CPP 14: Poster: Polymer Networks and Elastomers, Hydrogels, Soft Robotics

Time: Monday 18:15–21:00 Location: Poster B2

CPP 14.1 Mon 18:15 Poster B2

Theoretical and experimental investigations of sealing systems — •Felix Senf and Othmar Marti — Institut für Experimentelle Physik, Ulm, Deutschland

In technical applications the sealing of hardware components is described with leakage rates based on different boundaries of the system. In general the physical rules state an absolutely sealed system is not possible. Different parameters like materials, surface structures, roughness parameters, closing forces and finally the design of the sealing system influence the function of the sealing joint. Engineer standards to describe the surface influence of sealing is only with roughness parameters of the hardware surface. They do not consider that roughness parameters are only statistical parameters with limited information to the real sealing behavior of the joint. Out of this the real systems can show high tolerances in sealing limits.

The research program is about understanding the alignment between elastomers and metal surface structures and the resulting open volumes. The theory of contact problems, FEA simulation tasks and compression experiments will help us to describe this alignment. An experimental set up for leakage measurements and the combination with CFD simulation are the main part to understand the leakage nature more detailed. Out of this toolbox we want to create a new practical understanding how sealing works.

CPP 14.2 Mon 18:15 Poster B2

Rheo-Raman: Chemo-mechanical monitoring of the cross-linking process in epoxy resins — •Moritz Strobel[1], Sabine Hild[1], Milan Kracalik[1], Carola Eyssell[2], and Bernhard Strauss[2] — [1]Johannes Kepler Universität Linz, Institute of polymer science, Altenbergerstraße 69, 4040 Linz, Austria — [2]voestalpine Stahl GmbH, voestalpine Straße 3, 4020 Linz, Austria

Mechanical properties of pure epoxy resins depend on the cross-linking density. Additives are used to tailor the properties of resins. To investigate their influence, two methods are used: A) Mechanical: Rheological data give information regarding the storage and loss modulus, viscosity, gel point etc. B) Chemical: Raman-microscopy is an excellent tool for the observation of cross-linking of epoxy resins, as it displays the splitting of the epoxy bonds at 1257 cm-1. The combination of both methods provides extensive insight in the curing process of different resin systems. By the in situ measurements of Raman and rheological data one can investigate the influence of the degree of cross-linking on the viscosity, storage and loss modulus. The simultaneous investigation of rheological and spectroscopic data enables a closer look at the processes and the responses of the system during the curing of resins. The Rheo-Raman-System consists of a Thermo Fischer DXR Raman Microscope and an Anton Paar MCR 502 Rheometer, linked by an optical adapter. The aim of the project is to investigate the cross-linking of epoxy resins with different additives like accelerators, flexibilizers or diluents, at different curing temperatures by in situ Rheo-Raman-measurements.

CPP 14.3 Mon 18:15 Poster B2

Replacement of organic solvents by using a soil-release polymer network — •Florian Szillat[1], Nacera Infed[1], Stephan Dietzel[2], Hans-Günter Hloch[1], and Jürgen Bohnen[1] — [1]wfk - Cleaning Technology Institute, D-47807 Krefeld, Deutschland — [2]Fogra - Forschungsgesellschaft Druck, D-81673 München

Printing machine housings are contaminated during sheet as well as web offset printing by deposition of aerosols (e.g. inkjet colour, moistening agents). These deposits induce printing errors due to carryover of inkjet colours on to be printed areas. We investigate sacrificial polymer network coatings that allow easy removal of adhesive inkjet colour after soaking with water. Further, this approach has the advantage of replacing organic solvents. To obtain a better understanding of their coating behaviour as well as their functionality during cleaning process surface tension, rheology as well as porosity are studied. Moreover, the polymer network's barrier effect is investigated via diffusion by means of finite difference method and scanning electron microscopy (EDX). The influence of polyetheramine composition with different molecular weight on the networks properties will be discussed and results of the practical use of such soil-release polymer networks will be shown.

CPP 14.4 Mon 18:15 Poster B2

Mechanical characterization of microcapsules and their rupture under compression — •Inga Melnyk[1], Ali Ghaemi[2], Alexandra Philipp[3], Andreas Bauer[4], Klaus Last[5], Stephan Gekle[2], and Andreas Fery[1] — [1]Institute Of Physical Chemsitry and Polymerphysics, Hohestr.6, 01069 Dresden, Germany — [2]Bio uid Simulation and Modeling, University of Bayreuth, Universitätsstr. 30, 95440 Bayreuth, Germany — [3]Physical Chemistry I, Universitätstr. 30, University of Bayreuth, Germany — [4]Henkel AG & Co. KG, Krefeld, Hentrichstr. 17-25, 47809 Krefeld — [5]Follmann GmbH & Co. KG, Heinrich Follmann-Str. 1, 32423 Minden

We present the characterization of the micromechanical properties of melamine microcapsules (MCs) on the single particle level by colloidal probe atomic force spectroscopy (CP-AFM).[1] The CP-AFM allowed for the precise measurement of the mechanical response of single capsules upon lateral linear elastic deformation in the small deformation regime (deformation << wall thickness). The obtained force-deformation curves were evaluated using contact mechanics model in combination with structural information by electron microscopy.[2] To study the rupture upon compression of MCs, higher forces were applied resulting in plastic deformation and ultimately in failure of the wall material. [3] We discuss the mechanical stability of the capsule material in the context the material requirements in various microcapsule applications. [1]*M. Pretzl et al. ACS Appl. Mater. Interfaces. 2012, 4, 2940*2948. [2]*M.P. Neubauer et al. Adv. Coll. Interface Sci. 2014, 207, 65*80. [3]*A.Ghaemi et al. Chem.Eng.Sci. 2015

CPP 14.5 Mon 18:15 Poster B2

Simulation of partially reversible networks under deformation or swelling — •Toni Müller[1,2], Jens-Uwe Sommer[1,2], and Michael Lang[1] — [1]Leibniz Institut für Polymerforschung Dresden, Hohe Straße 6, 01069 Dresden, Germany — [2]Institute of Theoretical Physics, Technische Universität Dresden, Zellescher Weg 17, 01062 Dresden, Germany

Self-healing and partially reversible networks are interesting elastic materials that self-repair damage [1] and can be used to optimize energy dissipation [2]. Using the bond fluctuation model, we study networks made of varying fractions of reversible and irreversible bonds and investigate the molecular mechanism of bond breaking and rearrangement under uni-axial extension or swelling. One goal is to better understand the influences of the fracture energy and sticker density to optimize the properties of such materials.

[1] Long et al, Macromolecules 47, 7243 (2014).
[2] Sun et al. Nature 489, 133 (2012).

CPP 14.6 Mon 18:15 Poster B2

Microstructure analysis of PET via Raman spectroscopy and x-ray diffraction — •Birgit Neitzel, Florian Aschermayer, Milan Kracalik, and Sabine Hild — Johannes Kepler Universität Linz, Altenberger Str. 69, 4040 Linz Austria

Polyethylene terephthalate (PET) is a polymer applied in a broad field of applications requiring specific mechanical properties. For the tailoring of PET properties, its microstructure has to be controlled and characteristic parameters such as crystallinity and orientation of the polymer chains have to be investigated. In general, X-ray scattering is used, which has the disadvantage of recalculation data from an inverse room. In contrast, polarized Raman spectroscopy allows direct investigation of polymer micro-structure since for semi-crystalline polymers such as PET peaks can be assigned, which are only sensitive for chemical structure an do not change with polarization direction of incident light. Beside, also peaks can be found which change their intensity with polarization of the laser. These peaks can be used to determine the degree of crystallization (705 cm-1 and 998cm-1), as well as orientation of polymer chains (705 cm-1 and 1616 cm-1) Raman imaging allow the determine local crystallinity- and orientation distributions on different positions on the sample. The aim of this study is to find a correlation of micro-structure and mechanical properties using X-ray as well as Raman microscopy. Therefore the micro structure of an amorphous and an isotropic crystallized PET, as well as PET stretched to different strain rates will be investigated.

CPP 14.7 Mon 18:15 Poster B2

Synthesis and characterization of expandable hydrogels for flexible electronics — •Robert Gerstmayr, Melanie Baumgartner, Siegfried Bauer, and Sabine Hild — Johannes Kepler Universität Linz, Altenberger Straße 69, 4040 Linz, Österreich

Hydrogels are aqueous microgels and have found their way in a considerable number of applications but often with the disadvantage of their poor mechanical properties. To apply such polymers for flexible electronics they should be transparent, easy to manufacture and expandable, beyond that they should be able to interact with the encapsulated electronics. Double crosslinked microgels (DX microgels) are shown to achieve these properties. hydrogels formed by linking together polymer networks show a unique structure-property relationship. The preparation of hydrogels made of purely biological and nontoxic precursors, is based on commonly used and cheap biopolymers like gelatine or chitosan. These hydrogels are reinforced by acrylate precursors. The produced materials are focused on acrylate polymers, because they are excellent for crosslinking via photopolymerization. Further, gels forming ionically and covalently crosslinked networks to improve stretchability, are produced. The structure and mechanical properties in the nanometre range are investigated by atomic force microscopy (AFM). Raman spectroscopy is complementary used to characterize the chemical structure and their changes in contact with water, salt solution or the encapsulated electronic. Information about wetting properties and adhesion are obtained by contact angle measurement.