Photocatalytic Reduction of Methylene Blue using Infrared-Active Heterosturucture Nanocrystals

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Colloidal semiconductor quantum dots exhibit size-tunable energy gap, potentially useful for a wide variety of applications such as photocatalysis, photovoltaics and light emittind divices. Core/shell heterostructure also enables the control of exciton dynamics: through a relatively simple experimental tweaks, one can tune the morphology and dimension of core and shell. We synthesized PbSe/CdSe/CdS core/shell/shell nanocrystals with type II band offset and varying morphologies ranging from sphere to pyramid and tetrapod structures. In addition, we obtained metal-semiconductor nanohybrid by growing gold nanoparticles at the corners of the semiconductor nanocrystal surface to promote photocatalytic performance for reduction of methylene blue. It turned out that the morphological change leads to significant difference in photocatalytic efficiency. Tetrapods show the highest photocatalytic performance over that of pyramids and sphere. The Au-tipped PbSe/CdSe/CdS nanocrystals exhibited exceptional photocatalytic activity in the visible and near infrared region out to 785 nm. (e.g., tetrapod heteronanocrystals under 785 nm light with 70% methylene blue reduction in 4 h)