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Curved Brushes: Ordering and Dynamics of Silica Polymer Nanocomposites

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The structure and dynamics of polymer-tethered silica nanocomposites are examined here. Local dynamics of the hybrids suggest a significant increase in the glass transition temperature of the polymer chains, compared to the free polymer for the case of poly(butyl acrylate) systems. Mesoscale dynamics probed under quiescent conditions indicate a solid-like response for the nanocomposite, and this was seen to persist even upon dilution of the end-grafted chains with free PBA of approximately the same molecular weight. For the end-tethered hybrid, an ordered arrangement of the nanoparticles is observed using small angle x-ray scattering and transmission electron microscopy. Dilution results in a homogenous system of the hybrid with the free chains, and the resulting scaling of the correlation between hybrid domains suggest a fully penetrated brush system. In addition, linear viscoelastic characteristics of the blends were found to exhibit strong dependence on the hybrid volume fraction.