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Synthesis of CdSe quantum dots in ethanol: A facile way to achieve photoluminescence with high brightness

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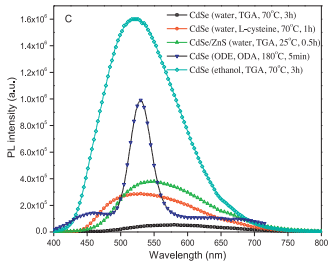
HIGHLIGHTS

- Luminescent CdSe QDs are synthesized using ethanol as a solvent.
- The QDs agglomerate to form a tri-level microstructural characteristic.
- The strong fluorescent emissions are expectedly related to such microstructure.

GRAPHICAL ABSTRACT



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ABSTRACT

Luminescent CdSe quantum dots are synthesized using ethanol as a solvent instead of commonly-used water or organic compounds with long alkyl chains. The strong fluorescent emission of the quantum dots is expectedly related to particle agglomeration that dramatically form a tri-level microstructural characteristic.

The synthetic routes for CdSe quantum dots (QDs) in the literature can be principally divided into two types, i.e. organic-phase and aqueous-phase approaches [1–3]. For organic-phase approach long alkyl chain compounds of trioctylphosphine (TOP), trioctylphosphine oxide (TOPO), octadecene (ODE), and liquid paraffin are generally used as solvents [4–7]. In the case of the aqueous-phase approach water is used and therefore the approach is simpler, cheaper, and less toxic [8]. To our best knowledge, however, no research work is conducted using ethanol as a solvent. So in this work the CdSe QDs are synthesized in ethanol and thioglycolic acid (TGA) is used as a ligand based upon our previous investigation [9]. The ultraviolet–visible (UV–vis) spectra of the ethanol-derived QDs in Fig. 1 are essentially different from those of the water-derived QDs. The exciton peaks are dramatically absent. Moreover, the extinction at long wavelength is evidently stronger. Note that the water-derived colloid samples are typically transparent with a pale yellow color while in the case of the ethanol-derived samples they are not transparent but a bit opaque with a slight blue color. The presence of some large particles is proposed to be responsible for such semitransparency. In order to confirm the truth of this proposal, some UV–vis measurements are intended. The results coincide well with our proposal. The strong extinction is from light scattering that is caused by the suspended large particles. With the increase of the centrifuging time from 1 min to 5 min, the extinction of the supernatants largely decreases. The absorption shoulders in Fig. 1A are checked to be nearly invariable with the reaction time. Consequently, the CdSe particles scarcely grow up with the extension of the reaction time. Such result is in disagreement with that

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