Nanocomposites and nanomaterials

Synthesis of highly luminescent CdTe quantum dots

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The recent progress in chemical synthesis and methods of optical analysis has permitted a detailed understanding of semiconductor nanocrystals (NCs) – also known as nanoparticles, clusters, crystallites or quantum dots (QDs).

In particular, when the size of nanocrystallites are close to or smaller than the exciton Bohr radius within the corresponding bulk material, they exhibit very special physical and chemical properties, they exhibit quantum confinement effect with significant blue shift in absorption spectra. The band gap of quantum dots could be tuned by varying either the size through a control of growth parameter (e.g., reaction time, temperature) or the composition through an alloying with elements of a diverse nature, the resulting QDs showing color-tunable emissions accordingly. Doped semiconductor NCs have been intensively studied in the past few decades.

The most common II-VI semiconductor nanoparticles are cadmium chalcogenide nanocrystals (CdTe, CdSe and CdS). Reactions in presence of thiols mercaptans), which contain S-H group attached to carbon atom, result in surface modification of the nanoparticles and reduction of the non-radiative local surface traps which, in turn, lead to an enhancement of the quantum yield of the excitonic transitions. These specific properties of certain impurities (transitional and rare earth elements) can use them for semiconductor qualitatively new materials with a wide range of possibilities of use in optoelectronics.

In this work, we consider a simple way of getting at room temperature doped CdTe NC f-elements. CdTe nanocrystals capped with thioglycolic acid (TGA) and, thus, carrying a negative charge were synthesized in aqueous medium by the method colloidal synthesis in a semi-periodic reactor. CdTe synthesis process performed at 20C under argon using the following reagents: 0.1 M solution CdI_2, 99% TGA and obtained electrochemically H_2Te. As a dopant impurity were used the f-elements (La). It was shown that changing of the dopant type and its concentration lead to changes in electronic and luminescent properties of NCs.

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