قطب علمی سیستم‌های پیچیده و ماده چگال

سمینار هفتگی ماده چگال نرم

Journal Club:

Dynamics and rheology of ring-linear blend semidilute solutions in extensional flow: Single molecule experiments

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Abstract

In this work, we directly observe the dynamics of DNA rings in semidilute ring-linear polymer blends using single molecule techniques. We systematically investigate ring polymer relaxation dynamics from high extension and transient and steady-state stretching dynamics in a planar extensional flow for a series of ring-linear blends with varying ring fraction. Our results show multiple molecular subpopulations for ring relaxation in ring-linear blends, as well as large conformational fluctuations for rings in a steady extensional flow, even long after the initial transient stretching process has subsided. We further quantify the magnitude and characteristic time scales of ring conformational fluctuations as a function of blend composition. Interestingly, we find that the magnitude of ring conformational fluctuations follows a nonmonotonic response with increasing ring fraction, first increasing at low ring fraction and then substantially decreasing at large ring fraction in ring-linear blends. A unique set of ring polymer conformations are observed during the transient stretching process, which highlights the prevalence of molecular individualism and supports the notion of complex intermolecular interactions in ring-linear polymer blends. In particular, our results suggest that transient intermolecular structures form in ring-linear blends due to a combination of direct forces due to linear chains threading through open rings and indirect forces due to hydrodynamic interactions; these combined effects lead to large conformational fluctuations of rings over distributed time scales.

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