International Journal of NanoScience and Nanotechnology.
ISSN 0974-3081 Volume 4, Number 1 (2013), pp. 35-39

http://www.irphouse.com

Morphology of Cadmium Sulfide/Polystyrene Nanocomposites.

Vijaya S. Sangawar and Roshani N. Bhagat*

Polymer/Nanomaterials Research Laboratory,
Govt. Vidarbha Institute of Science And Humanities,
Amravati (M.S.), India, 444604.
Email: vijayasangawar@yahoo.co.in, roshubhagat@gmail.com

Abstract

In the present work, Solution growth technique was employed for the preparation of cadmium sulfide /polystyrene nanocomposite thin films by varying the composition of cadmium sulfide by wt. % (1,5,10 & 15 wt.%) in polystyrene. XRD reveals that CdS/PSt nanocomposite thin films are in single phase having cubic structure. Microstructural analysis using Scanning Electron Microscope (SEM) shows that dispersion of CdS nanoparticles are in polymer matrix, having average particle size of about 20 nm.

Keywords: Thin films, XRD, SEM.

1. Introduction

Inorganic–organic polymer nanocomposites have attracted wide interest, because the addition of inorganic nanoparticles to polymers can enhance conductivity [1], mechanical toughness [2], optical activity [3,4], and catalytic activity [5]. Polymer nanocomposites have been found successful applications in versatile areas such as organic batteries [6], microelectronics [7], nonlinear optics [8], and sensors [9].

Polystyrene is a commercial polymer available in molecular weights ranging from 100,000–400,000. It is soluble in toluene, benzene and in several organic solvents. In the present work X-RD & SEM analysis of CdS/PSt nanocomposite thin films has been discussed in detail.

2. Experimental

2.1. Sample preparation

The CdS/PSt nanocomposite thin films were prepared by dissolving PS resin (MW 100,000–400,000) in toulene at 100^0C under vigorous stirring for 1 hour. In PS, CdS

was remain in the dispersed phase. The composition of CdS in PS is 1, 5, 10 and 15 by wt. %. The sample was obtained by casting the solution on a leveled glass substrate and evaporating the solvent at room temperature under normal atmospheric pressure.

2.2. Characterization

The X-ray diffraction (XRD) was made on a PHILLIPS HOLLAND PW1710 X-ray diffractometer using CuKά radiation (λ=0.154056nm). The morphology of the prepared thin films was examined using a Leica Cambridge scanning electron microscope (Steroscan 360).

3. Result and Discussion

3.1 X-Ray Diffraction (XRD) Analysis

The CdS in the form of fine nanopowder has been synthesized in our laboratory by simple chemical rout technique and was found to be crystalline in nature. X-RD pattern showed four peaks at 23.435^0, 26.590^0, 47.920^0 & 61.605^0 were observed details are given elsewhere [10].

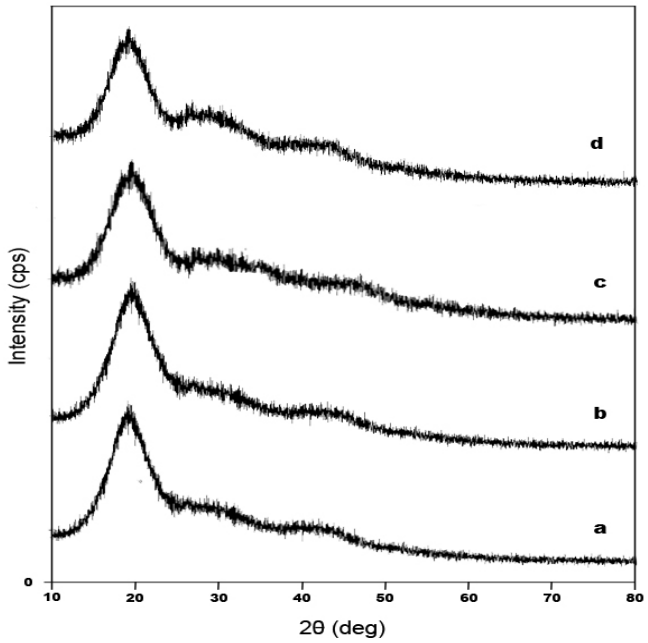

Figure 3.1 : X-ray diffractograms of CdS/PSt nanocomposite thin film.

In order to observe the effect of semiconducting nanoparticles CdS on morphology of PS which is amorphous in nature, CdS has been added in different wt.% i.e. (1, 5, 10 & 15 wt.%). Fig. 3.1(a), (b), (c) & (d) are the diffractograms for 1, 5, 10 & 15 wt. % for CdS/PSt nanocomposite thin film respectively.

For all the composite thin film, a broad peak is observed represents amorphous nature. Peak position for all filled samples is observed at an angle 19.03^0, 19^0, 18.7^0 & 18.33^0 for 1, 5, 10 & 15 wt. % CdS/PSt composite respectively. From diffractograms it is observed that as % of CdS in PS increases peak shifted towards the lower angle, along with increase in peak width where as peak height decreases. This type of findings might be due to the small size of the crystal.
Apart from broad peak, two small hump like structure is observed in all diffractograms in the region 25^0-45^0 which analogous to the presence of CdS in PS, which are clearly observed in pure CdS diffractogram [10].

3.2 Structural (SEM) Analysis
Surface morphology was observed using SEM image for 1, 5, 10 & 15 wt. % of CdS/PSt nanocomposite thin film presented in fig. 3.2(a), (b), (c) & (d) respectively. All SEM pattern shows that the film is almost homogenous, without any pinholes or cracks and covered the substrate well. It shows the evenly dispersion of CdS nanoparticles in PS.

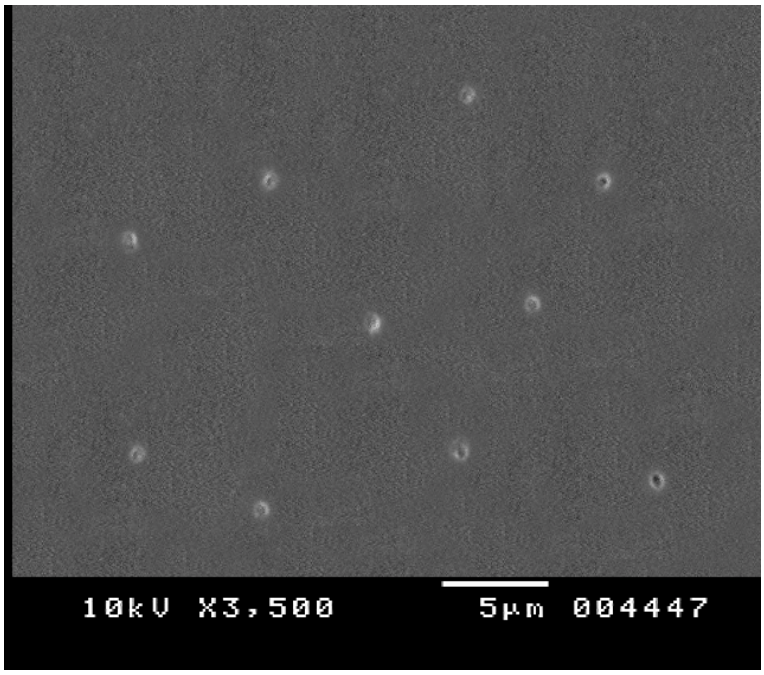

Figure 3.2(a): SEM pattern of CdS-1%/PSt nanocomposite thin film.

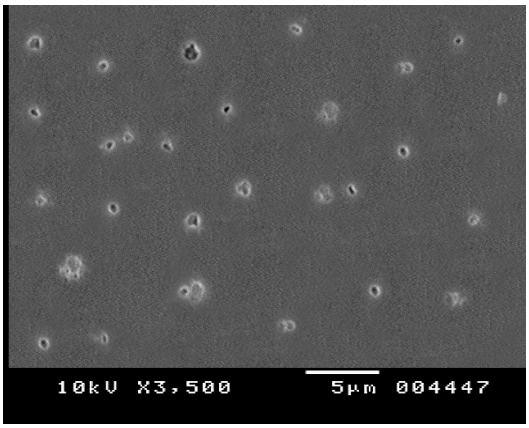

Figure 3.2(b): SEM pattern of CdS-5%/PSt nanocomposite thin film.

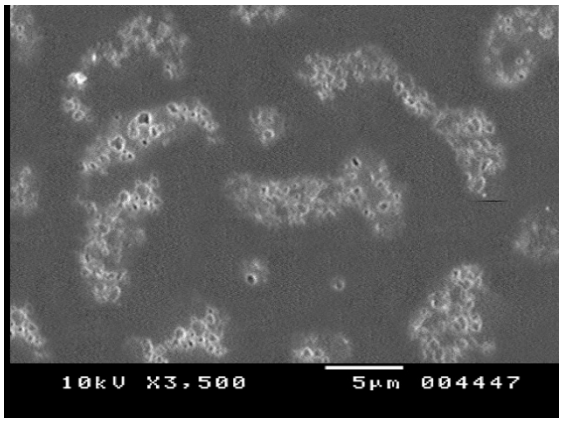

Figure 3.2(c): SEM pattern of CdS-10%/PSt nanocomposite thin film.

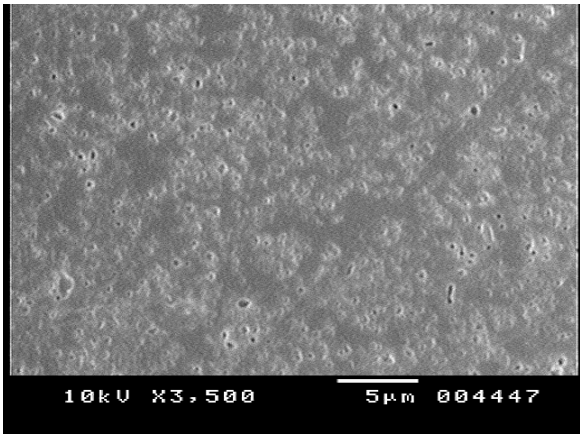

Figure 3.2(d): SEM pattern of CdS-15%/PSt nanocomposite thin film.

Fig. 3.2 (a) is the 1% of CdS/PSt nanocomposite thin film shows that the average particle size of CdS is calculated to be 2.65 nm using Scherrer formula having cubic phase and crystalline in nature[10] are in well dispersed form in PS microspheres. As wt. % increases (fig. 3.2 (b), (c) & (d)) presence of number of CdS particle increases and also the agglomeration are clearly observed.

Conclusion

The CdS/Polystyrene nanocomposites films were prepared by solution growth technique. The structural characterization through the diffraction of X-rays revealed that the introduction of crystalline particles of CdS of cubic structure in the polystyrene films. And microstrctural analysis shows that CdS nanoparticles in polymer matrix.

This method constitutes a promising way to prepare versatile inorganic–organic polymer nanocomposite microspheres.

References

[1] F. Croce, G.B. Appetecchi, L. Persi, B. Scrosati, Nature 394 (1998) 456.
[2] T.J. Pinnavaia, Science 220 (1983) 365.
[3] Y. Wang, N. Herron, Science 273 (1996) 632.
[4] J.G. Winiarz, L.M. Zhang, M. Lal, C.S. Friend, P.N. Prasad, J. Am. Chem. Soc. 121 (1999) 5287.
[5] G. Schmid (Ed.), Clusters and Colloids, Wiley, Weinheim, Germany, 1994.
[6] L.F. Nazar, Z. Zhang, D. Zinkweg, J. Am. Chem. Soc. 114 (1992) 6239.
[7] J.K. Vassilion, R.P. Ziebarth, F.J. Disalvo, Chem. Mater. 2 (1990) 738.
[8] L.L. Beecroft, C.K. Ober, Chem. Mater. 9 (1999) 1302.
[9] G. Cao, M.E. Garcia, M. Aleala, L.F. Burgess, T.E. Mallouk, J. Am. Chem. Soc. 114 (1992) 7574.
[10] Manisha C. Golchha, Roshani N. Bhagat and Vijaya S. Sangawar, International Journal of Nanotechnology and Applications, (2011).