

Recombination Dynamics of Semiconductor Nano-Structures

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The experimental techniques, molecular beam epitaxy of II-VI and III-V compound semiconductor nano-structures, [1] scanning electron microscope/cathode-luminescence, [2] and time-resolved photoluminescence (TRPL), of our research group will be introduced. The TRPL was used to study the recombination dynamics of semiconductor nano-structures.

The application of semiconductor nano-structures in photonic devices and bio-labelling relies on the good quantum efficiency and recombination dynamics of nano-structures. Colloidal CdSe/ZnS quantum dots (QDs) were modified by various functional ligands to study the effect of ligand modification on the fluorescence emission wavelength, efficiency, and mechanism for their application in nano-bio-photonics. The blinking behavior of individual CdSe/ZnS QDs can be dramatically modified by additional hexadecylamine (HAD) ligands. Both the ratio of the mean on/off time lengths and the total number of emitted photons within the on-time duration can be enhanced. [3] Photoinduced fluorescence enhancement (PFE) in colloidal CdSeTe/ZnS core/shell QDs was investigated by monitoring ensemble fluorescence and single-QD fluorescence blinking behavior upon illumination. The PFE origin from single-QD viewpoint is attributed to the contributions of surface passivation by photoinduced charged carriers and the formation of neutral core/charged shell QD states. [4] The dependence of Förster resonance energy transfer (FRET) on donor-acceptor (D/A) concentration ratios in mixed-size CdTe QDs films by using PL and TRPL spectroscopy was also investigated. [5] Pressure-induced nonradiative energy transfer from small to large CdTe QDs in concentrated QD solution, confirmed by high-pressure TRPL measurements, leads to asymmetric and double-peak PL emissions under high pressure. These effects must be considered in any investigation of pressure-mediated phenomena. [6] Finally, TRPL measurements used to study the formation of magnetic polarons in ZnMnTe QDs will be reported. [1]

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