ABSTRACT

The nanocomposite films of ZnSe nanocrystals in polyvinyl alcohol (PVA) matrix were synthesized by environmental friendly chemical method for optoelectronic Applications. These composites were characterized by X-ray diffraction and AFM, which indicates the hexagonal crystalline structure with particle size up to a few nm. The Particle size is found to decrease by increasing PVA Concentration. The photoluminescence properties of these composite films with varying concentration of PVA and Zn have been investigated. This may be useful for their potential application in anti-reflection coating, display devices and optical sensors. Micro Hardness of these nanocomposites was also measured by Vicker hardness tester and its dependence with varying load and mechanical behavior of samples was discussed.
INTRODUCTION

• Polymer- inorganic nanocomposites have attracted much attention recently due to their unique size dependent chemical and physical properties [1].

• ZnSe nanocomposites exhibit size dependent tunable photoluminescence [2].

• Studies have been under taken to prepare ZnSe nanoparticles in PVA matrix and investigate their Photo luminescence.
**EXPERIMENTAL**

- ZnSe/PVA Nanocomposites were prepared by chemical method.
- First PVA solution was prepared in distilled water and then 1 ml ZnCl₂ solution was added to it for ZnSe/PVA.
- After setting the pH by NH₃ solution at 10, 1 ml of freshly prepared Na₂SeSO₃ solution was added and 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 varying Zn\textsuperscript{2+} content and different PVA concentrations and subjected to X-ray diffraction and photoluminescence and AFM investigations.
XRD

- XRD pattern reveals cubic structure for ZnSe/PVA.
- Three Peaks are obtained at $2\theta=27.57^\circ, 45.59^\circ, 53.27^\circ$ indicating reflection from (111), (220), (311) planes for ZnSe/PVA.
- The peak corresponding to $2\theta=20^\circ$ represents PVA matrix.

Fig. 1. XRD pattern of ZnSe/PVA
• The Particles size of samples computed from Debye Scherrer formula are obtained up to 13nm.
• The Particle size is found to decrease by increasing PVA Concentration.
• PVA is acting as capping agent and by increasing its concentration smaller ZnSe particles are formed in its matrix.
higher intensity is observed by increasing PVA content in ZnSe nanocomposite films without any change in position of PL peak.

Higher intensity is obtained for smaller ZnSe in PVA matrix.

Fig. 2 Photoluminescence Spectra of ZnSe/PVA Samples with different PVA Concentrations
• The emission may be attributed to band to band transition of which is greater than bulk band gap of ZnSe.

• The oscillator strength is increased by reducing the size which enhances the PL intensity.

• Due to proper passsivation of surface states non radiative transitions are not increased which enhance the PL intensity.
The Photoluminescence spectra of ZnSe/PVA with variations of Zn$^{2+}$ content excited by 325nm (fig. 3)

It shows blue shift with lower particle size due to quantum confinement effect.
Refractive Index Measurements

• Optically transparent ZnSe/PVA composite Samples of comparatively larger thickness are prepared and obtained in thin film form.

• All prepared films exhibit excellent optical transparency in the visible region.

• The Refractive index of these composites was measured at sodium line (5893Å) with the help of Abee’ refractometer and was found in the range of 1.695-1.730.
Microhardness Measurements

- Micro-hardness of these nanocomposites was also measured by Vicker hardness tester-Vaiseshika microhardness tester 7005.
- It is seen that hardness increases with small size of Nanocomposite.

**Fig. 4**

![Graph showing microhardness measurements](image)
AFM Measurements

- The Particle sizes from AFM image is below than 50nm shows strong aggreement with those obtained from XRD.
- I have shown some of the AFM Pictures of ZnSe/PVA nanocomposites.
5. CONCLUSION

- Thus ZnSe/PVA Nanocomposites can be synthesized by very simple chemical route.
- XRD analysis revealed that, increasing PVA concentration in ZnSe/PVA composites, particle size is reduced.
- The average particle size of ZnSe reduces on increasing PVA concentration and Zn$^{2+}$ content in ZnSe/PVA composites.
- PL intensity is also increased due to enhanced oscillator strength in nanoparticles.
- The polymer matrix acts to stabilize the nano particle.
• It is seen that refractive index decreases with increasing polymer concentration.
• Hardness increases with smaller size and follows meyer’s law for n>2.
• This may be useful for their potential application in anti-reflection coating, display devices and optical sensors.
• Due to the PL peak in green these composite films are promising materials for Opto electronic Devices.
Nanocomposites of High refractive index, enhanced PL intensity are used to prepare optical display devices like light emitting diodes (LEDs), Liquid crystal display (LCDs).
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Thanks for your attention