Formation Mechanism of Monodisperse Colloidal Semiconductor Quantum Dots

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A long-standing goal in nanoparticle science is the mechanism guided synthesis of particles with desired size and narrow size distributions. Historically, the development of synthetic methods towards this end has been largely empirically driven. This reflects both the inherent kinetic complexity of these reactions, in addition to the spectroscopic challenge of developing in-situ probes which can reliably monitor crystal growth at the nanoscale. To address these challenges we have used in-situ X-ray scattering to directly observe the nucleation and growth processes of recently developed PbS and PbSe nanoparticle syntheses from thio/selenoureas developed in our group. Our results suggest that the heavily cited mechanistic hypothesis that monodisperse colloidal ensembles arise from a classical LaMer like “burst nucleation” process is not operative in these systems.