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Diffusion of Small Sticky Nanoparticles in a Polymer Melt: A Dynamic Light Scattering Study BOBBY CARROLL, University of Tennessee-Knoxville, VERA BOCHAROVA, Oak Ridge National Laboratory, SHIWANG CHENG, University of Tennessee-Knoxville, UMI YAMAMOTO, California Institute of Technology, ALEX KISLIUK, University of Tennessee-Knoxville, KEN SCHWEIZER, University of Illinois at Urbana-Champaign, ALEXEI SOKOLOV, University of Tennessee-Knoxville — The study of dynamics in complex fluids such as polymers has gained a broad interest in advanced materials and biomedical applications. Of particular interest is the motion of nanoparticles in these systems, which influences the mechanical and structural properties of composite materials, properties of colloidal systems, and biochemical processes in biological systems. Theoretical work predicts a violation of Stokes-Einstein (SE) relationship for diffusion of small nanoparticles in strongly-entangled polymer melt systems, with diffusion of nanoparticles much faster than expected D_{SE} . It is attributed to differences between local and macroscopic viscosity. In this study, the diffusion of nanoparticles in polymer melts below and above entanglement molecular weight is measured using dynamic light scattering. The measured results are compared with simulations that provide quantitative predictions for SE violations. Our results are two-fold: (1) diffusion at lower molecular weights is slower than expected D_{SE} due to chain absorption; and (2) diffusion becomes much (20 times) faster than D_{SE} , at higher entanglements due to a reduced local viscosity.

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