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Length and time scales of entanglement and confinement effects constraining polymer chain dynamics

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Abstract

With characteristic time constants for polymer dynamics, namely τs (the segment fluctuation time), τe (the entanglement time), and τR (the longest Rouse relaxation time), the time scales of particular interest (i) τ < τss (ii) τS < t < τe, and (iii) τe < t < τR will be discussed and compared with experimental data. These ranges correspond to the chain-mode length scales (i) ℓ < b, (ii) b < ℓ < d2 /b, and (iii) d2/b < ℓ < L, where b is the statistical segment length, d is the dimension of constraints by entanglements and/or confinement, and L is the chain contour length. Based on Langevin-type equations-of-motion coarse-grained predictions for the mean-squared segment displacement and the spin-lattice relaxation dispersion will be outlined for the scenarios "freely-draining", "entangled", and "confined". In the discussion we will juxtapose "local" versus "global" dynamics on the one hand, and "bulk" versus "confined" systems on the other.