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Entangled Polymer-Nanocomposites: Dynamics and phase stability RAHUL MANGAL, Cornell University, SAMANVAYA SRIVASTAVA, The University of Chicago, LYNDEN ARCHER, Cornell University — Polymer nanocomposites (PNCs) prepared by incorporating nanoparticles (NPs) in polymer hosts, have been reported to exhibit unusual mechanical, dynamical, and glassy features when the particle size approaches the random coil dimensions of the host polymer, even at low NP content. By taking advantage of favorable enthalpic interactions between particle-tethered and high-molecular weight host polymer molecules, we show by means of small-angle X-ray scattering that it is possible to create model PNCs in which spherical NPs are uniformly dispersed in polymeric hosts. Using these materials as model systems for studying polymer dynamics, we find that even at low concentrations, NPs profoundly alter a host polymer's dynamics on all timescales. On short timescales, NPs slow-down fast segmental motions and lowers the glass transition temperature of the host. On intermediate timescales where entanglement and tube dynamics are typically observed in entangled melts, NPs hasten the onset of these effects, leading to an early transition to reptation behavior. On long timescales, NPs lead to an earlier than expected onset of tube escape. This latter behavior appears correlated with previous reports of viscosity reductions in entangled PNCs, but in reality would only be experimentally observable in systems where nanoparticles do not also slow-down segmental scale motions of their polymer host.

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