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**Enhanced Nanorod Diffusion in Polymer Melts** RUSSELL J. COMPOSTO, University of Pennsylvania, NIGEL CLARKE, University of Sheffield, KAREN I. WINEY, JIHOON CHOI, University of Pennsylvania — Using Rutherford backscattering spectroscopy (RBS), the translational diffusion of titanium oxide ( $\text{TiO}_2$ ) nanorods ( $l = 43.1$  nm and  $d = 4.6$  nm) is measured in entangled and unentangled polymer melts, polystyrene (PS;  $M_n = 9$ -2000 kg/mol). Nanorods in entangled systems ( $M_n = 160, 650,$  and  $2000$  kg/mol) are found to diffuse up to two orders of magnitude faster than predicted by classical theory. However, diffusion of nanorods in unentangled systems ( $M_n = 9$  and  $65$  kg/mol) is captured by this continuum theory. Below or near the entanglement limitation,  $M_n \leq M_e$  ( $M_e$ : entanglement molecular weight), unentangled polymer melts described by Rouse dynamics can be modeled as a continuum matrix against nanoscale inclusions. However, in highly entangled systems ( $M_n \gg M_e$ ) the standard continuum models are no longer valid and lead to local non-hydrodynamic friction at the length scale of the tube diameter (i.e.,  $d_t = 8$  nm for PS) [1]. Thus, enhanced diffusion of nanorods parallel to the tubes may be responsible for the faster than expected translational diffusion in entangled polymer melts. These experiments provide new insight into the relevant parameters that govern the diffusion of anisotropic nanoparticles in complex fluids. [1] Yamamoto et. al., J. Chem. Phys., 135, 224902 (2011).

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