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Emission in Mn-Doped Quantum Dot

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Extended Abstract

We theoretically investigate the magneto-photoluminescence (PL) of Mn2+doped semiconductor core-shell colloidal quantum dot to explain the experiment results from a recent magneto-photoluminescence study of strongly confined diluted magnetic semiconductor (DMS) in Mn2+-doped ZnSe/CdSe core-shell colloidal nanocrystals.

Unlike the cases in bulks or in other conventional DMS materials, the yellow emission characterized for in Mn2+-which is associated with the d-d internal transition 4T1-6A1, was reported not suppressed in an applied B //z magnetic field and circularly polarized as usual and instead, developed a circular polarization. More interestingly, Mn2+- photoluminescence has been found to have a large splitting between σ+ and σ−components which depends on the applied field. This behavior has not been found in characteristics of the Mn2+ PL in bulks and other conventional DMS materials and is the result of the strong confinement of the nanocrystals.

Our theory and preliminary calculations show that, the reason the yellow Mn2+ PL band in quantum dots, indifferent to their counterparts in bulks and other low-dimensional systems, is not suppressed under applied magnetic field originates from the dot geometry and properties. Our theory of Coulomb exchange interaction of the impurity ions with the confined electrons inside the dot as well the existence of the internal electric field inside the dot show that these two effects are the reasons of the observed behaviors. The competition and combination between these two effects give different results depending on parameters and conditions.

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