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Polymer-Nanoparticle Interfacial Interactions in Polymer Nanocomposites: Confinement Effects on Glass Transition Temperature and Suppression of Physical Aging. PERLA RITTIGSTEIN, JOHN M. TORKELSON, Northwestern University, Evanston, IL 60208-3120 — Confinement effects on glass transition temperature (Tg) and physical aging are measured via fluorescence in polystyrene (PS), poly(methyl methacrylate) (PMMA) and poly(2-vinyl pyridine) (P2VP) nanocomposites (NCs) containing 10-15 nm diam. silica nanospheres or 47 nm diam. alumina nanospheres. At 0.1-10 vol% nanofiller, Tgs can be enhanced or depressed relative to neat, bulk Tg or invariant with nanofiller content. For alumina NCs, Tg increases relative to bulk Tg by as much as 16 K in P2VP, decreases by as much as 5 K in PMMA, and is invariant in PS. These results are explained by wetted P2VP-nanofiller interfaces with attractive interactions, non-wetted PMMA-nanofiller interfaces, and wetted PS-nanofiller interfaces lacking attractive interactions, respectively. The presence of wetted or non-wetted interfaces is controlled by choice of solvent; silica/PMMA NCs exhibit Tg enhancements or reductions relative to bulk Tg when films are made from methyl ethyl ketone or acetic acid solutions, respectively. A factor of 10 reduction of physical aging rate relative to that of neat P2VP is shown in a 4 vol% alumina/P2VP NC. Hence, a strategy for achieving non-equilibrium, glassy polymer systems that are nearly stable to physical aging is to incorporate well-dispersed nanoparticles possessing attractive interfacial interactions with the polymer.

John Torkelson
Northwestern University

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