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Phase Stability and Dynamics of nanoparticles in Polymer Nanocomposites RAHUL MANGAL, Cornell University, SAMANVAYA SRIVASTAVA, The University of Chicago, LYNDEN ARCHER, Cornell University — In polymer nanocomposites, polymer grafted nanoparticles, where the tethered polymer chains are chemically identical to the host chains, have been reported to irreversibly aggregate if the length of host chains (P) become 5 or more times larger than the length tethered chains (N) due to the autophobic dewetting of the polymer brush. Utilizing Small Angle X-ray scattering as a tool, here we show that by choosing appropriate chemistry one can utilize the enthalpic attractions between the tethered chains and host chains to facilitate uniform nanoparticle dispersion in very large $\mathrm{M_w}$ hosts (P/N ˜140). A generic phase diagram has also been proposed. Xray Photon Correlation Spectroscopy (XPCS) is employed as a sensitive probe of nanoparticle relaxation dynamics to investigate particle dynamics in these model PNCs. Remarkably, we find that for nanoparticle size D,slightly larger than the tube diameter of the host polymer (a), particles undergo a transition from normal diffusion to hyperdiffusive relaxation dynamics,. In contrast, for unentangled hosts, diffusive particle relaxation are observed. Our experimental observations are rationalized by finding that nanoparticle motion in entangled melts only disturb sub-chain entangled segments of size comparable to the particle diameter.

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