CPP 60: Molecular and Polymer Dynamics, Friction and Rheology II

Time: Friday 12:15–13:00 Location: HÜL/S386

CPP 60.1 Fri 12:15 HÜL/S386

Fouling in Emulsion Polymerization of Different Copolymers investigated in-situ with the Quartz Crystal Microbalance (QCM) — •Kevin Marvin Hoffmann and Diethelm Johannsmann — Clausthal University of Technology, Institute of Physical Chemistry, Arnold-Sommerfeld-Straße 4, 38678 Clausthal-Zellerfeld, Germany

In emulsion polymerization, reaction and particulate fouling leads to clogging, product contamination, and reduced heat transfer efficiency. Common techniques for in-line monitoring of fouling are based on the heat transfer efficiency across the surface and the pressure drop in pipes or tubes. These techniques show fouling layers at thicknesses of a few tens of micrometers, at least. They are not sensitive enough to study the initial stages of a fouling.

A quartz crystal microbalance with dissipation monitoring (QCM-D) was used to study fouling in-situ. The QCM infers changes in mass on its surface to changes of its resonance frequency. It is sensitive down to the nanometer range. In addition to an estimate of the layer thickness, the QCM-D provides for additional information, derived from the comparison between the shifts in frequency and half-bandwidth as well as the comparison between different overtones.

It was found that polyacrylates behaved characteristically differently from polyvinyl acetates. The polyacrylates formed compact and stiff fouling layers. The polyvinyl acetates formed softer and more porous, extended layers. We assume that the stabilizing agent has a major impact on the fouling layer's nature.

CPP 60.2 Fri 12:30 HÜL/S386

Cluster growth dynamics of nickel particles in viscoelastic matrices — •Konstantin Gerstenberger und Günter K. Auernhammer — Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, 01069 Dresden, Germany

Magnetic elastomers can dynamically modify their mechanical properties in response to a magnetic field giving them the potential for new applications as soft actuators. A common method of producing these materials involves embedding magnetic particles in an elastomer matrix. In the presence of an applied magnetic field, the particles tend to arrange themselves into chain-like clusters which react to external stimuli, even if the matrix is crosslinked.

As part of the research unit FOR 5599 on structured magnetic elastomers we investigate the formation process of these materials, paying particular attention to the interaction between particle cluster formation and simultaneous cross-linking of the surrounding matrix. We use particle tracking velocimetry techniques to observe the cluster development over time and investigate how this process depends on various parameters. Therefore, it can be concluded that the development of chains is influenced by not only the particle concentration and matrix viscosity, but also the rotation of the applied magnetic field. This rotation can be used to adjust the mean length of the chains to a specific value.

Further investigation of larger sample sizes will be possible due to a new kind of Hallbach array that is currently under construction. This presentation will also cover the general idea of this machine.

CPP 60.3 Fri 12:45 HÜL/S386

Maps of High Viscoelastic Properties Generated with an Instrument Combining a Quartz Crystal Microbalance (QCM) with an AFM — •Cedric Jünemann, Diethelm Johannsmann, and Arne Langhoff — Clausthal University of Technology, Instutite of Physical Chemistry, Arnold-Sommerfeld-Straße 4, 38678 Clausthal-Zellerfeld

We present an instrument, which images the high-frequency viscoelastic properties of various samples. The instrument combines an atomic force microscope (AFM) with a quartz crystal microbalance with dissipation monitoring (QCM-D). Imaging becomes possible by a fast measurement of a resonator's frequency and bandwidth, achieved with a multi-frequency lockin amplifier (MLA). The MLA tracks multiple overtones simultaneously. To improve contrast and to facilitate quantitative interpretation, the colloidal force probe configuration was used. The cantilever was modified by gluing a glass sphere with a diameter of 50 μm to the tip, thereby increasing the contact radius to a few hundred nanometers. The sphere is heavy enough to clamped in place by inertia, which simplifies the analysis. A quantitative interpretation can rely on ratios between the different QCM signals, which eliminates the unknown contact area from the analysis. Printed drops and a biofilm composed of yeast were chosen for demonstration. This approach provides for a flexible method to investigate viscoelastic properties on the nanoscale at high frequencies.