrenic reactive groups.

CPP 11.42 Tue 17:00 P3

Analytical centrifugation to describe rheological behaviours of concentrated suspensions — ●TORSTEN DETLOFF, TITUS SOBISCH, and DIETMAR LERCHE — L.U.M. GmbH, Rudower Chaussee 29, 12489 Berlin, Germany

The flow behaviour of concentrated suspensions is mostly characterized by viscometric approaches. The interpretation of the results, especially at low shear rates, is often difficult due to sedimentation and particle migration within the viscometric gap. But studying separation processes can give information about the viscosity behaviour of such suspensions, because of the close connection between sedimentation kinetics and rheology. In this paper analytical centrifugation were used to determine the viscosity functions of spherical rigid particles in the nanometer range depending on volume concentrations between 5 and 47%. The measurement device - a multisample analytical centrifuge - LUMiSizer® (L.U.M. GmbH, Berlin Germany) employs the STEPTM-Technology (Space and Time resolved Extinction Profiles), which allows to measure the intensity of transmitted light as function of time and position over the entire sample length simultaneously. From this data the values of the flux density function at different initial volume concentrations were determined and a viscosity law as functions of volume concentration obtained by fitting. The approach was applied to spherical biological cells and silica particles.

CPP 11.43 Tue 17:00 P3

Dendrimer-Based Nanoassemblies: Insights from Small Angle Scattering Experiments — ●RALF KLEPPINGER — DSM Research

Highly branched macromolecules have found widespread applications in the growing field of nanomaterials. From an application point of view, hyperbranched systems (with less defined architecture) appear to be rather attractive candidates for bulk applications that allow tailoring of rheological properties. Dendrimer systems with their highly defined three-dimensional architectures on the other hand appear to be promising candidates in the field of biomedical materials where they have been proposed as new type of drug delivery systems. In any case, the investigation of such systems and in particular their complexes, represents a significant challenge. In this contribution we summarize results from small angle X-ray and -neutron scattering investigations that were performed on dendrimers and dendrimer-based complexes.

CPP 11.44 Tue 17:00 P3

Rigid Amorphous Fraction of Polymer Nanocomposites and Semicrystalline Polymers — ●ALBERT SARGSYAN¹, SELVIN THOMAS², ANDREAS WURM¹, SABU THOMAS², and CHRISTOPH SCHICK¹ — ¹aUniversity Rostock, Dept. Physics, Universitätsplatz 3, 18051 Rostock, Germany — ²Mahatma Gandhi University, School of Chemical Sciences, Kottayam, India

Very often semicrystalline polymers cause significantly smaller relaxation strength at glass transition than expected from the non-crystalline fraction. This observation could be explained by the introduction of a rigid amorphous fraction (RAF) which does not contribute to the heat of fusion or X-ray crystallinity nor to the relaxation strength at glass transition. The RAF is non-crystalline and in a glassy state above the common glass transition temperature. From heat capacity the temperature and time dependence of the RAF can be obtained. For PC, PHB and sPP it is possible to study the creation and disappearance of the RAF in situ during isothermal crystallization and on stepwise melting. A RAF can be detected for polymer nano-composites too. The approximate amount of the RAF was calculated taking into account the difference in Δc_p step between pure and filled polystyrene nano-composites. The solvents added as plasticizers haven't entered into the RAF even above the glass transition temperature (T_g). This gives the opportunity to create highly solvent resistant polymer nano-composites based on common polymers like polystyrene.

CPP 11.45 Tue 17:00 P3

Thermoplastic SBS nanocomposites based on brush coated silica microgels — ●LESZEK JAKUCZEK^{1,2} and JOCHEN GUTMANN^{2,3} —

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Physical modification of block copolymers enables the preparation of new types of materials exhibiting significantly improved mechanical and rheological properties. Especially well-defined nanofillers, with properties tailored at molecular level, are believed to be effective reinforcing agents, capable of meeting the expectations in new areas of application. One route leading to such nanocomposites is synthesis and incorporation of surface modified nanoparticles, like e.g. ultrafine polymer-grafted silica beads synthesized in emulsion. After surface modification via a grafting from ATRP synthesis, the resulting core-shell composites can be used in selective reinforcement of a chosen phase. Linear styrene-*b*-butadiene-*b*-styrene thermoplastic elastomer was modified with polystyrene-grafted organosilicon micro-gel particles. The state of filler dispersion and degree of grafting, morphology of the resulting nanocomposites, as well as their mechanical, rheological and thermal properties are examined using SEM, SAXS, GPC, DSC and dynamic thermomechanical analysis in order to provide information on interactions between filler and the modified matrix.

CPP 11.46 Tue 17:00 P3

Modification of the thermal properties of epoxies by anorganic nanoparticles — ●JÖRG BALLER^{1,2}, ROLAND SANCTUARY^{1,2}, MARTINE PHILIPP^{1,2}, RAVI BACTAVATCHALOU¹, and J. K. KRÜGER¹ —

¹Laboratoire Européen de Recherche Universitaire : Saarland-Lorraine-Luxembourg — ²Université du Luxembourg, Laboratoire de Physique des Matériaux, 162 a, avenue de la Faiencerie, L-1511 Luxembourg

Curing and polymerisation behaviour of epoxies filled with nanoparticles were investigated using Modulated Differential Scanning Calorimetry. Depending of the type of incorporated nanoparticles, important properties like relaxation behaviour and glass transition are considerably

modified. Comparison with results from viscosimetry and Brillouin scattering yields insights into the interaction between matrix and nanoparticles.

CPP 11.47 Tue 17:00 P3

Rheological properties of Carbon-nanofibre Reinforced Poly(ether ether ketone) Composites under Shear and Elongational Flow — •D.S. BANGARU SAMPATH¹, HOLGER RUCKDAESCHEL¹, JAN K.W. SANDLER¹, VOLKER ALTSTAEDT¹, and MILO S.P. SHAFFER² — ¹Polymer Engineering, University of Bayreuth, Universitaetsstrasse 30, 95447 Bayreuth, Germany — ²Department of Chemistry, Imperial College, London, Sw7 2A2, UK

The rheological properties of vapor grown carbon nanofibre (VGCNF) reinforced poly(ether ether ketone) (PEEK) are studied both under oscillatory shear as well as in uniaxial extension at 360 °C. The composites containing upto 15 wt% of carbon nanofibres are melt-blended in a Brabender co-rotating twin-screw extruder. It was shown that both the elastic moduli and the viscosity change with amplitude of oscillation and with the CNF concentration, respectively. The dynamic moduli and the viscosity were found to be increasing with increasing the CNF content. The composite with high fibre loading exhibits enhanced shear thinning. Furthermore, the linear viscoelastic data shows a transition to a solid like response at low frequency which indicates the so-called *percolation threshold* appearing between 10 and 15 wt% of CNF. Interestingly, the melt elongational measurements show significant increase in melt strength, whereas the elongation at break remains unchanged upto 10 wt% CNF. We have shown that the addition of CNF can be significantly improve the foaming behaviour through its effect on the melt strength as well as extensibility.

CPP 11.48 Tue 17:00 P3

Non-linear rheological properties of fibrillar networks by self-organization — •MARTIN KÜHNE and CHRISTIAN FRIEDRICH — Freiburg Materials Research Centre (FMF) & Institute of Macromolecular Chemistry Albert-Ludwigs-University, Stefan-Meier-Str. 21, 79104 Freiburg, Germany

Dibenzylidene sorbitol (DBS) is known to gel in organic liquids and polymers by the formation of long fibres due to the self-organization of DBS molecules. We studied this process in detail for DBS organization in poly(propylene oxides) of different molecular weight. We report on the morphological as well as the linear and non-linear viscoelastic properties of these materials in the gel state. While the linear viscoelastic properties can be understood quantitatively on the basis of the "soft glassy materials" model, the non-linear properties are mainly determined by the damage of the fibre network.