



## Original Research Article

# Morphology of Cadmium Sulfide/Poly(ethylene)Oxide Nanocomposites

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## ABSTRACT

### Keywords

Cadmium Sulfide, Poly (ethylene) Oxide Nanocomposites

The present study the thickness of all the thin film samples are measured by occlusometer in conjunction with microscope. The thickness was found to be of the order~46.14  $\mu\text{m}$  of all the samples and taken constant throughout the entire work. The resin used in this work is poly (ethylene oxide) (M W 4,000,000) obtained from CNR (Nopoli-Italy). Composite thin films of unfilled PEO and CdS filled PEO were prepared by solution evaporation technique. Before casting the mixture solution of PEO and CdS was stirred for two hours using magnetic stirrer so that the CdS nanopowder uniformly mixed with PEO solution. The complex formation in CdS/PEO composite system has been confirmed from the XRD results, it shows that the intensity of the crystalline peaks of the XRD pattern decreases and the area under the peak was broadening. From diffractograms it is observed that as percentage of CdS in PEO 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. SEM result revealed that as weight percentage increases presence of number of CdS particle increases and also the agglomeration are clearly observed.

## Introduction

Various metals, ceramics and polymers are considered suitable for the use in biomedical and industrial applications. Polymers are too flexible and too weak to be used in certain applications and their properties can adversely be affected by sterilization processes. They may also absorb liquids and swell, or leach undesirable products [Orefice R L et al (2003)].

In composite polymers, the second component with very different properties is added to the polymer so that both

components contribute to the properties of the product. The second component often increases the strength or stiffness of the product and said to reinforce it. Although composites are very important class of polymeric materials and they form a separate subject of study, it is necessary to consider the properties of both-polymer matrix and reinforcing material [Devid I Bower (2002)].

Poly (ethylene) Oxide is water-soluble polymer, a non-ionic high molecular weight

polymer with good water solubility and heat formative. It is non-toxic, non-irritant, and it will not generate residue sediment and vaporous elements.

## **Materials and Methods**

### **Materials**

The Poly(ethylene oxide) was purchased from (Sigma-Aldrich) with 99% purity. Deionised water was used as solvent. Synthesized Cadmium Sulfide by aqueous solution method was used as filler.

### **Synthesis of sample preparation**

The resin used in this work is poly (ethylene oxide) (M W 4,000,000) obtained from CNR (Nopoli-Italy). Composite thin films of unfilled PEO and CdS filled PEO were prepared by solution evaporation technique. Before casting the mixture solution of PEO and CdS was stirred for two hours using magnetic stirrer so that the CdS nanopowder uniformly mixed with PEO solution. Then the mixture was cast on a leveled glass substrate and was allowed to evaporate the solvent at room temperature under normal atmospheric pressure. Composite thin films of PEO with 1, 5 10 and 15 weight percentage of CdS were dried at room temperature for two days. Then after completing evaporation, the film was detached from surface. In this way, the thin films of unfilled PEO and CdS filled in PEO were prepared by solution evaporation technique.

Thus in the present study the thickness of all the thin film samples are measured by ocurometer in conjunction with microscope. The thickness was found to be of the order~46.14  $\mu\text{m}$  of all the samples and taken constant throughout the entire work.

### **Characterization**

Electrical and optical properties of the samples are influenced by the crystallographic nature. X-Ray diffraction (XRD) studies were carried out to study the crystallographic properties of the experimental samples. X-ray diffraction measurement was carried out using PHILLIPS Holland, XRD system PW 1710 diffractometer using  $\text{CuK}\alpha$  radiation ( $\lambda = 0.154056 \text{ nm}$ ). Scanning Electron Microscopy technique is used owing to its high degree of accuracy in determining the morphological details of the samples under investigation. Surface morphology analyses of nanocomposite thin films were performed by a field emission Scanning Electron Microscopy (SEM), JEOL-63330F, 15 KV, Diya lab, Mumbai.

### **Results and Discussion**

#### **X-ray diffractogram (XRD)**

X-ray diffraction method is commonly used to study the crystallinity in polymers. Generally polymers cannot be regarded as 100 % crystalline. The degree of crystallinity varies from polymer to polymer and many polymers are non-srystalline that is amorphous in nature. The presence of crystalline and amorphous region in polymers can be accounted by X-ray diffraction.

The diffraction or interference pattern of X-ray from the specimen provides information on wide variety of quantitative physical structure characteristic such as shape and dimension, distance between scattering centers and the extent of order or repeat distance in a given structural arrangement etc. for understanding and elucidating the structure of crystalline.

Figure 3.1 shows X-Ray diffractograms (Intensity versus  $2\theta$  curve) of unfilled PEO sample. The sample is crystalline with sharp PEO peaks at  $2\theta=18.77^\circ$ ,  $22.42^\circ$ ,  $28^\circ$ ,  $43.18^\circ$  and  $52^\circ$  respectively. The strongest XRD peak present at  $2\theta=22.42^\circ$ .

From XRD diffractograms it is concluded that the crystalline nature of the unfilled PEO composite thin film. Our result is good agreement with Mohd. Rafie Johan et al (2011), Angesh Chandra (2013), Rajendran S et al (2011).

Figure 3.1 (a, b, c and d) shows the X-ray diffraction patterns of (a)1, (b)5, (c)10 and (d)15 weight percentage for CdS filled PEO composite thin films respectively. Slight differences are observed in the peak positions between the unfilled PEO and CdS filled in PEO composite thin films.

The diffraction peaks between  $2\theta=15^\circ-30^\circ$  are clearly apparent in unfilled PEO and also in CdS filled in PEO composite thin films for all concentrations. [Sreekanth T et al (1999), Hashmi S A et al (1990)]. Accompanying the decrease is in the gradual broadening of the diffraction peak with increasing weight percentage of CdS in PEO [Jaipal Reddy M et al (2002)]. The peaks exhibit a drastic decrease of their intensity with broadening at higher weight percentage of CdS. The results affirm both the decrease of degree of crystallinity and the lamellae size with increasing CdS. The lost of long-range order in X-ray diffraction results evidence of decrease in crystallinity with increasing the concentration of CdS [Jaipal Reddy M et al (2002)]. From diffractograms it is observed that as percentage of CdS in PEO increases peak was shift 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 [Chin- Yeh Chiang et al (2003)].

Apart from these diffraction peaks, two broad peaks observed at an angle  $2\theta=43.18^\circ$  and  $52^\circ$  respectively which analogous to the presence of CdS in PEO, which is clearly observed in unfilled CdS diffractogram [Sangawar V S et al 2011].

It is observed that the intensity of the crystalline peaks of composite thin films in the XRD pattern decreases with increase in loading percentage of CdS in PEO and the area under the peak was also found to be increased.

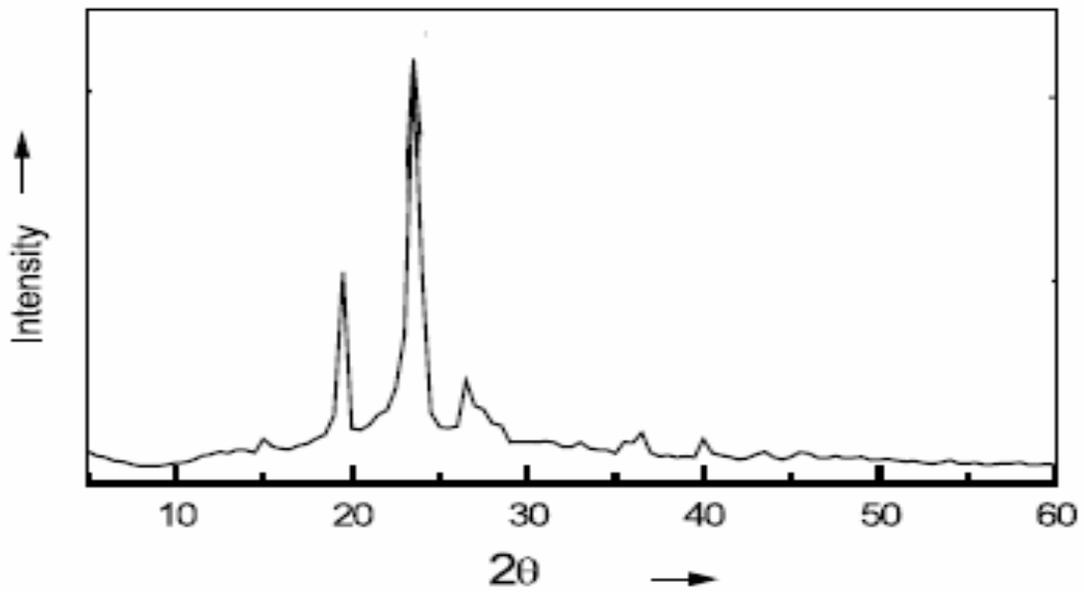
### Scanning electron microscopy (SEM)

The morphology of composite thin films can be investigated using Scanning Electron Microscopy (SEM). The wide range of magnification makes it suitable for investigation of microstructure and sometimes nanostructure of polymers. SEM also shows doping/dedoping process is often accompanied by major changes in morphology perhaps due to swelling caused by the insertion and removal of ions within the polymer.

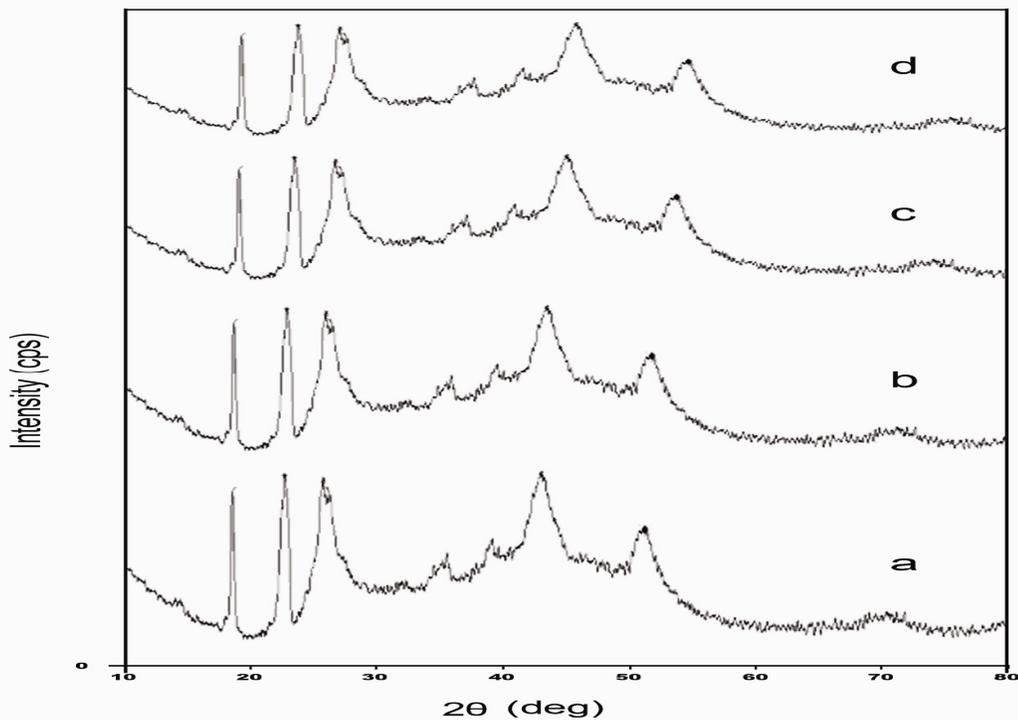
SEM micrographs for (a)1, (b)5, (c)10 and (d)15 weight percentage of CdS filled PEO composite thin films are shown in figure 3.2(a, b, c and d) respectively. On comparing micrographs of CdS [Sangawar V S et al 2011] and CdS filled PEO composites, it is observed CdS nanoparticles are well dispersed in PEO matrix.

Figure shows that CdS are in well dispersed form in PEO microspheres and this dispersion is non uniform. As weight percentage of CdS increases presence of number of CdS particle increases and gets the agglomerated as clearly observed in SEM micrographs.

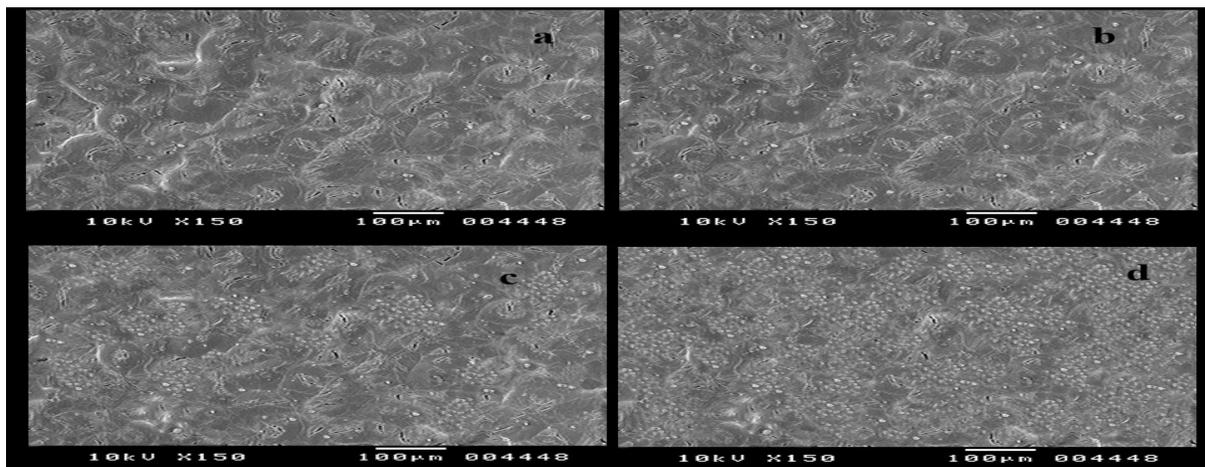
**Figure 3.1:** X-ray diffract gram for unfilled Poly(ethylene)Oxide thin film



**Figure 3.1(a, b, c, d):** shows the X-ray diffraction patterns of (a)1, (b)5, (c)10 and (d)15 weight percentage for CdS filled PEO composite thin films respectively.



3.1 (a, b, c and d): SEM pattern Cadmium Sulfide filled Polyethylene Oxide composite thin film for a)1, b)5, c)10 and d) 15 weight percentage respectively.



Thus SEM of all the samples revealed the successful incorporation of CdS nanoparticles in PEO matrix. The SEM images for lower loading percentage of CdS were similar to one another but as the CdS proportion reached towards highest value, the morphology of CdS can be easily observed in host matrix.

Well prepared PEO composite thin film using CdS as filler by solution casting technique. The complex formation in CdS/PEO composite system has been confirmed from the XRD results, it shows that the intensity of the crystalline peaks of the XRD pattern decreases and the area under the peak was broadening.

From diffractograms it is observed that as percentage of CdS in PEO 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. SEM result revealed that as weight percentage increases presence of number of CdS particle increases and also the agglomeration are clearly observed.

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