Nanoscale type-II heterojunctions with infrared spatially indirect energy gaps

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Semiconductor nanocrystal quantum dots represent an important class of chemically processible nanomaterials. Their use in photovoltaic devices is particularly promising, as their moderate synthesis temperature and solution-processibility offer opportunities to address constraints on alternative technologies such as scalability. In this talk, I will discuss new developments that enable spatial separation of electrons and holes in infrared-bandgap semiconductor nanocrystals. To simplify separation of charged carriers within a nanocrystals, one can use heterojunctions with a staggered, type-II alignment of band-edge states. The spatial separation of electrons and holes leads to increased recombination lifetimes, a key to successful extraction and collection of carriers in photovoltaic applications. I present the synthesis of type-II heterostructured PbSe/CdSe/CdS semiconductor nanocrystals that exhibit ultra-long carrier lifetimes.