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**Nanoparticle Brush Architecture Controls Polymer Diffusion in Nanocomposites** JIHOON CHOI, University of Pennsylvania, MICHAEL J.A. HORE, National Institute of Standards and Technology, NIGEL CLARKE, University of Sheffield, KAREN I. WINEY, RUSSELL J. COMPOSTO, University of Pennsylvania — We show that polymer diffusion in polymer nanocomposites (PNCs) is controlled by the architecture of polymer brushes grafted to silica nanoparticles (NPs). The tracer diffusion of deuterated polystyrene (dPS, $M_n$ =23 - 532 kg/mol) is measured in a polystyrene ($M_n$ =160 kg/mol) nanocomposite containing soft NPs with low (0.154 $nm^{-2}$) and high (0.383 $nm^{-2}$) grafting density. At high grafting density, diffusing chains having radius of gyration, $R_g$, are excluded from the polymer brush leading to greater confinement. However, at lower grafting density, these chains penetrate the brush and diffusion is similar to the hard NP case, compared at the same silica loading. The effective interparticle spacing ($ID_{eff}$) is determined by modeling polymer penetration into the brush using self-consistent field theory. When plotted against a confinement parameter ($ID_{eff}/2R_g$), reduced diffusion coefficients ($D/D_0$) fall on a master curve independent of brush architecture. These findings show that brush architecture provides a new route towards controlling polymer dynamics and viscoelasticity of PNCs.

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