Ultrafast Charge Transfer from Higher Excitonic States of CdSe Quantum Dots to an Organic Dye

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Nanocrystal Quantum Dots (QD) are used as photon collectors in hybrid photovoltaic solar cells. Some of the hybrid composites focus on an efficient Charge Transfer (CT) from the QD band-edge exciton (BEE) to an organic dye.[1] In this work we follow the ultrafast decay of two higher excitonic states (HES) of CdSe QD [2] and show that the CT process can take place from higher states to the Indocyanine-Green (ICG) dye. The two detected HES have decay times of 2.7 ps (500 nm) and 5.2 ps (550 nm); when eight molecules of ICG per QD are added to the system these higher states decay in 2 ps and 4.2 ps, respectively. Analyzing the energy levels of the composite (QD-ICG), it is concluded that the detected HES are involved in the CT process and that a hole transfer is more likely to occur from the higher states. Understanding the dynamics that take place from the HES could help to develop hybrid photovoltaic solar cells with better efficiencies.

CdSe dynamics and CT process. A. Up-Conversion signals detected at different wavelengths. B. Absorption and emission spectra (detected wavelengths indicated). C. HES energy levels involved on the CT process to the ICG. D. Up-Conversion signals detected with eight molecules of ICG.

References:
