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The Role of morphology and interface in photoluminescent properties in CdSe/CdS Heterostructure Nanocrystals[1]

ARNAUD DEMORTIERE, CHUNXING SHE, Argonne National Laboratory, DONOVAN N. LEONARD, Oak Ridge National Laboratory, SOMA CHATTOPADHYAY, MATTHEW PELTON, ELENA SHEVCHENKO, Argonne National Laboratory — Semiconductor core/shell colloidal nanocrystals (NCs) are promising materials for many applications such as luminescent solar concentrators and lasing media, due to their high PL quantum yield (PLQY) and their charge separation effect. The role of interface in PLQY and in band alignment type is studied in this nanoscale heterojunction. Rod-shaped CdSe/CdS NCs have been synthesized by colloidal chemical approach via epitaxial process, which gives us a fine-tuning of both the spherical core size and rod-like shell length. The modification of the relative morphology changes the effective core/shell band alignment, which impacts the electron and hole delocalization into the nanorods. The evolution of the PLQY and PL lifetimes has been studied as a function of the relative core/shell sizes. High PLQY of up to 80% and PL lifetime of 36 ns have been obtained for a shell-excitation wavelength of 450 nm with a large quasi-Stokes shift (∼100nm). Radiative decay rates have been correlated with the rod volume and the band alignment type has been identified as being core size dependent. Finally, UltraSTEM and EXAFS analyses have been used to characterize the crystalline configuration at the core/shell interface and the lattice strain.

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