CPP 37: Poster: Rheology (joint focus with DRG)

Time: Thursday 18:45–19:45 Location: Poster A

CPP 37.1 Thu 18:45 Poster A

Active fluids in Taylor Couette Systems — •Matthias Mussler, Albrecht Ott, and Christian Wagner — Universität des Saarlandes, Saarbrücken

The behavior of active fluids is poorly understood. Here we study experimentally the hydrodynamic behavior of active polar gels using the methods of rheology and particle tracking (PT) in a Taylor-Couette Geometry. Taylor-Couette hydrodynamics are well-understood for passive fluids, such as polymer solutions. Active fluids are expected to show deviations from passive behavior. Micro-swimmer suspensions of Chlamydomonas Reinhardtii are suitable model systems for studying active fluids. The presence of active swimmers increased the viscosity and is not yet understood. Experiments using the methods of Rheology and Optical Tweezers are performed to study these systems.

CPP 37.2 Thu 18:45 Poster A

The reversibility of modifications created by processing linear and long chain branched polypropylene melts — •Bernadette Duscher[1,2], Alois Schausberger[2], and Wolfgang Stadlbauer[1] — [1]Transfercenter für Kunststofftechnik GmbH, Franz-Fritsch Str. 11, A-4600 Wels — [2]Johannes Kepler University, Altenberger Str. 69, A-4040 Linz

The rheological properties of long chain branched polypropylene (LCB-PP) and of its blends with linear PP (L-PP) are strongly affected by processing time, temperature, machining method and even screw configuration. The resultant modification and its reversibility are investigated by means of rheological experiments in shear and elongation. In addition, the flow activation energies (E_a) of process-modified samples are determined in order to describe the entanglement state.

Three different processing methods (measuring mixer, twin-screw extruder with varying screw set-ups) and varying processing parameters have been used. The reduction of dynamic moduli and E_a depends on the operational demands the polymer blend has passed. By dissolving process-modified samples, an equilibrium state is created and the activation energies as well as the rheological properties of the blends are determined. The dynamic moduli do not recover totally but superimpose in a limit function. However, after dissolving E_a of the samples equal those of neat, dissolved and untreated samples. By determining strain hardening behavior, it is shown that the smaller the strain rates are, the higher the difference between the process-modified samples and its dissolved equivalents is.

CPP 37.3 Thu 18:45 Poster A

Complex rheological behavior of epoxy resin based nanocomposites — •Matthieu Thomassey, Jörg Baller, Jan-Kristian Krüger, and Roland Sanctuary — Laboratory of Physics of Condensed Matter and Advanced Materials, University of Luxembourg, 162A, Avenue de la Faïencerie, L-1511 Luxembourg

Rheology is a well-suited tool to reveal flow-induced structural changes in complex soft matter systems. The knowledge of these structural changes is essential to ensure an efficient processing of numerous composites materials. Furthermore it is highly interesting with regards to the fundamental understanding of the mechanisms underlying the structural formation. This contribution presents a detailed rheological study of an oligomer epoxy resin (diglycidylether of bisphenol A) filled either with hydrophilic alumina or hydrophobic silica nanoparticles. For both systems steady-shear viscosity measurements reveal shear-thinning and subsequently shear-thickening behavior when the shear rate increases. Despite similar flow behaviors of both nanocomposites their transient responses at given shear rates are different. Results are discussed in terms of geometry of nanoparticles, particle-particle interactions and interactions between nanoparticles and matrix molecules.

CPP 37.4 Thu 18:45 Poster A

Gap dependence of the trim distance in parallel plate rheometry — •Roman Sebastian Rittberger[1,2] and Gerhard Eder[2] — [1]Transfercenter für Kunststofftechnik GmbH, Wels, Österreich — [2]Institute of Polymer Science, Johannes Kepler Universität, Linz, Österreich

Calculations in parallel plate rheometry rely on cylindrical sample shapes. However, trimming excessive material after sample loading often leads to a slightly dinted rim. Consequently the gap is lowered additionally by the trim distance δ to achieve cylindrical sample geometry. Thus gap dependence of the trim distance δ for a given measurement geometry and material has to be known a priori.

For this investigation polymer samples were melted in the rheometer and the gap was set to trim position H_T. After thermal equilibration excessive melt was removed with an applicator and the samples were quenched to solidify for following weighing. The trim distance is modeled by approximating the rim geometry as parabola and assuming the depth of dint $\Delta r = \Delta r^* H_T$. The model also accounts for potential gap errors. Doing regression analysis on a series of trim positions gives the material specific constant Δr^* and the gap error of the measuring system.

The dependence of the trim distance δ on the trim position H_T was found to be quadratic (higher terms can be neglected). Plotting δ/H_T versus H_T/R leads to a unified representation, which can be deployed for plates with arbitrary radii. The only parameter left is the constant Δr^*, solely depending on the materials properties.

CPP 37.5 Thu 18:45 Poster A

Following UV Induced Chemical Reactions with Rheometry and Simultaneous FTIR-Spectroscopy — •Jan Philip Plog[1], Veit Zschuppe[1], and Manfred Feustel[2] — [1]ThermoFisher Scientific, Dieselstraße 4, 76227 Karlsruhe, Germany — [2]Resultec, Gartenstraße 23, 89171 Illerkirchberg, Germany

In this article a new and unique combination of a rheometer and an FTIR-spectrometer is presented. The so-called Rheonaut module allows the coupling of the Thermo Scientific HAAKE MARS rheometer platform with an FTIR-spectrometer. With this set-up, samples can be characterized rheologically using cone/plate- or plate/plate-geometries while IR-spectra are being recorded simultaneously. To test this new concept, UV induced polymerization and cross-linking reactions have been followed with the combination of HAAKE MARS and the Rheonaut module. Depending on the chemical nature of the components involved, the disappearance of the starting materials reactive group and/or the appearance of chemical groups, which are characteristic for the product can be seen and correlated with the development of the mechanical properties. Details of this unique instrument set-up as well as selected results will be presented.

CPP 37.6 Thu 18:45 Poster A

Decay of elastic turbulence in a von Karman swirling flow — •Christof Schäfer[1], Teodor Burghelea[2], and Christian Wagner[1] — [1]Experimental Physics, Saarland University, 66123 Saarbrücken, Germany — [2]Laboratoire de Thermocinétique, University of Nantes, Nantes 44306, France

We present results of the experimental study of the decay of elastic turbulence in a von Karman swirling flow. We characterize various decay regimes by combined measurements of the integral power injected into the system and local measurements of the velocity gradients as a function of the initial Weissenberg number. Following relevant literature [1] a detailed description of the time evolution of the decaying flow structures is given. The characteristic decay time scales of the locally measured velocity gradients in both the bulk and in the elastic boundary layer of the flow is compared to the characteristic decay times of the integral power, the Eulerian correlation time of velocity fields and the largest relaxation time of the polymer solution. Based on these results, the possibility of exciting nonlinearly unstable states from an initially linearly stable base state is discussed.

[1] T. Burghelea, E. Segre, and V. Steinberg, "Elastic turbulence in a von Karman swirling flow between disks", Phys. Fluids 19, 053104 (2007)

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dynamics of thermosensitive core-shell dumbbell-shaped microgels — •Fangfang Chu, Miriam Siebenbürger, Nils Heptner, Joachim Dzubiella, Yan Lu, and Matthias Ballauff — Soft Matter and Functional Materials, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, 14109 Berlin, Germany

We present a study of the dynamics of dumbbell-shaped microgels. The thermosensitive dumbbell-shaped microgel latices consist of a dumbbell-shaped polystyrene-core and a themosensitive shell of cross-linked poly(N-isopropylacrylamide). These colloidal particles could be

synthesized with an uniform size and morphology. The aspect ratio L*, which is defined as the ratio of the center to center distance L and the diameter D, was L*~0.24. Oscillatory experiments in the linear viscoelastic regime and flow curves in the steady sheared state were performed to investigate the phase diagram and the dynamics of concentrated dumbbell suspensions at various volume fractions and aspect ratios. The formation of a plastic crystal phase for higher volume fractions was found which was predicted by simulations [1,2,3]. For the higher volume fractions a glassy like behavior is found.

References 1. C. Vega, P. A. Monson, J. Chem . Phys. 1992, 97, 8543 2. C. Vega, P. A. Monson, J. Chem . Phys. 1997, 107, 2696 3.J. J. Crassous, M. Siebenburger, M. Ballauff, M. Drechsler, D. Hajnal, O. Henrich, M. Fuchs, J. Chem . Phys. 2008, 128, 9606

CPP 37.8 Thu 18:45 Poster A

Unsteady low Reynolds pipe number flows of a Carbopol solution: why the simplest flow problems still remain elusive? — Antoine Poumaere[1], Miguel Moyers-Gonzales[2], •Cathy Castelain[1], and Teodor Burghelea[1] — [1]Universite de Nantes, CNRS, Laboratoire de Thermocinetique de Nantes, UMR 6607, La Chantrerie, Rue Christian Pauc, B.P. 50609, F-44306 Nantes Cedex 3, France — [2]Department of Mathematics and Statistics, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand

Carbopol solutions are often referred to as non-thixotropic "model yield stress fluids". It has been only recently shown that this picture does not suffice to tackle simple flow problems, particularly close to yield point (Putz et al., Phys. Fluids 20(3), 2008). The present study focuses on a equally simple flow configuration: a low Reynolds number unsteady pipe flow. Measurements of the unsteady velocity fields allow time-dependent measurements of the mean flow velocity, width of the viscoplastic plug, slip velocity and wall velocity gradients. The dependence of each of these quantities on the applied pressure drop reveals three distinct regimes: a solid regime corresponding to pressure drops significantly below the yield limit, a solid-fluid flow regime corresponding to intermediate flow regimes and a fluid regime far beyond the yield limit. Upon a decrease of the applied forcing a clear hysteresis in the dependence of each of the measured quantities on the applied pressure drop is observed. This finding comes into a perfect agreement with the yielding scenario recently proposed by Putz et al. (Rheologica Acta 48(6), 2009).

CPP 37.9 Thu 18:45 Poster A

Mechanical Properties and Structure in Precipitated Colloidal Silica — •Miao Wang[1,2], Marcel Roth[1], H. Henning Winter[2], and Günter K. Auernhammer[1] — [1]Max Planck Institute for Polymer Research, Mainz, Germany — [2]University of Massachusetts, Amherst, MA, USA

The mechanical properties of colloidal systems strongly depend on structure and interaction potential. Inorganic precipitated silica-gels of various compositions, as widely used as filler in paints, cosmetics and polymers, show this phenomenon. To analyze the correlation between 3D-structure and mechanics we use combined measurements by confocal reflection microscopy, piezo-rheometry, and Couette rheometry. Samples get prepared in a low-viscosity sol state and then transfered into the measurement cell before gelation sets in. In-situ confocal reflection microscopy visualizes the formation of gel. Simultaneously, this process is studied with a piezo-rheometer, which allows dynamic mechanical measurements on samples of less than 100 micrometer thickness. The applied shear strain lies typically below 0.001 (absolute displacement smaller than 100 nm). Classical rheometer measurements with a Couette cell extend the data to lower frequencies. Depending on composition, we find a relaxation process (frequency dependent shear modulus) at low frequencies. This frequency dependence suggests the structural relaxation of the network structure at long times. Structure and properties depend on water content in the sample. An increased water fraction in the gel results in a finer and more connected network with longer relaxation time but lower plateau modulus.

CPP 37.10 Thu 18:45 Poster A

Structure Formation in Processed Cheese and Rheological Evaluation of Some Influencing Factors — •Yamen Edelby and Bernhard Senge — Institut for Food Technology, Department of Food Rheology, TU Berlin

The objective of the present paper is to elucidate the effect of melting salt content, rotational speed, fat and water content on the structuring process of processed cheese. The structure formation was detected by using oscillation measurements by Rheometer MCR301. For temperature sweeps: Deformation = 10^{-3}, f = 1 Hz, cool-running 85-10 °C with a cooling rate of 1 K /min. The processed cheese was manufactured at laboratory scale by a knife mill, a water bath and an agitator with a paddle stirrer. By means of a basic concept (66,0 g Gouda, 28,0 g curd cheese, 6,0 g butter, 2,8 g JOHA S 9 (as melting salt), 13,6 g water), a processing sequence for the manufacturing of processed cheese was performed. The melting salt content of processed cheese was changed at 300 rpm. The rotational speed of the agitator was increased. Then, the fat and water content were examined and evaluated. Throughout the processing and for all the measurements, the storage modulus (G') was > the loss modulus (G"), which indicates the solid state properties with dominant elastic properties. The loss factor curves (tan δ curves) show a relative minimum at about 70 °C as peak 1, an absolute maximum at about 45 °C as peak 2 and a relative maximum at 10-15 °C as peak 3. The best result of the optimization steps that will be made are: Melting salt content: 3.0 g, Rotational speed: 900 rpm, Fat content: 50%, Water content: 50%