CPP 65: (Hydro)gels and Elastomers

Time: Thursday 9:30–10:30 Location: PC 203

CPP 65.1 Thu 9:30 PC 203

Application of a micro-structure based model to filler reinforced elastomer compounds typically used for rubber rollers — •Jan Plagge and Manfred Klüppel — Deutsches Institut für Kautschuktechnologie e.V., Hannover, Germany

The mechanical properties of several typical rubber roller compounds are investigated to get a deeper insight into the aging and wear mechanisms of rubber rollers under praxis conditions. For this purpose, a micro-structure based theoretical model is used linking the macroscopic mechanical response to microscopic network parameters, among them polymer-network moduli, polymer-filler-bond strengths and average filler-cluster-size. This so-called Dynamic Flocculation Model (DFM) is based on the non-affine tube model for highly entangled polymer networks and additionally takes into account hydrodynamic amplification by filler clusters as well as cyclic cluster-breakage and re-aggregation of filler-filler bonds. The influence of cross-linker-type and -concentration on the network parameters is investigated. Additionally, the effect of thermal aging is studied, whereby the focus is put on the polymer-filler and filler-filler bonds. To establish a connection to macroscopic quantities, several mechanical tests, including tensile strength, rebound and hardness are carried out for different stages of aging and cross-linker concentration. It can be concluded that the DFM is a very promising approach to relate aging and wear to changes in the microscopic structure of the polymer-filler-network.

CPP 65.2 Thu 9:45 PC 203

Excluded volume effects in polymer brushes at moderate chain stretching — •Dirk Romeis and Michael Lang — Leibniz-Institut für Polymerforschung Dresden e.V.

We develop a strong stretching approximation for a polymer brush made of self-avoiding polymer chains [1]. The density profile of the brush and the distribution of the end monomer positions in stretching direction are computed and compared with simulation data. We find that our approach leads to a clearly better approximation as compared to previous approaches based upon Gaussian elasticity at low grafting densities (moderate chain stretching), for which corrections due to finite extensibility can be ignored. Ref. [1] Romeis, D.; Lang, M.; Journal of Chemical Physics 141 (10) 104902 (2014)

CPP 65.3 Thu 10:00 PC 203

Tunable microcavities with dielectric elastomer actuators — •Irma Slowik[1], Nils Kronenberg[3], Markus Franke[2], Hartmut Fröb[1], Malte Gather[3], Andreas Richter[2], and Karl Leo[1] — [1]Institut für Angewandte Photophysik, TU Dresden, Deutschland — [2]Institut für Halbleiter- und Mikrosystemtechnik, TU Dresden, Deutschland — [3]School of Physics, University of St Andrews, Scottland

Dielectric elastomers are promising materials for electromechanical systems because of their high dielectric strength and their ability to deform under applied voltage up to very high strains. Dielectric elastomer actuators are used for artificial muscles, conformable displays, stretchable integrated circuits, and biomedical electrode interfaces. Due to their high transparency and flexibility, they show excellent potential for tunable optical elements like tunable phase plates, cavities, or gratings.
We discuss the design and performance of an electrically tunable multi-half wavelength cavity. Here, the cavity resonance can be tuned by changing the cavity thickness due to electrostriction of the soft elastomer. For a proof of principle, metal-elastomer-DBR cavities are build, which exhibit quality factors between 100 and 800. Applying a voltage between a bottom ITO electrode and the top metal layer leads to a reversible shift of the cavity modes up to 15 nm, which relates to a cavity thickness change of about 400 nm. Depending on the metal film thickness, the Young's modulus of the device differes between 10-300 kPa.

CPP 65.4 Thu 10:15 PC 203

Biomimetic adhesives with self-healing properties — •Weina Wang[1,2], Yisheng Xu[1], Xuhong Guo[1], and Regine von Klitzing[2] — [1]State Key Laboratory of Chemical Engineering, East China University of Science and Technology, Shanghai, People's Republic of China — [2]Physikalische Chemie, TU Berlin, Straße des 17. Juni 124, 10623 Berlin, Germany

Marine mussels live in the harsh seawater environment by attaching themselves onto any hard surface due to the functional unit, DOPA, in their adhesive proteins. To copy this adhesive property into synthetic material, Dopa was grafted onto poly(acrylicacid) (PAA) backbone.

In our work, the highest ratio of DOPA in mussel was mimicked into the biomimetic material PAA-DOPA. Taking advantage of a weak divalent ion, a tunable crosslinking method from reversible to irreversible was obtained. The crosslinked bioadhesive possesses water-endurable adhesion and self-healing properties by increasing pH value in sequence. The optimization of the cohesive and adhesive forces imparts the material with both hardness and adhesive properties. Besides, this adhesive is injectable and could be cured near body temperature effectively. Such properties make it the ideal candidate as wound sealant in tissue engineering process.