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Effect of Quantum Confinement on Radiative and Nonradiative Decay Rates in Ge Nanocrystals ISTVAN ROBEL, DOH C. LEE, SCOTT A. CROOKER, JEFFREY M. PIETRYGA, RICHARD D. SCHALLER, VICTOR I. KLIMOV, Los Alamos National Laboratory — We study the effects of quantum confinement on radiative and nonradiative Auger recombination in colloidal germanium nanocrystals (NCs). The observed temperature- (1.7-300K) and magnetic field-dependence (0-15T) of the photoluminescence lifetimes indicates the presence of an optically dark (dipole-forbidden) lowest excited state closely separated from an optically active bright state. Thermal activation of the bright state and magnetic-field-induced mixing of the dark and bright states independently yield a consistent energy scale of the splitting of about 1 meV. Further, we investigate the effect of spatial confinement on nonradiative Auger recombination. An interesting result of these studies is that Auger rates in Ge NCs are close to those in similarly sized NCs of direct gap semiconductors despite a large (orders of magnitude) difference in their respective bulk Auger constants. This observation indicates that, as in the case of radiative decay, spatial confinement eliminates the need for the momentum-conserving phonon in Auger recombination.

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