

Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Polymer Dynamics Studied by Field-Cycling NMR Relaxometry

MARIUS HOFMANN, Department of Chemistry, Louisiana State University, Baton Rouge (LA, USA), BENJAMIN KRESSE, ALEXEI PRIVALOV, FRANZ FUJARA, Institut fuer Festkoerperphysik, Technische Universitaet Darmstadt, Darmstadt (Germany), NAIL FATKULLIN, Institute of Physics, Kazan Federal University, Kazan (Tatarstan, Russia), ERNST ROESSLER, Experimentalphysik II, Universitaet Bayreuth, Bayreuth (Germany) — We apply Field-Cycling (FC) ^1H NMR relaxometry to study translational as well as reorientational segmental dynamics in linear polymer melts. Assuming frequency-temperature superposition the fluctuation spectrum of the dipole-dipole interaction $J(\omega)$ is probed over ten decades in frequency, covering the local, Rouse and entanglement dynamics at high M . Fourier transformation yields the dipolar correlation function $C_{DD}(t)$, which turns out to be generic for different polymers with comparable M . Using the isotope dilution technique $C_{DD}(t)=C_{intra}(t)+C_{inter}(t)$ is separated into an intra- and an intermolecular component. While $C_{intra}(t)=C_2(t)$ reflects reorientational motion in terms of the $l=2$ Legendre polynomial, $C_{inter}(t)$ is related to translation, specifically to the segmental mean square displacement. The found transition from Rouse to constrained Rouse dynamics is probed, and the data agrees with such of neutron scattering well. Combining FC and field-gradient NMR all four power-law regimes of the tube-reptation (TR) model are reproduced. Concerning reorientation, however, $C_2(t)$ doesn't conform to the TR model, a result which is also verified by FC ^2H relaxometry. Based on our findings the return-to-origin hypothesis is challenged.

Marius Hofmann
Department of Chemistry, Louisiana State University, Baton Rouge (LA, USA)

Date submitted: 09 Nov 2016

Electronic form version 1.4