Highly luminescent Nanostructures of CdS and ZnS prepared by microwaves heating: effect of ions metal concentration

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Colloidal semiconductor nanocrystals (NCs) are of great interest for fundamental studies[1,2] and technical applications[3-5] such as light-emitting devices, lasers, and fluorescent labels. Because of their size-dependent photoluminescence across the visible spectrum,[1] ZnS and CdS nanocrystals have become the most extensively investigated NCs. Besides the development of synthesis techniques to prepare samples with narrow size distributions,[2,6] much experimental work is devoted to molecular surface modification aiming to improve the luminescence efficiency[1] , the colloidal stability of the particles and developing a reliable processing chemistry.[2] . This work presents the results of the study in the synthesis of CdS and ZnS in presence of cadmium citrate as stabilizer agent and processed by microwaves heating. Effect of concentration of Cd and Zn ions were studied in the luminescence property. RXD, AFM, TEM and UV-Vis were used too as analytical equipment for characterization.

Nearly monodisperse and highly luminescent ZnS and CdS NPs were obtained by microwave irradiation. The ZnS and CdS NPs solutions were prepared by adding freshly prepared ZnSO4 or CdSO4 solution to a thioacetamide solution at pH 8 in the presence of sodium citrate in solution used as stabilizer. The precursors concentration were such that the metal ion concentrations were [Zn-Cd] = 3x10-2M, [Zn-Cd] = 6x10-2M and [Zn-Cd] = 8x10-2M, for each of these [Zn] or [Cd] concentrations the [S] content was fixed at [S] = 3x10-2M. NPs were prepared under microwave irradiation for 1 min at 905 W of power. The NPs samples were taken when the temperature descended to ambient temperature for further analysis.

The UV-vis spectra of the nanoparticles synthesized by microwave heating shows a blue-shift due to the quantum confinement and the reduction of the particle size. This effect is due the increase of the concentration of metal ion. The band gap of the semiconductors increases when the particle size decreases. The crystal structure of the ZnS synthesized is cubic sphalerite form and for CdS was cubic type zinc blend according the XRD analysis, Fig. 2 and 3 respectively. The results of AFM of ZnS are in accordance with the XRD results, showing sizes of around 100nm. The morphology of the prepared ZnS shows islands with a nanocenter as well as nanoparticles of about 100 nm (Fig. 4). The ZnS NPs obtained shown high monodispersity according to PL analysis, see Fig. 1. The high luminescence is present when the NPs are irradiated with UV light using energy higher than the band gap value found for each sample, this property is due to the reduction of the particle at nanometer scale. Synthesis by microwave heating provides a very powerful option to prepare ZnS and CdS nanoparticles with highly luminescent properties.

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References:

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Figures:

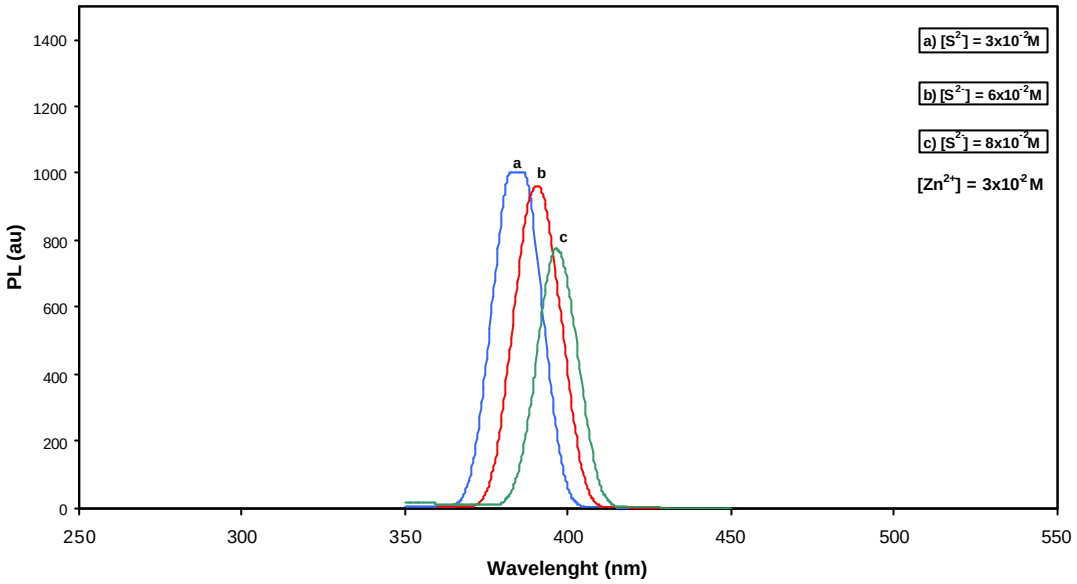

Fig. 1. Photoluminiscense of ZnS nanoparticles.

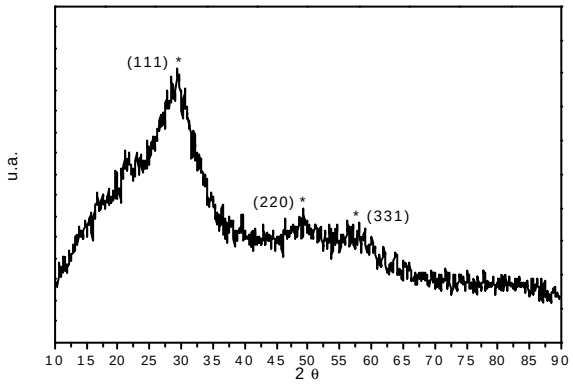

Fig. 2. XRD of ZnS nanoparticles.

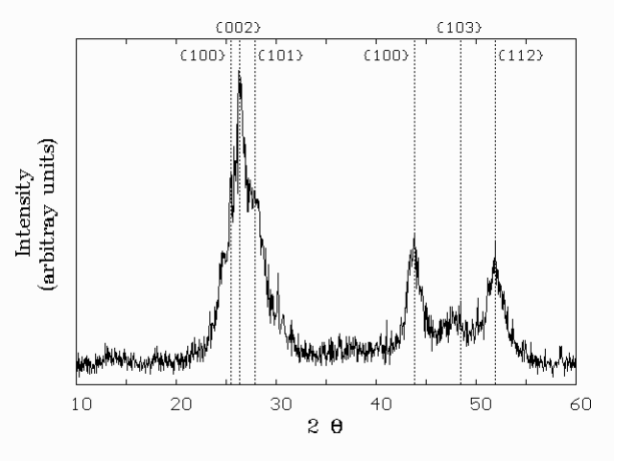

Fig. 3. XRD of CdS nanoparticles

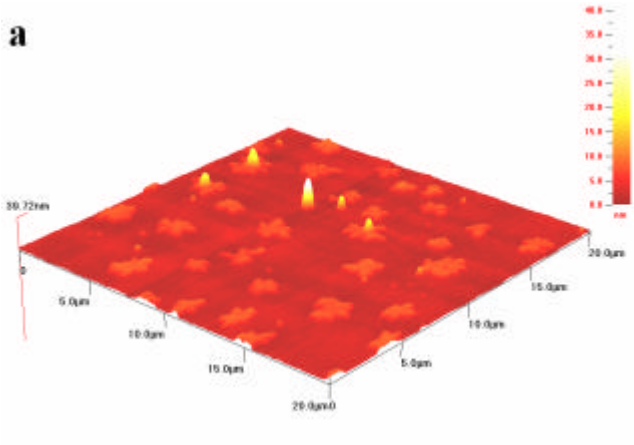

Fig. 4. AFM of ZnS nanoparticles.

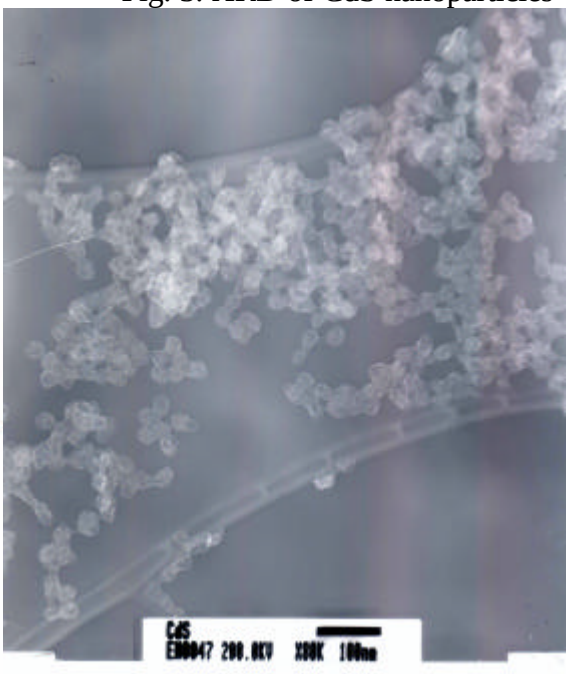

Fig. 5. TEM of CdS nanoparticles.