CPP 2: Polymer Networks and Elastomers

Time: Monday 9:30–10:30 Location: H39

CPP 2.1 Mon 9:30 H39

The non-ideal preparation state of polymer (model) networks — •Michael Lang[1] and Toni Müller[1,2] — [1]Institut Theorie der Polymere, Leibniz Institut für Polymerforschung Dresden, Hohe Straße 6, 01069 Dresden, Germany — [2]Institut für Theoretische Physik, Technische Universität Dresden, Zellescher Weg 17, 01069 Dresden, Germany

We demonstrate that the phantom modulus can be split into two major contributions: the cycle rank of the active network structure and a correction resulting predominantly from non-ideal chain conformations at the instance of cross-linking. The correction contains several contributions related to loop formation, an effective repulsion between network junctions, and an excess strain of chains that develops towards the end of the reactions, if reaction partners become sparse. This challenges the text-book assumption that network strands are incorporated into the network with the same conformations as a free chain inside the reaction container. Our results are relevant for developing a better understanding of rubber elasticity and its dependence on the network formation process.

CPP 2.2 Mon 9:45 H39

Nonlinear elasticity under constraints and predeformations: a group theoretical approach — •Segun Goh[1,2], Hartmut Löwen[2], and Andreas M. Menzel[3] — [1]Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Heinrich-Heine Universität Düsseldorf, 40225 Düsseldorf, Germany — [3]Otto-von-Guericke-Universität Magdeburg, 39106 Magdeburg, Germany

The mechanical response of elastic materials frequently involves predeformations. Moreover, if an active or driven material is exposed to an external condition, a mismatch between the activity/driving and external condition may lead to a hidden predeformation in the system in its mechanical equilibrium state. Then the assumption of linear response breaks down, making descriptions of nonlinear elasticity compulsory even if the applied deformation is infinitesimally small. In this talk, we discuss how to develop a theoretical framework to meet this challenge and thereby, to address elasticity consistently for both small and large deformations. Specifically, employing concepts from group theory and Lie algebra, we suggest an idea to construct finite deformation gradients from infinitesimal group generators. Generalized nonlinear shear deformations and elastic moduli are defined subsequently. Possible applications will also be discussed.

CPP 2.3 Mon 10:00 H39

Surface structure and rheology of amphiphilic co-polymer networks on different length scales — •Kevin Hagmann[1], Nora Fribiczer[2], Sebastian Seiffert[2], Carolin Bunk[3], Frank Böhme[3], and Regine von Klitzing[1] — [1]Institute for Condensed Matter Physics, Technische Universität Darmstadt, D-64289 Darmstadt — [2]Department of Chemistry, Johannes Gutenberg University Mainz, D-55128 Mainz — [3]Leibniz-Institut für Polymerforschung Dresden e.V., D-01069 Dresden

This study focuses on the relation between structure, swelling abilities and mechanical/rheological properties of films of amphiphilic copolymer networks (ACNs). First, the correlation between different synthesis strategies for gel films and their resulting properties will be described. Secondly, the effect of solvents of different polarity on the swelling ability will be presented on different length scales. For this purpose, topology and near surface structure are studied with atomic force microscopy (AFM) and grazing incidence small angle x-ray scattering (GISAXS), respectively. We also put special emphasis on the determination of mechanical and rheological properties laterally and orthogonally to the gel surface by carrying out dynamic AFM indentation experiments. In order to evaluate heterogeneities the mechanical and rheological behaviour at the interface of the ACNs will be presented on various length scales (nm - μm). The study shows that the synthesis strategy has a strong effect on the gel structure and on nano/microrheological properties. The structure and rheology of gel films will be compared with results obtained of the respective bulk gel.

CPP 2.4 Mon 10:15 H39

Correlations of infrared spectroscopy and DSC measurements to determine the yield of scission under irradiation in biopolyesters — •David Krieg, Mirko Rennert, and Michael Nase — Institut für Biopoylmerforschung der Hochschule für Angewandte Wissenschaften Hof

Under the influence of ionizing irradiation, biopolyesters can either undergo crosslinking or scissioning. It was shown that the yield of corsslinking for polyesters such as polybutylenadipat-terephthalat (PBAT) can be correlated to changes in peaks in the IR spectrum and the onset time of the melting peak while heating during DSC measurements using the Avrami equation [Kijchavengkul 2008]. For biopolyesters such as polyhydroxybutyrate (PHB) and polylactic acid (PLA) sicsioning is the dominant process under irradiation. This talk will go into detail, whether similar correlations as seen in crosslinking PBAT can be found in PLA and PH3B, when scission is the dominate reaction and what structural changes in the polymer make this correlation possible.