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Structure-Induced Asymmetry of Auger Decay Rates Between Positive and Negative Trions YOUNG-SHIN PARK, University of New Mexico and Los Alamos National Laboratory, USA, WAN KI BAE, Korea Institute of Science and Technology, S. Korea, LAZARO PADILHA, Universidade Estadual de Campinas, Brazil, ISTVAN ROBEL, JEFFREY PIETRYGA, VICTOR KLIMOV, Los Alamos National laboratory, USA — We report spectroscopic studies of nonradiative Auger decay rates of negative (X^-) and positive (X^+) trions for three QD samples having different energy-band structures. We observe that the symmetry between X^- and X^+ Auger decay rates observed for core-only PbSe QDs (characterized by mirror-symmetric conduction and valence bands) can be substantially distorted in CdSe/ZnS QDs, where the spectral density of valence-band states is much higher than that of the conduction-band states, leading to a relative enhancement of the X^+ decay channel. The asymmetry between X^- and X^+ Auger rates observed for CdSe/ZnS QDs is further enhanced in thick-shell CdSe/CdS QDs wherein the hole is confined within the core, but the electron is delocalized over the entire QD, which causes a considerable reduction in the X^- Auger decay rate. In single-dot studies of thick-shell QDs, we are able to identify photoluminescence (PL) bands of X^- and X^+ along with that of a neutral exciton (X^0). We found that, while X^+ emission shows a short lifetime (1-2 ns) and a low quantum yield (<5%), X^- PL features an increased lifetime (up to $\sim$ 10ns) and a high emission efficiency (up to $\sim$ 60% of that of X^0) due to strong suppression of the X^- Auger decay pathway, which agree well with ensemble measurements.

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