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INFLUENCE OF THERMALLY INDUCED POLY TO SINGLE CRYSTALLINE STRUCTURAL PHASE TRANSITION ON PHOTOLUMINESCENCE AND OPTICAL ABSORPTION BEHAVIOR OF ZNO.78CD0.22S QUANTUM DOTS FOR PHOTO ELECTRONIC APPLICATIONS

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In this paper, we conduct a first trial to study the dependence of photoluminescence (PL) emission, and optical absorption edge of $Zn_{0.78}Cd_{0.22}S$ quantum dots on thermally induced - poly to single crystalline structural phase transition and morphological changes, along with excitation wavelength. It is found that, increasing annealing temperature (Ta) results in two structural phase transitions: firstly, from polycrystalline cubic to crystalline hexagonal $Zn_{0.78}Cd_{0.22}S$ structures at Ta 500°C, secondly, from polycrystalline cubic to single crystalline predominant ZnO hexagonal structure at 600°C, accompanied by an increase in XRD peaks intensity, sharpness, the crystallite size, the reduction of the internal local strain and the dislocation density, and consequently red shift of the optical gap. In addition, analysis of HRTEM images and SAED patterns, FTIR and Raman spectra indicates good agreement with XRD results. Moreover, the deconvoluted PL emission spectra at excitation wavelength 325 nm of the as-prepared and annealed nanoparticles up to 500°C demonstrate UV- blue emission bands at 362, 395, 443, and 523 nm, which quenched and red shifted to 402, 469, 509, 540 nm with increasing ex to 370 nm, along with the evolution of new emission bands at 594, 637, and 685 nm. In addition, the as-synthesized $Zn_{0.78}Cd_{0.22}S$ colloidal solution at ex of 325 nm reveals multiple broad emission bands associated with quenching and red shift in the PL intensity with increasing ex to 370 nm. Increasing Ta up to 500 oC at ex of 370 nm results in quenching and red shift of the overall PL spectra, whereas at ex of 325 nm, no change is observed. Moreover, $Zn_{0.78}Cd_{0.22}S$ nanopowder at either 600 or 700 oC at ex 370 nm reveal new and red shifted PL emission bands, along with a drastic increase in PL intensity by one order of magnitude higher than that observed at ex 325 nm. The unusual excitation wavelength dependent enhancement and blue shift of PL in $Zn_{0.78}Cd_{0.22}S$ nanopowder has demonstrated. Trapping and recombination radiative levels have been identified and the corresponding energy band diagrams are suggested.

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