CPP 11: DRG-DPG SYMPOSIUM Rheology III

Time: Tuesday 10:00–12:15 Location: C 264

CPP 11.1 Tue 10:00 C 264

Blood-Rheology on single drops before, during and after coagulation — •Wolfgang Pechhold, Theresia Gross, and Hubert Dammann — Institute for dynamic Materials Testing (IdM) at the University Ulm

Blood is a complex fluid in many respects. It contains about 45 p.c. of hematocrit (RBC, WBC and platelets) in low viscous plasma (1,8 mPa s), with dissolved proteins and clotting factors, including fibrinogen (2%). We report on its viscoelastic characterization ($\eta = \eta$'-iη") in the frequency range 1 Hz to 3 kHz using the dynamic squeeze flow of the Piezo Axial Vibrator (PAV) which needs only a droplet (10-50μl) of blood or plasma: in the anticoagulated state we varied the hematocrit from 0 to 92 p.c. and found an exponential increase of viscosity above 40 p.c. In full blood we measured η in the course of time before and during coagulation and found a strong gap dependence in the clotted state in both, intrinsic and extrinsic, clotting. Adding Heparin to the blood droplet, the clotting time becomes prolonged and exceeds 100 min for 1800 I.E. per 5 l. In platelet-free plasma no intrinsic coagulation takes place, and in high platelet-concentration (1,2 E6/mm3) we did not find any change in clotting time up to 3600 I.E. per 5 l Heparin added. For the used blood in all measurements of the coagulated state, i.e. after fibrin forming, the viscous part clearly dominated at all frequencies.

CPP 11.2 Tue 10:15 C 264

Combination of NMR relaxometry and mechanical testing during vulcanisation — Stefan Kahle[1,2], Manfred Hehn[2], Hans-Peter Raich[2], Walter Nussbaum[1], Peter Blümler[3], and •Manfred Wilhelm[2,4] — [1]www.scarabaeus-gmbh.de — [2]www.mpip-mainz.mpg.de — [3]www.econmr.org/bluemler — [4]www.polymer.uni-karlsruhe.de

A new design for an in-situ combination of NMR and rheological measurements is presented. The NMR is based on a BRUKER MINISPEC spectrometer. The magnet is self-made via a construction of 64 permanent magnets in a so called MANDHALA arrangement. The magnetic field strength reaches about 0.23 T, corresponding to a 1H resonance frequency of about 9.5 MHz. For the in-situ rheological measurements a Scarabaeus SISV50 instrument with modified sample cells is utilized. This unique combination and first measurements are presented.

CPP 11.3 Tue 10:30 C 264

Rheo-NMR Studies of Liquid Crystals in Shear Flow — Gönül Ar, Shahram Shafaei, and •Claudia Schmidt — Department Chemie, Universität Paderborn, Warburger Str. 100, 33098 Paderborn, Germany

Nuclear magnetic resonance spectroscopy has proven a useful tool for the investigation of shear-induced phenomena in liquid crystals [1,2]. Due to the anisotropy of the interactions of nuclear spins, information about shear-induced orientations can be obtained. In deuterium NMR, the quadrupolar interaction is used to probe the orientation of the liquid crystalline director. In situ observations of director orientations under shear can reveal the microscopic origin of macroscopic rheological phenomena. Recent examples for deuterium NMR investigations of shear phenomena in different types of liquid crystals, such as nematic, lamellar and hexagonal phases will be presented.

[1] P. T. Callaghan, Rep. Prog. Phys., 62, 599 (1999).

[2] C. Schmidt, in: Modern Magnetic Resonance, Vol. 3, Springer, New York, 2006.

CPP 11.4 Tue 10:45 C 264

Flow at the interface of immiscible fluids — Ute Böhme, Frank Bagusat, and •Ulrich Scheler — Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, D-01069 Dresden

Flow in a modified Couette cell with a region of high shear has been investigated at the interface of oil and water. Flow NMR, which is a combination of PFG NMR for the measurement of displacements with NMR imaging has been applied to measure the flow with spatial resolution. NMR contrast has been generated from longitudinal relaxation which enable the measurement of both the spatial distribution and the flow field of each of the components separately. Upon shear in the Couette cell the interface between water and oil becomes bent. Flow measurements reveal, that this bending results from strong axial velocity in the region of high shear. While in homogeneous systems stable eddies in plane are found at the region of high shear, at the interface region between oil and water an eddy out of plane is found as well. The eddies depend on shear reate and viscosity. The out-of-plane eddy is attributed to the difference in viscosity between the two components.

break

CPP 11.5 Tue 11:15 C 264

Bridging the gap between microrheology and tribology — •Christian Clasen[1], Pirouz Kavehpour[2], and Gareth H. McKinley[3] — [1]Department of Chemical Engineering, Katholieke Universiteit Leuven (KUL), 3001 Leuven, Belgium — [2]Mechanical and Aerospace Engineering Department, University of California Los Angeles (UCLA), Los Angeles, CA90095, USA — [3]Department of Mechanical Engineering, Massachusetts Institute of Technology (MIT), Cambridge, MA 02139, USA

Tribology and elastohydrodynamic lubrication have traditionally been considered to be a subject apart from classical bulk rheology and the rapidly developing area of microrheological investigation. The principal reason for this separation is that although fluid properties in each field are key to the observed flow and friction phenomena, the experimental approach and the resulting terminology differ substantially and prohibit a direct translation of the results. In particular the lack of well-defined viscometric kinematics for tribological experiments and the difficulties in achieving sufficiently-precise fixture alignment in regular rheometry on the microscale have inhibited the merging of the results from these fields.

We show in this paper how recent developments in the area of sliding plate microrheometers with controlled gaps on the order of micro- to nanometers, and triborheometers with defined plate-and-plate geometry parameters and normal stress control can bridge this gap between classical tribology and rheology.

CPP 11.6 Tue 11:30 C 264

Polymer Solutions under Circular Couette Flow — •Andreas Zell and Christian Wagner — Technische Physik, Universität des Saarlandes, D-66123 Saarbrücken

We investigate the behaviour of dilute polymer solutions in a Taylor-Couette cell with independently rotatable cylinders. The focus of our interest lies on the examination of the elongation of the solved polymers and their response on the imposed flow. Our measurements show that we are able to detect these counteracting forces and that we can relate them to the polymer relaxation time of the respective solution. In addition we give a summary of a mathematical discussion of possible laminar flow states in a Taylor-Couette system, where the final argumentation is pointing to the usefulness of one of these flow states to our investigations.

CPP 11.7 Tue 11:45 C 264

Diffusion of Linear Macromolecules and Spherical Nanoparticles in Semidilute Polymer Solutions and Gels — •Sebastian Seiffert and Wilhelm Oppermann — Institute of Physical Chemistry, Clausthal University of Technology, Arnold-Sommerfeld-Strasse 4, D-38678 Clausthal-Zellerfeld, Germany

The dynamics of fluorescently labeled linear macromolecules and spherical particles that are enclosed in polymer matrixes were studied by fluorescence recovery after photobleaching. The experiments were designed such that the transition from a semidilute solution to a permanent network could be covered. This was achieved by employing a matrix polymer, polyacrylamide, carrying pendent dimethylmaleimide groups. Stepwise irradiation of such samples causes dimerization of the moieties via photochemical [2+2]-addition leading to progressive crosslinking. Thus, studies on the diffusion of linear and spherical tracers are enabled especially within the interesting transition region between a physically entangled system and a covalently crosslinked matrix. Comparability of the results is ensured since the same sample is analyzed merely at different degrees of crosslinking, respectively. The parameters varied were the concentration of matrix polymer and the molar mass of the enclosed linear chains as well as the size of the spheres. The aim of this study is to point out differences between

the dynamics of linear tracers in contrast to spherical particles and to work out the behavior of the system when a semidilute polymer solution is chemically crosslinked. A central problem in this context is the adaptability of the reptation model in fairly dilute systems.

CPP 11.8 Tue 12:00 C 264

Near-surface dynamics explored by grazing incidence neutron techniques — •Marco Walz[1], Max Wolff[2], Nicole Voss[1], Hartmut Zabel[2], and Andreas Magerl[1] — [1]Chair for Crystallography and Structural Physics, University of Erlangen-Nürnberg, Staudtstr. 3, 91058 Erlangen — [2]Chair for Condensed Matter Physics, Ruhr-University Bochum, Universitätsstr. 150, 44780 Bochum

An understanding of boundary slip requires a knowledge of the structural and dynamical properties of interface regions on short length scales, and experimental methods with pronounced interfacial response are needed. To highlight the properties of the boundary layer we carried out for the first time a neutron spin-echo experiment under condition of grazing incidence (GINSE). With an aqueous solution of a tri-block copolymer with micellar orderings we could verify that the investigation of the dynamics of the sample is well feasible with GINSE, and we present first data taken near the critical angle of total reflection. It appears that the diffusive motion at the hydrophilic (attractive) interface is reduced as compared to a hydrophobic (repulsive) interface.

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