

Optical and Structural Properties of ZnO Quantum Dots Functionalized with 3-Aminopropylsiloxane Prepared by Sol-gel Method

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Abstract : In this study, zinc oxide (ZnO) quantum dots (QDs) have been prepared by a simple route. The growth parameters for ZnO QDs were systematically studied inside a SiO₂ shell; this shell acts as a capping agent and also enhances stability of the nanoparticles in water. ZnO QDs in silica shell could be produced by initially synthesizing a ZnO colloid (containing ZnO nanoparticles in methanol solution) and then was mixed with 3-aminopropylsiloxane used as SiO₂ precursor. ZnO QDs were deposited onto silicon substrates (100) orientation by spin-coating technique. ZnO QDs into a SiO₂ shell were pre-heated at 300 °C for 10 min after each coating, that procedure was repeated five times. The films were subsequently annealing in air atmosphere at 500 °C for 2 h to remove the trapped fluid inside the amorphous silica cage. ZnO QDs showed hexagonal wurtzite structure and about 5 nm in diameter. The composition of the films at the surface and in the bulk was obtained by Secondary Ion Mass Spectrometry (SIMS), the spectra revealed the presence of Zn- and Si- related clusters associated to the chemical species in the solid matrix. Photoluminescence (PL) spectra under 325 nm of excitation only show a strong UV emission band corresponding to ZnO QDs, such emission is enhanced with annealing. Our results showed that the method is appropriate for the preparation of ZnO QDs films embedded in a SiO₂ shell with high UV photoluminescence.

Keywords : ZnO QDs, sol gel, functionalization

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