Pinned luminescence emission and absorbance band from ultrasmall ball-milled Cd0.3Zn0.7Se nanocrystals

ABSTRACT

We report the pinned absorbance and emission spectra of Cd0.3Zn0.7Se nanocrystals synthesized via mechanical alloying. The first emission peaks of Cd0.3Zn0.7Se nanocrystals milled for 5 and 10 h are observed at 3.36 eV, while the absorbance spectra of those milled for 10 and 20 h are observed at 4.47 eV. The emission peaks of nanocrystals milled for 5, 10, and 20 h have broad emissions centered at 2.90, 2.88, and 2.92 eV, respectively. Transmission electron microscopy histogram shows that each nanocrystal size distribution has a single population maxima of <2 nm. In addition, the center of each size distribution shifts toward the ultrasmall particles upon continuous milling. Particle sizes (d) of 0.73 nm are calculated from the first excitonic peaks of the pinned absorbance bands through the semiempirical sizing equation. The continuous reduction in particle sizes increases the surface-to-volume ratios of the nanocrystals. This increase eventually results in an increase in the surface states that translate into low photoluminescence intensity of pinned emission.