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Quasielastic Neutron Scattering Study in Poly(tetrahydrofuran-co-epychlorohydrin) Based All-Polymer Nanocomposites

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Single-Chain NanoParticles (SCNPs) are nano-objects obtained by intra-molecular cross-linking of individual macromolecular chains ('precursors'). Due to their ultra-small size, softness and internal compartmentalization, they are good candidates for nanotechnology, e.g., for SCNPs was to form part of all-polymer nanocomposites (NC), i. e., mixtures where such nanoparticles are dispersed in a (linear) polymeric matrix.
We study by quasielastic neutron scattering (QENS) a mixture consisting of 75 wt% poly(tetrahydrofuran-co-epychlorohydrin) (P(THF-co-ECH)) linear precursor chains and 25 wt% of P(THF-co-ECH) based SCNPs. Two samples are investigated, where one of the components is protonated (h) and the other one deuterated (d). Thus, with our QENS experiments we can discern how the dynamics of both components are mutually affected. In order to cover a wide dynamic range, we have combined a backscattering spectrometer (IN16B) and a time-of-flight (IN5) instrument. The Q-range accessed (approx. $0.2 \leq Q \leq 2$ Å-1) corresponds to relatively local length scales of observation.
We observe the development of dynamic heterogeneity in the intermediate scattering function of the NC components, which grows with increasing time. Local motions in the precursor matrix of the NC are accelerated with respect to the reference bulk behavior, while the displacements of SCNPs'hydrogens display enhanced deviations from Gaussian and exponential behavior compared with the pure melt of SCNPs.

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