113

Investigation of the structure formation process of magnetic elastomers using “intermediate states”and X-ray tomography

Author: Nils Magin[1]

Co-author: Stefan Odenbach [2]

[1] *Tu Dresden*

[2] *TU Dresden*

The term “magnetic elastomer” denotes a composite of magnetic particles and an elastic polymer matrix. The application of an external homogeneous magnetic field during the polymerization process allows for the structuring of particles within the initial liquid polymer matrix. This process leads to the fabrication of anisotropic (or structured) materials. However, the process of structure formation in three dimensions remains a relatively under-researched area. In order to utilize X-ray tomography in the investigation of structural formation, it is imperative to consider the disparity in temporal scales between the formation of structures and the acquisition of a high-resolution tomogram. The formation of structure occurs within minutes, whereas the acquisition of a high-resolution tomogram can take up to an hour. In order to surmount this discrepancy, the “intermediate states” method is employed. This method is predicated on the premise that the viscosity of the polymer increases during the cross-linking process, thereby causing a decrease in particle mobility over time. In the event of the application of a magnetic field at subsequent stages of polymerization, subsequent to the initiation of the process, the structures formed by the particles are unable to fully develop due to the reduced mobility (see Figure 1). Following polymerization, these intermediate structures are frozen in the polymer, and their microstructure can be examined using X-ray tomography without time constraints. It is possible to analyze and comprehend the process of structure formation in intermediate steps by tracing the viscosity curve backwards and thus identifying the changes in microstructure. The presentation at the conference will provide a detailed exposition on the impact of varying viscosities on the microstructure of “intermediate states”, with particular emphasis on the correlation between chain length and these phenomena. We thank the Deutsche Forschungsgemeinschaft (German Research Foundation, DFG) for support through the Research Unit FOR 5599 on structured magnetic elastomers, project no. 511114185, via DFG grant reference no. OD 18/35-1.

Figure 1: Microstructure changes belonging to “intermediate states”along the dynamic viscosity curve over time for a set of samples with 1vol.% iron particles. Higher Viscosity results in smaller particle mobility and therefore shorter chains and in the end a more isotropic configuration.

Type:

Oral