Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Universal size dependence of Auger constants in direct- and indirect-gap semiconductor nanocrystals ISTVAN ROBEL, Chemistry Division, Los Alamos National Laboratory, RYAN GRESBACK, UWE KORTSHAGEN, Department of Mechanical Engineering, University of Minnesota, RICHARD D. SCHALLER, VICTOR I. KLIMOV, Chemistry Division, Los Alamos National Laboratory — We compare Auger recombination rates in several direct- and indirect-gap semiconductor nanocrystals including Ge, PbSe, InAs, and CdSe. Our size-dependent biexciton lifetime measurements indicate that the most important factor determining recombination rates is nanocrystal size, while details of the materials' electronic structure such as the width of the energy gap or its direct/indirect nature play only a minor role. We observe that the effective Auger constants for all semiconductor nanocrystals in this study exhibit a universal cubic dependence on particle radius (R), $C_A \sim R^3$. Moreover, absolute values of nanocrystal Auger constants are comparable across different materials despite a dramatic difference (up to 4-5 orders of magnitude) in C_A values in the respective bulk solids. Our results can be explained by confinement-induced relaxation of momentum conservation, diminishing the difference between direct- and indirect-gap semiconductors at the nanoscale.

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Date submitted: 19 Nov 2008 Electronic form version 1.4