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XPCS Studies of Nanoparticle Motion within Glassy Polymer Melts H. GUO, JHU, G. BOURRET, R. B. LENNOX, M. SUTTON, McGill U., J. L. HARDON, U. of Ottawa, R. L. LEHENY, JHU — We report x-ray photon correlation spectroscopy (XPCS) experiments to investigate the motion of nanoscale gold particles within polystyrene (PS) melts of molecular weight between 2K and 48K g/mol. The particles, with radius of approximately 2 nm, are dispersed in a highly dilute concentration (volume fraction 0.0004) and are functionalized with PS chains to stabilize them against aggregation. At high temperature, the observed motion is diffusive, with a rate that follows a Vogel-Fulcher temperature dependence. When the melts are quenched to lower temperature, the XPCS results indicate hyper-diffusive motion that can be modeled as strain in the melt in response to localized stress relaxation. These dynamics evolve with time following the quench, suggesting that they are coupled to aging of the polymer. Our observation of this hyper-diffusive motion among such a dilute concentration of stable nanoparticles indicates that the particles act as passive tracers and the motion is an intrinsic property of quenched melts.

hongyu guo
Johns Hopkins University

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