Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Dynamical and Optical Properties of Si and Ge Nanocrystals
KELLY KNUTSEN, MATT BEARD, P.R. YU, QING SONG, WYATT METZGER, ART NOZIK, RANDY ELLINGSON, National Renewable Energy Lab — Si nanocrystals exhibit the unusual property of having a high photoluminescence quantum yield as well as a long first exciton lifetime. This implies that the decay rates for the non-radiative channels have decreased compared to the bulk. We explore this phenomenon by first characterizing the optical properties of the Si nanocrystals by measuring their linear absorption and photoluminescence spectra as a function of nanocrystal size, which show an expected shift to the blue for the transition onset with decreased particle size. The nanoparticles exhibit indirect transition characteristics, and emit roughly 1eV to the red of the absorption onset. We also employ time-resolved photoluminescence (TRPL) and transient absorption (TA) spectroscopy to investigate the Auger dynamics of the single and biexcitons. Initial results for 9nm Si nanoparticles show that the biexciton lifetime is roughly 200 ps and the single exciton lifetime is greater than 200 microseconds. The size dependence on the single and biexciton lifetimes, as well as the potential presence of multiple exciton generation (MEG) in these materials will be presented. Initial optical studies of Ge nanocrystal charge carrier dynamics will also be presented.

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Date submitted: 13 Dec 2006 Electronic form version 1.4