

Abstract Submitted
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Macromolecular Diffusion in Dynamic Polymer Nanocomposite¹

CHIA-CHUN LIN, MATTEO CARGNELLO, University of Pennsylvania, NIGEL CLARKE, University of Sheffield, KAREN WINEY, RUSSELL COMPOSTO, University of Pennsylvania — We consider diffusion of tracer polymers in the presence of mobile nanoparticles in polymer nanocomposites (PNCs). These nanoparticles are mobile on the time scale of polymer diffusion and have dimensions less than the entanglement mesh size (i.e., tube diameter). The PNC consists of titanium dioxide nanorods (NR, diameter=4.5nm; length=30.1nm) grafted with phenyl groups uniformly dispersed in a polystyrene (P=650kg/mol; tube diameter=8nm) matrix up to 10 volume percent. Three deuterated polystyrenes (dPS; M=800, 1800 and 3200 kg/mol) are chosen because their diffusion relative to NR allows for investigating fixed and mobile NR by simply changing M. For all M, the reduced tracer diffusivities are observed to decrease monotonically as NR loading increases. However, the reduced diffusivity of dPS (3200 kg/mol) is faster than expected compared to the fixed NR case. These findings suggest that mobile NR do not effectively slow down tracer diffusion relative to fixed particles. To test this hypothesis, dPS diffusion is investigated in a high molecular weight matrix PS (2000 kg/mol) in order to slow down NR diffusion relative to dPS (3200 kg/mol). New models are needed to incorporate these mobility dependent entanglements into a comprehensive understanding of dynamics in PNCs.

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Chia-Chun Lin
University of Pennsylvania

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