Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Polymer Nanocomposites Leading to the Suppression of Physical Aging: Effects of Attractive or Covalent Polymer-Nanofiller or Polymer-Substrate Interactions PERLA RITTIGSTEIN, RODNEY D. PRIESTLEY, JOHN M. TORKELSON, Northwestern University, Evanston, IL 60208 — Physical aging, or the change in properties accompanying the relaxation of a glass toward equilibrium, results in many deleterious effects ranging from embrittlement to reduction in permeability. Here we demonstrate how physical aging can be dramatically suppressed via the addition of well-dispersed nanofiller to a polymer matrix. Examples will be given associated with both real nanocomposites, in which silica or alumina nanoparticles or single-wall carbon nanotubes are dispersed in polymer, and model nanocomposites, with polymer of a known thickness confined between two silica slides. In both systems, we find a major reduction in physical aging rate, relative to neat polymer, when there are attractive polymer-substrate interactions, e.g., hydrogen bonds, or covalent bonds between the polymer and nanofiller. A molecular-level explanation of this effect will be provided which is related to a reduction in beta-relaxation dynamics caused by the attractive interactions/covalent bonding. In contrast, in cases where there is no attractive polymer-nanofiller interaction, e.g. polystyrene-silica nanocomposites with wetted interfaces, there is little or no effect of the nanofiller on aging rate.

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Date submitted: 20 Nov 2006 Electronic form version 1.4