Abstract

ZnS, ZnS:Mn, ZnS:Ni nano-crystals were successfully synthesized at different weight percentage into poly-vinyl alcohol matrix by chemical route method. The influence of different dopant concentrations on the formation of surface morphology, particle size and optical properties of both undoped and doped ZnS nano-crystalline compounds were investigated. The nano structure was characterized with the help of X-ray diffraction (XRD). XRD studies confirmed that the nano crystalline compounds formed were zinc blende. Using Debye Scherrer's formula, the crystal size of ZnS, ZnS:Mn, ZnS:Ni nanoparticles were calculated and the average particle were found to be 2.88 nm, 2.27 nm, 2.49 nm respectively. However, the broadening of the XRD peaks at different weight percentage of Mn and Ni indicates the presence of both Mn and Ni. With the increase of dopant concentration, the particle size decreases and band gap energy increases. Transmission Electron Microscopy (TEM) showed the uniformity of the nanoparticles and their size. The particles were found to be spherical in shape and the average particle size for ZnS, ZnS:Mn, ZnS:Ni obtained from TEM were 3.5 nm, 2.45 nm, 3.75 nm respectively. Selected area electron diffraction (SAED) showed a set of three well defined rings corresponding to planes (111), (220), (311) which tallied well with the JCPDS card No. 05-0566. Surface morphology was studied with the help of Scanning Electron Microscopy (SEM). The compositional analysis of ZnS:Mn and ZnS-Ni were carried out by EDX spectrum confirms the doping percentage of Mn and Ni in ZnS nanoparticles. The EDX spectra for Mn and Ni doping at 0.25%, 0.50% 0.75%, 1.0%, also confirm the presence of Mn and Ni in ZnS. The PL study indicates that both Mn and Ni act as electron trapping centres and this results

nonradiative recombination and hence the luminescence intensities decreases because of S^{-2}. The band gap energy was calculated from the absorption spectra using Double Beam Automated Spectrophotometer (Hitachi – U3210) [UV-Visible spectrometer] and band gap was found higher than bulk ZnS. The absorbance peaks for ZnS:Mn and ZnS:Ni showed a tendency towards blue shift. It is also observed that with the increase of doping concentration, the band gap increases. The particle size obtained from XRD, TEM and Brus equation are nearly equal at different concentration for both Mn and Ni. Raman spectra indicated ZnS in well crystalline state both for Mn and Ni doping. The 0.25% doping percentage is more effective in respect of particle size for both Mn and Ni which is one of the fundamental requirement in nanoparticles. Blue and green emission at 0.5% to 1.0% indicate large band gap which has industrial application. More broadening of PL peaks for ZnS:Mn has been observed than ZnS:Ni.