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Gelation of Polymer-grafted SiO_2 Nanoparticle Colloid Studied with 20 us X-ray Photon Correlation Spectroscopy (XPCS)[1] QINGTENG ZHANG, ERIC DUFRESNE, SURESH NARAYANAN, ALEC SANDY, Argonne National Laboratory, DIVYA BAHADUR, SUBRAMANIAN RAMAKRISHNAN, Florida AM University- Florida State University, PIOTR MAJ, PAWEL GRYBOS, AGH University of Science and Technology — The nanoscale and microsecond resolved structure and dynamics associated with the gelation of octadecyl-grafted silica nanoparticles dispersed in decalin with a volume fraction of 0.2 was studied via XPCS in the small-angle x-ray-scattering geometry. The length-scale resolved dynamics of the colloidal particles was measured from 20 us to 2 s in delay time using a prototype 50 kHz frame rate x-ray area detector providing spatial sensitivity that spans from the self-diffusion to collective diffusion regimes. Above the gel point, the correlation functions are well described by a stretched exponential function. The diffusion coefficient decreases with decreasing temperature. At and just below the gel point, the correlation functions show a two-stage decay as a function of delay time corresponding to, first, fast dynamics from free particle diffusion and, second, slow dynamics from gel network. Our results reveal the nanoscale behavior of colloidal nanoparticles during gelation at unprecedented time and spatial scales and provide information that can be used to test various models and deepen our understanding of the gelation process.

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