PHOTOPHYSICAL PROPERTIES OF CDTE QUANTUM DOTS

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Abstract

In this study the effect of various capping ligands on the optical properties of CdTe quantum dots were investigated. Ligand exchange procedure was used to prepare water dispersive CdTe nanocrystals capped with aminoethanethiol, 3-mercaptopropionic and dihydrolipoic acids, starting from bare quantum dots synthesized in octadecene matrix. The nanocrystals exhibit emission quantum yield in water in the order of 30 %. The photophysics of the nanocrystals were studied by steady-state and transient photoluminescence spectroscopy. It was found that the photostability of water dispersible nanocrystals were strongly influenced by molecular oxygen, which exist naturally in the water environment. Cyclic voltammetry was employed to measure the amount of dissolved oxygen in nanocrystals solutions and correlate it with the photoluminescence of the nanocrystals. We attribute this deviation to the dissolved oxygen (O2) in the samples. Oxygen is a well-known quencher of luminescence for a wide variety of dye molecules. The luminescence quenching by oxygen in general occur through electron transfer mechanism. Similarly, in this study photoinduced electron transfer from the nanocrystals to the oxygen molecule is observed in water solutions. Figure 1 shows the effect of oxygen on the luminescence properties of CdTe nanocrystals. The spectra were taken before and after exposure to oxygen. The decrease of nanocrystals luminescence was explained by photoinduced electron transfer. Moreover, it was found that the capping ligands play crucial role in preserving the nanocrystals luminescence. The latter was tested by electron acceptor such as methylviologen. We found that the rate of electron transfer from the nanocrystals to the acceptor species was greatly influenced by the chain length of the capping ligands. Moreover, these findings explain the precipitation mechanism of water dispersible CdTe nanocrystals exposed to sunlight.

Keywords: quantum dots, ligand exchange and cyclic voltammetry

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