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Hole Trapping Dynamics in CdSe Semiconductor Nanoparticles

David Morgan
Department of Chemistry
University of California, Merced

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For more information contact:
David Kelley
dfkelley@ucmerced.edu

ABSTRACT

Hole trapping is one of the main losses of photoluminescence efficiency in II-VI semiconductor nanoparticles, so developing the conceptual framework for understanding hole trapping and the various factors involved is an important task. Transient absorption and time-resolved photoluminescence spectroscopy are particularly well-suited for interrogating carrier trapping processes since they allow excited state populations to be monitored as a function of time. The manifestations of hole trapping in the transient absorption spectra of 2-dimensional CdSe nanoplatelets are investigated and compared with the case of spherical CdSe nanoparticles. The differences in the spectroscopy are attributed to differences in the angular momentum fine structure, which depends on the shape of the nanostructure. The effects of ligating CdSe nanoparticles with alkylamines on hole trapping dynamics will also be explored. Contrary to the traditional model of electronic surface passivation by organic ligands, the differences in hole trapping rates upon alkylamine ligation seen here are attributed to electrostatic effects.