Direct Observation of Heterogeneous Translational Motion at Tg

STEPHEN SWALLEN, MARK EDIGER, University of Wisconsin-Madison — Recent experiments have provided direct evidence of heterogeneous translational motion in a supercooled small molecule organic liquid, tris-naphthylbenzene. The early stages of diffusion were measured using neutron reflectivity, and indicate that translational motion near the glass transition temperature T_g is qualitatively different than diffusion in “normal” liquids. The diffusion coefficient was found to be wave-vector dependent, D(q) \propto q^{-2}, with a crossover to a q-independent value, D(q \rightarrow 0), at a length scale of \sim 22 \text{ nm} at T_g. These results demonstrate that translational motion on the nanometer length scale can be extremely heterogeneous in a single component system near T_g, giving rise to large jumps of roughly 20 molecular diameters. This observation explains the unusually fast diffusion coefficients found in many materials near T_g, and also the unusually rapid crystallization of supercooled liquids.

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