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Nanoparticles alignment, exclusion and entrapment during failure of Glassy Polymer Nanocomposite JONG-YOUNG LEE, QINGLING ZHANG, TODD EMRICK, ALFRED CROSBY, University of Massachusetts — Crazing is a polymer deformation process during which dense arrays of nanoscale fibrils grow prior to the propagation of a crack. In the presence of nanoscale inorganic fillers, the mechanisms of craze formation and propagation are altered significantly. We use a model material of polystyrene blended with surface modified CdSe nanoparticles to investigate the interaction between polymer molecules and nanoparticles during the process of crazing. We demonstrate that 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. These results not only provide direct evidence for the physical mechanisms that control the mechanical properties of polymer nanocomposites, but they give fundamental insight into the behavior of polymers and nanoparticles in the presence of a directed field, which will impact a wide array of advanced material applications.

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