MAR14-2013-000447

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Multiexciton Generation in Nanocrystals and Nanorods

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Multiexciton generation (MEG) is a process where several excitons are generated upon the absorption of a single photon in semiconductors. This process enjoys great technological ramifications for solar cells and other light harvesting technologies. For example, it is expected that the more charge carriers created shortly after the photon is absorbed, the larger fraction of the photon energy can successfully be converted into electricity, thus increasing the device efficiency. Strict selection rules and competing processes in the bulk allows MEG at energies of five times the band gap. It was suggested that nanocrystals, where quantum confinement effects are important, may exhibit MEG at lower values of (typically 2 to 3 times the band gap). Indeed, MEG in nanocrystals has been reported recently for several systems, showing that the threshold was size and band-gap independent. However, more recent studies have questioned the high efficiency of MEG in nanocrystals. In this talk we will discuss the process of MEG in semiconducting nanocrystals (NCs) and nanorods (NRs). A general theoretical framework will be presented and the limits of indirect absorption and impact ionization will be derived. The role of composition material, size, geometry and energy on the MEG efficiencies will be explored using a stochastic approach to calculate MEG with a numerical effort that scales linearly with system size.