

Semiconductor nanocrystals: How do they grow and why do they glow?

D. D. Sarma

Solid State and Structural Chemistry Unit

Indian Institute of Science, Bangalore 560012, INDIA

Controlling the size, composition or dopant concentration is well known to tailor properties of semiconductor nanocrystals. Specifically, photophysical properties of semiconductor nanocrystals are strongly influenced by such manipulations. A large variety of semiconductor nanoparticles can be synthesised by reacting two chemicals, one providing cations and the other anions, often in presence of additional chemicals that influence the reaction path. The popularity of this approach, known as the Bottom Up approach, stems from the tremendous flexibility and the ease of controlling the size, shape and various functionalities of resulting nanoparticles in the really small size (typically < 10 nm) limit. Targeting and tailoring nanocrystals with specific size or composition with desired properties require understanding the mechanism that governs the formation of such materials in the nm size regime. I shall discuss a few examples of time-resolved studies to elucidate often counter-intuitive growth mechanisms and dopant behaviours observed in these systems. This will be followed by illustrating how unexpected information on internal structures of complex nanocrystals, for example a quantum-dot quantum-well system, can be extracted using a photoemission technique that may be termed "microscopy without a microscope"! Finally, I shall relate such derived information to discuss exceptionally high photoluminescence efficiencies found in a variety of semiconductor nanocrystals.