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Intermediate Band Gap Solar Cells: The Effect of Resonant Tunneling on Delocalization REID WILLIAM, DOTY MATHEW, U. Delaware, SHILPA SANWLI, U.Delaware, DAN GAMMON, ALLAN BRACKER, NRL — Quantum dots (QD's) have many unique properties, including tunable discrete energy levels, that make them suitable for a variety of next generation photovoltaic applications. One application is an intermediate band solar cell (IBSC); in which QD's are incorporated into the bulk material. The QD's are tuned to absorb low energy photons that would otherwise be wasted because their energy is less than the solar cell's bulk band gap. Current theory concludes that identical QD's should be arranged in a superlattice to form a completely delocalized intermediate band maximizing absorption of low energy photons while minimizing the decrease in the efficiency of the bulk material. We use a T-matrix model to assess the feasibility of forming a delocalized band given that real QD ensembles have an inhomogeneous distribution of energy levels. Our results suggest that formation of a band delocalized through a large QD superlattice is challenging; suggesting that the assumptions underlying present IBSC theory require reexamination. We use time-resolved photoluminescence of coupled QD's to probe the effect of delocalized states on the dynamics of absorption, energy transport, and nonradiative relaxation. These results will allow us to reexamine the theoretical assumptions and determine the degree of delocalization necessary to create an efficient quantum dot-based IBSC.

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