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Enhanced photoluminescence emission and optical absorption edge in EDTA capped Zn0.78Cd0.22S quantum dots via excitation energy and UV photo-induced effects for photonic devices implementations

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In this work we investigate the excitation wavelength dependent photoluminescence (PL) behavior of $Zn_{0.78}Cd_{0.22}S$ nanopowder and colloidal solution. Moreover, we study the UV-induced effect on the optical band gap tuning and PL enhancement of the as-synthesized and aged $Zn_{0.78}Cd_{0.22}S$ NPs. It is found that PL emission spectrum of the nanopowder at excitation wavelength 325 nm reveals UV emission bands at 362 and 395 nm, blue emission at 443 nm, and weak green emission at 523 nm. Whereas, increasing to 370 nm, results in a spectral red shift of PL peaks position to 402, 469, 509, 540 nm and quenching in the emission intensity accompanied with the evolution of new long wavelength emission bands at 594, 637, and 685 nm. In the case of colloidal solution at 325 nm, PL emission spectrum exhibits UV emission band at 375 nm, violet band at 405. Blue band 486, as well as green bands at 542 and 570 nm. These bands are red shifted to 406, 453, 535, 604, 641, respectively, at longer of 370 nm, along with a new band at 679 nm is detected. The excitation wavelength dependent photoluminescence (PL) behavior in $Zn_{0.78}Cd_{0.22}S$ nanoparticles was studied. It is found that the deconvoluted PL emission bands for nanopowders and their colloids reveal noticeable spectral blue shift with decreasing accompanied by the intensity enhancement. This unusual behavior is explained in terms of selective particle size distribution in nanostructures, advancing of fast ionization process at short lex; and solvation process in polar solvent. In light of the obtained results, trapping, and recombination levels in $Zn_{0.78}Cd_{0.22}S$ NPs have been identified and an energy band diagrams were suggested. The observed enhancement in PL intensity and the increase of Eg by UV irradiation of colloidal solution are ascribed to the reduction in the particle size (i.e. the improvement of quantum size effect) by photo-corrosion, surface modification by photo-polymerization, the formation of photo-passivated layers, as well as oxygen adsorption on the surface of $Zn_{0.78}Cd_{0.22}S$ NPs. In addition, with increasing UV irradiation dose, PL emission intensity of aged nanopowder remarkably increases without any change in the PL peak position. This behavior was explained according to the electron filling model.

Biography

M A Osman is currently working at Assiut University, Egypt. His research interest includes Enhanced photoluminescence emission and optical absorption edge in EDTA capped Zn0.78Cd0.22S quantum dots via excitation energy and UV photo-induced effects for photonic devices implementations.

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