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PLs from bandedge and surface-trapped state transitions in CdSe quantum dots for white light applications

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Semiconductor quantum dots (SQDs) of CdSe exhibit tunable absorption and emission, suitable photo-stability, high absorption coefficient, fine emission width and large PL enhancement in the vicinity of plasmonic nanoparticles. The II–VI group of SQDs has been revered for their excellent characteristics stemming from quantum confinement of carriers and a high surface-to-volume ratio. Typically in well synthesized II-VI materials, surface defects are well passivated with neutral ligands or other semiconductor materials which precludes defect related transitions between the band gap and results in narrow spectral emission. CdSe SQDs usually have some atoms on the surface that remain unbonded during the synthesis process and can lead to abundant defects on the surface of SQDs resulting in a large density of surface states at the bandedge. CdSe SQD fluorescence originates from exciton recombination from the bandedge while surface related transitions arise when the size is reduced and passivating ligands are not present. Discrete energy states and the observed blue-shift from the bulk bandgap (~1.74 eV) arises from quantum confinement of the charge carriers when the SQDs are near the exciton Bohr radius (~5.8 nm). In this study, plasmon-coupling of CdSe SQDs displayed ~2-fold PL enhancement of the surface-trapped state and shortened exciton lifetime at the bandedge via the Coulomb interaction. Although this effect has been largely studied for the band edge transition, temperature-resolved spectroscopy further elucidates the thermal and spectral dynamics at the surface trapped state.

Biography

Bagher Tabibi is a retired Professor of Physics and Scientist from Hampton University and NASA Langley Research Center, and is currently serving as a Research Professor and Principle Investigator (PI) for funded research programs. His research area includes atomic/molecular spectroscopy, stimulated Raman scattering, ultrafast non-linear laser spectroscopy, and quantum optics. He has published and presented over 250 journal publications and conference presentations as an author/co-author. In addition, he was a PI or Co-PI for numerous projects with a total budget over $25M. One of his prestigious awards was the Group Achievement Award on the solar-pumped lasers for NASA's space mission in 1992.

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