Magnetism of diluted magnetic semiconductor CdSe: Mn nanocrystals

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Abstract

Dilute magnetic semiconductors (DMS) nanocrystals (NCs) have attracted the attention, since they can be used in developing spintronics, optoelectronic devices, and nano-structured quantum devices. Here, we have studied theoretically and experimentally the magnetic properties of CdSe NCs doped with Mn ions. In magnetic NCs, the short range antiferromagnetic (AFM) and ferromagnetic (FM) spin interactions affect the magnetic and optical behaviors significantly. However, because of the unknown spatial distribution of magnetic dopants in magnetic NCs, it is difficult to fully account the AFM/FM interactions. In order to really expose the AFM/FM features, we propose a simple method in which the magnetic susceptibility and the temperature dependence of the magnetic susceptibility are considered. We also use the simplified constant interaction model to analyze and explain the experimental observations. By these analysis, we confirm that a part of the magnetic ions in a magnetic NC have the short range AFM interactions. And, we can estimate the number of Mn ions in a NC and roughly their distributions as well.