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Photoluminescence of ZnSe PVA nano composite films

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Abstract

The Luminescence properties of ZnSe/PVA were investigated with different Zn^{2+} content and with different PVA concentrations. These nanocomposite samples were prepared by environmental friendly chemical method. The prepared samples were characterized by using X-Ray Diffraction (XRD), Atomic force microscope (AFM) and photoluminescence (PL).The X ray diffraction revealed cubic structure of ZnSe/PVA with particle size less than 13nm. Photoluminescence (PL) spectrum shows blue shift and intensity is found to increase with reducing particle size.

Keywords: ZnSe/PVA Nanocomposite, XRD, AFM, Photoluminescence.

1. INTRODUCTION

Organic–inorganic hybrid materials have attracted considerable attention in recent years due to their novel physical and chemical properties [1]. The combination of Polymer with semiconducting Nanoparticles allows the fabrication of thin film light-emitting devices several approaches have been reported, using two layer structure of PVA and ZnSe Particle. The ZnSe nanocomposites exhibit size dependent tunable photoluminescence, therefore they are Potentially useful in a wide range of applications [2-5]. Studies have been under taken to prepare ZnSe nanoparticles in PVA matrix and investigate their luminescence.

2. EXPERIMENTAL

ZnSe/PVA Nanocomposites were prepared by chemical method. First PVA solution was prepared in distilled water and then 1 ml $ZnCl_2$ solution was added to it. After setting the pH at 10, 1 ml of freshly prepared Na_2SeSO_3 solution was added & stirred for 90 minutes to obtain ZnSe/PVA nanocomposite. The solution was spread on glass plates and on solvent evaporation nanocomposites films were obtained. A number of samples were prepared with different PVA concentration and different Zn^{2+} content subjected to X-ray diffraction and photoluminescence and Atomic force microscopy investigations. All samples were characterized at Inter University consortium (IUC) Indore. XRD pattern have been obtained by Rigaku Rotating Anode (H-3R) diffractometer with irradiation from K_α, line of copper (λ=1.548A) and PL Studies have been Performed at MANIT, BHOPAL by F-7000 FL Spectrophotometer. The particle size was calculated using Debye scherrer formula.

3. RESULT AND DISCUSSION:

For XRD analysis, thin film of ZnSe/PVA nanocomposites with different Zn^{2+} content and varying PVA concentration were prepared. The X-ray diffraction patterns of ZnSe/PVA nanocomposites are shown in figure(1). For ZnSe/PVA samples four peaks are obtained around 20, 27.57˚, 45.59˚, 53.27˚ respectively. The first diffraction peak is obtained due to presence of PVA polymer matrix and second, third and fourth peaks are corresponds to (1,1,1), (2,2,0), (3,1,1) lattice planes of zinc blend cubic phase (ICSD-II Card no-067791). Considerable broading is observed in the X-ray pattern of the samples and this is due to the finite size of the nanocrytallities. The Scherrer formula was used to calculate the particle size (D) from full width at half maxima (FWHM) of the sample peaks.

$$D=\frac{K\lambda}{\beta COS\theta}$$

Where D is crystallite size, K is constant, θ is bragg's angle, λ is wavelength, β is full width half maxima of peak and the width of line is determined from ruler on X-axis.

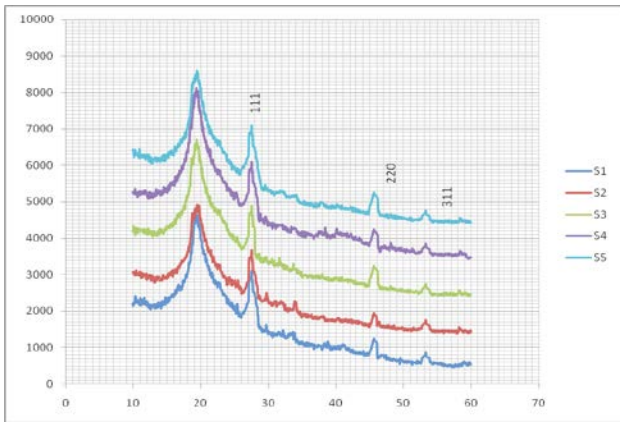


Figure1. XRD pattern of ZnSe/PVA Nanocomposite

Photoluminescence (PL) spectra, when excited by 230 nm UV light of ZnSe/PVA samples then a single peak is obtained at 465 nm and intensity is found to increase with increasing PVA concentration. Higher intensity is obtained for smaller ZnSe particles in PVA matrix. The emission may be attributed to band to band transition of ZnSe. The oscillator strength is increased by reducing the size which enhances the PL intensity. Due to proper passsivation of surface states nonradiative transitions are not increased.

The Photoluminscence spectra(fig.2) of ZnSe/PVA with variations of Zn^{2+} content excited by 325nm shows blue shift with lower particle size due to quantum confinement effect.The polymer matrix acts to stabilize the nano particle. Due to the PL peak in blue region these composite films are promising materials for optical display devices. The photoluminescence of ZnSe/PVA samples was measured by F-7000 Spectrophotometer at Department of Nanotechnology, MANAIT, Bhopal, M.P.

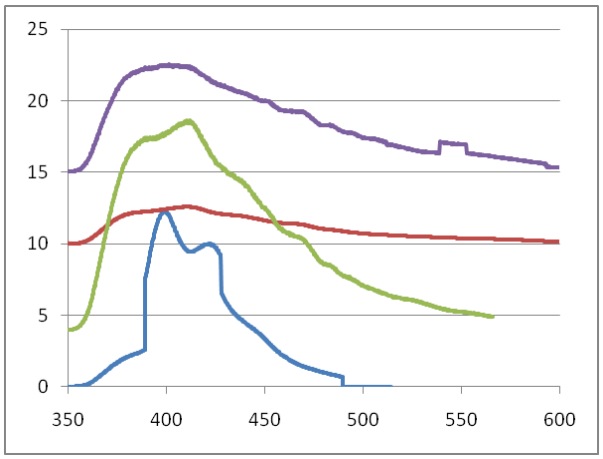
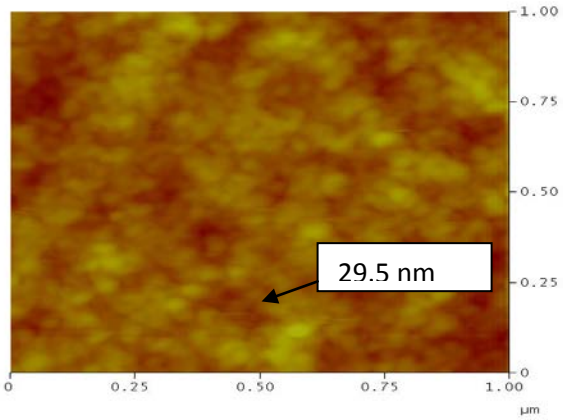


Figure 2. PL spectra of ZnSe/PVA Nanocomposite

The Particle sizes from AFM image is below than 50nm shows strong agreement with those obtained from XRD.

Figure 3. AFM Picture of ZnSe/PVA Nanocomposite



4. CONCLUSION

It is shown in present work; an economical and simple method was used to prepare nanocomposites. The average particle size of ZnSe reduces on increasing PVA concentration in ZnSe/PVA nanocomposites. The PL intensity was also increased due to enhanced oscillator strength in nanoparticles. Strongly blue shift was revealed due to shifting of PL peaks towards lower wavelength region in PL spectra and makes suitable these materials for display purpose. AFM observations showed uniform distribution of ZnSe particle in PVA matrix with nanometer regime.

5. REFERENCES

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