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Controlling Auger Decay Rates of CdSe/CdS Nanocrystals via Core/Shell Interfacial Alloying YOUNG-SHIN PARK, Los Alamos National Laboratory and University of Nex Mexico, WAN KI BAE, Korea Institute of Science and Technology, LAZARO PADILHA, Universidade Estadual de Campinas, JEFFREY PIETRYGA, VICTOR KLIMOV, Los Alamos National Laboratory —
We report single-dot spectroscopic studies to evaluate the effect of the core/shell interface (i.e., the shape of the confinement potential) on nonradiative Auger decay rates of CdSe/CdS quantum dots (QDs) that have either a sharp or a graded interface. Alloyed QDs with a graded potential are prepared by incorporating a $CdSe_xS_{1-x}$ alloy layer of a controlled composition and thickness between the core and the shell. In second-order intensity correlation ($g^{(2)}$) measurements, we observed that the interfacial layer has a negligible effect on single-exciton dynamics, but leads to a systematic increase in the biexciton photoluminescence quantum yield (Q_{BX}). We found that Q_{BX} of alloyed QDs can be up to ~ 10 times higher than that of the reference QDs with a sharp interface. These results are further supported by independent measurements of biexciton dynamics that show a considerable elongation of biexciton lifetimes (to several ns) upon interfacial alloying. Finally, a statistical investigation of over 100 individual QDs shows that the CdS shell thickness has only a minor effect on Q_{BX}. All of these findings point a significant role of the shape of the confinement potential in Auger recombination and should facilitate the development of "Auger-recombination-free" QDs.

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