Contribution ID: **180** Type: **Poster**

In-situ RheoSAXS: Relating Nanostructure to Macroscopic Properties Using A Laboratory Setup

Wednesday, 9 December 2020 17:40 (20 minutes)

Material research in all its complexity continuously calls for new analysis solutions to solve sophisticated issues in one go.
Rheology deals with the flow and deformation of matter. Applying shear force to a material can result in orientation or crystallization. With small-angle X-ray scattering (SAXS) structural parameters of nanomaterials such as size, shape, inner structure, and orientation can be determined.
Relating the nanostructure of a material to its macroscopic mechanical properties requires in-situ characterization techniques such as rheology combined with SAXS. RheoSAXS experiments have so far only been conducted at synchrotron beam lines, mainly due to the insufficient X-ray flux of laboratory X-ray sources and the lack of a dedicated RheoSAXS laboratory setup.
In this contribution we present a novel experimental setup for performing combined RheoSAXS studies with the SAXSpoint 2.0 laboratory SAXS system.
The integrated RheoSAXS sample stage enables temperature-controlled rheological experiments with in-situ determination of shear-induced structural changes of nanostructured materials on a nanoscopic length scale (from approx. 1 nm to 200 nm) by SAXS. The RheoSAXS module includes a rheological sample compartment which is integrated in the evacuated SAXS measurement chamber. The rheometer measuring head comprises a high-precision air-bearing motor which holds and controls the rheological scattering measuring system in the SAXS instrument chamber.

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Session Classification: Joint poster session of MLZ User Meeting and DN2020

Track Classification: DN: Instrumentation