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Crazing in Glassy Polymer Nanocomposites JONG-YOUNG LEE, QINGLING ZHANG, TODD EMRICK, ALFRED CROSBY, University of Massachusetts — Crazing is a polymer deformation process in which dense arrays of nanoscale fibrils grow prior to the propagation of a crack. Here, we discuss experimental results on the impact of two nanostructured materials on the crazing process: 1) ordered glassy block copolymers and 2) homopolymer/nanoparticle composites. We not only find that an ordered lamellar microstructure leads a lower craze growth rate compared with polystyrene homopolymer, but also nanoscale, surface terraces significantly decrease the failure strain of these advanced materials. For homopolymer/nanoparticle composites, we discover significant alterations in the crazing process. Specifically, nanoparticles in the presence of a craze undergo three stages of rearrangement: 1) Alignment along the precraze (fluid-like region), 2) Expulsion from nanoscale craze fibrils, and 3) Assembly into clusters trapped between craze fibrils. Although nanoparticles have no effect on the initiation strain, fibril breakdown strain, and craze growth rate, the composite failure strain can be increased significantly by nearly 100% compared to neat homopolymer films. These results provide direct evidence for the physical mechanisms that control the mechanical properties of polymer nanocomposites.

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