Minor Research Project: Synthesis and Nonlinear Optical Characterization ofCdS-based nanocomposites for Optical Applications

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SUMMARY

Semiconductor nanoparticles have been under continuous scientific interest because of their unique quantum nature,which changes the material solid-state properties. The linear and nonlinear optical properties of the semiconductors are the subject of much current theoretical and experimental interest . The optical properties of this material are currently the subject of tremendous investigations, in response to the industrial demand for optoelectronic devices that could operate at short wavelengths.

In the present work, chemical methods are used for the synthesis of CdS based nanocomposites with different dopants. In the initial stage,using chemical bath deposition we synthesised good quality CdS nanoparticles for various optical application . The CdS based nanocomposites (Ag-CdS&ZnO-CdS) were prepared by doping CdSwith different concentration of Ag and ZnO. Optical, structural, as well as morphological characterizations of these samples were done.From the absorption spectra of CdS and Ag doped CdS it is evident that the absorbance edges of CdS nanoparticles are blue shifted with respect to the bulk CdS (520 nm), indicating quantum confinement effect in nanoparticles. Doping of CdS nanoparticles with different concentration of Ag again makes the absorption peaks blue shifted. This might be due to the formation of smaller sized nanoparticles when silver impurity was doped into the pure CdS nanoparticles. The band gap for the undopedCdS nanoparticle was found to be 2.53eV whereas the doping of Ag increases the band gap to a value of 3.38 eV. The PL spectra of the CdS and Ag-doped CdS nanoparticles excited at 380nm show that CdS nanoparticles has two distinct peaks which are situated at 424 nm (narrow emission) and 525 nm (broad emission), respectively and a shoulder peak at around 492 nm whereas in Ag doped CdS nanoparticles these peaks are blue shifted . The peak around 424 nm and 492nm are assigned to the excitonic emission in CdS nanoparticles and the other peak around 525nm is assigned to surface state emission.From the XRD analysis, the mean particle size obtained is 7.24nm for the pure CdSsampleand for Ag doped CdS is 8.1725 nm. It is seen that particle are in the nanorange.From the SEM images, we observed that the particles are uniformly distributed. The SEM images of CdS and Ag doped CdS nanoparticle confirms the existence of very small crystalline nanoparticle.

In the case of ZnO-CdS Chemical bath deposition technique is used for the synthesis of Cds, hydrothermal technique is used for the synthesis of ZnO and ZnO-CdS nanocomposite were prepared by using colloidal chemical synthesis.From absorption spectra ZnO ,CdS and ZnO – CdS nanoparticles in water solvent shows an electronic absorption peak at about 373nm,507nm and 332nm.The excitonic peak of ZnO and that of CdS are found to be blue shifted with respect to their bulk, indicating quantum confinement effect in nanoparticle.The band gap of ZnO and CdS nanoparticle was found to be 3.04eV and 2.34eV, whereas the ZnO-CdSnanoparticles was found to be 2.66eV. The fluorescence maximum of ZnO and CdS is observed at 385nm and 535nm respectively. The ZnO-CdS has to distinct peak which are situates at 375nm and 565nm respectively.The 375nm emission is the near band edge emission of ZnO and 565nm emission is the near band edge emission of CdS .FromXRDanalysis,the mean particle size obtained is 12.83nm for ZnO,7.45nm for CdS and for ZnO-CdS is 20.64nm.