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A simple and fast synthesis route for preparing CdTe quantum dots in aqueous medium.

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Abstract – Luminescent CdTe quantum dots (QDots) with a narrow size- distribution were synthesized in aqueous medium at temperatures below 100 ◦C using sodium hypophosphite (NaH_2PO_2), as a reducing agent for tellurium metal. The UV-visible absorption spectra and photoluminescence measurements showed that monodispersed CdTe QDots were obtained with a narrow band of fluorescence (FWHM ~ 40 nm). This study presents a new, simple, rapid and less hazardous way of obtaining viable CdTe QDots at low temperature.

Due to the high potential of application of quantum dots a wide range of synthetic routes have been developed in order to obtain more efficient quantum dots[1-3]. As an alternative way of preparing CdTe QDots, we describe here a rapid, simple and low-cost methodology for preparing CdTe quantum dots in aqueous medium using the conventional method for transition metal ion reduction.

The methodology consists of using sodium hypophosphite (NaH_2PO_2), a reagent that is commonly used in electroless metal deposition processes, to reduce tellurium metallic powder in alkaline aqueous medium. After reduction, a solution containing Cd^{+2} ions and thioglycolic acid is added and an immediate color change from violet to brown is observed, indicating the formation of CdTe nanocrystals. In order to induce growth of nanoparticles, the suspension is then heated at 80 ºC for 60 minutes.

Figures 1 and 2 show the absorption and room-temperature photoluminescence (PL) spectra of CdTe nanocrystals. Initially we observed a clear absorption maximum for the first electronic transition of CdTe QDs that appears at 460 nm, which corresponds to the smallest CdTe nanocrystals, shifting to longer wavelengths as the particles grow as they are heated. The PL bands (Figure 2) are located close to the absorption thresholds (the so-called band-edge or “excitonic” photoluminescence) and are sufficiently narrow (full width at half-maximum, FWHM, from as low as 40 nm increasing to 55-60 nm for the size fractions of large CdTe nanocrystals). TEM analysis shows a spherical shape and monodisperse size of nanocrystals.

In short, we have developed a straightforward route for obtaining luminescent CdTe QDots with a narrow size distribution. In this case, Te metal was reduced using a conventional reducing reagent commonly used in electroless processes. This reagent is also less hazardous. The as-synthesized CdTe QDots are monodispersed and exhibit a single color PL.

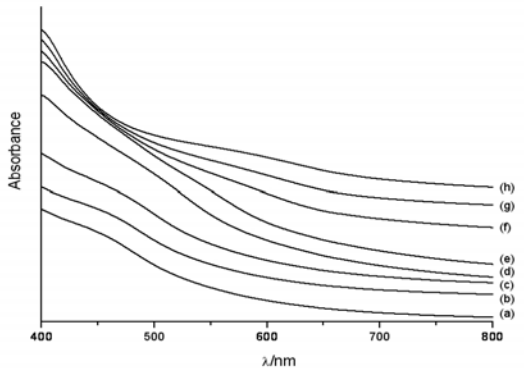

Figure 1: Absorbance spectra of CdTe QDot suspensions removed at different time intervals (a = 0 min; b = 5 min; c = 10 min; d = 20 min; e = 30 min; f = 40 min; g = 50 min; h = 60 min).

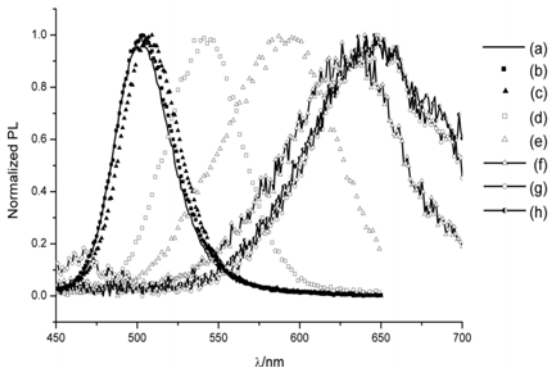

Figure 2: Photoluminescence spectra of CdTe QDots withdrawn at different time intervals (a = 0 min; b = 5 min; c = 10 min; d = 20 min; e = 30 min; f = 40 min; g = 50 min; h = 60 min).

References

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