

Abstract Submitted
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Macromolecular Diffusion in Polymer Nanocomposites SANGAH GAM, University of Pennsylvania, JEFF METH, STEVE ZANE, DuPont Co., KAREN WINEY, University of Pennsylvania, NIGEL CLARKE, Durham University, RUSSELL COMPOSTO, University of Pennsylvania — Macromolecular diffusion in crowded systems is important in biological and engineered systems. We have studied macromolecular diffusion through a model polymer nanocomposite (PNC) containing phenyl grafted silica nanoparticles (NPs), randomly distributed in a polystyrene matrix. Over a wide range of NP loading and tracer molecular weight (M), the scaling of the diffusion coefficient with M is in excellent agreement with the entropic barrier model (EBM) previously used to describe diffusion of DNA through confined media (e.g., gels and nanopores). To investigate the effect of NP size, diffusion was measured in PNC's with silica NPs having diameters of 28 and 12 nm. The normalized diffusion coefficients (D/D_0) plotted against the interparticle separation relative to probe size (i.e., $ID/2R_g$) collapse on a master curve. Diffusion in a poly(methyl methacrylate):silica NP system was also investigated to understand how attractive interactions (i.e., enthalpy) perturb motion relative to the polystyrene and phenyl-silica NP system which is athermal. Finally, a flux-based model is proposed and compared with experimental results.

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