Preperation CdS thin films for optoelectronic applications

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Abstract- Cadmium sulfide (CdS) thin films were prepared by Chemical Spray Pyrolysis Deposition (CPD) technique onto microscope glass substrates at 200, 250 °C, using aqueous solution of cadmium chloride and thiourea salts. The crystalline quality and the surface morphology of the deposited CdS thin film were characterized using X-ray diffraction and Atomic Force Microscopy, respectively. The optical properties of the prepared films were analyzed by UV-Visible . After all investitagions, it is concluded that 200, 250 °C substrate temperature is suitable for producing CdS thin with (CPD) technique.

II-IV compound semiconductors have hexagonal type structure, they have wide energy gap (1,7-13,4 eV) [1]. CdS is one of the most vital and classical II-IV group semiconductors with a direct band gap of 2.4 eV at room temperature[2]. CdS thin films are also widely used as n type window layers in thin film solar cells [3] because of suitable band gap, optical absorption, and good stability of the used materials[4]. Spray pyrolysis method is best suited for CdS thin film deposition because of simplicity, convenience, least expenses[5].

In the present work, the spray solutions were prepared using a mixture of solutions of $CdCl_2$ (source of cadmium ions) and (NH_2) CS (source of sulfur ions); water was added in order to obtain a concentration of 0.01 M. The schematic representation of the CPD apparatus is shown in Figure 1. Microscope glass was used as substrates. First, they were cleaned with acetone for ten minutes and then thoroughly washed in deionizer water for 15 minutes. The substrates were then dried in a drying oven. The temperature of the substrate was measured as 200 °C and 250 ±5 °C by a non-contact IR thermometer and a K type thermo couple.

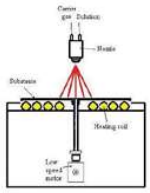


Figure 1. Spray Pyrolysis System

In this work , it is expected hexagonal (wurtzite) phase for as- deposited CdS thin films at 200 °C and 250 °C by Chemical Spray Pyrolysis Technique . It is observed from figure 2a-b, the highest reflection peak intensity that for as-deposited thin film at 200 °C and 250 °C is (002) hexagonal plane. However, Other peaks are observed that are very low intensity for 250 °C but they are very high intensity for 200 °C. The morphologies of as-deposited CdS thin film characterized by two-dimensional AFM scans of the sample surface after deposition are shown in Figure 3a-b. The images were obtained in tapping mode. From the micrograph it is seen grains of CdS thin films.

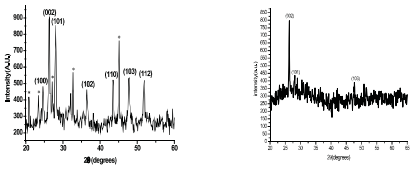


Figure 2. Xrd results of CdS thin film prepared at a)200 °C b) 250 °C

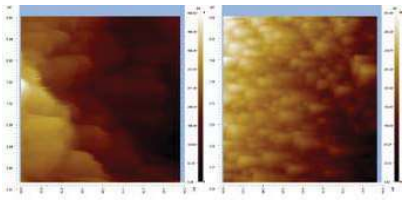


Figure 3. AFM results of CdS thin film prepared at a) 200 °C b) 250 °C

The optical properties of CdS thin film was measured by UV-Vis spectrometer. Figure 4a-b shows the transmittance spectra of CdS film as grown by Chemical Spray pyrolysis technique were observed in the wavelenght range 500-850 nm. According to results, CdS thin film exhibits high transparency (from 85 to 98 %) in the visible region from 530 to 850 nm, making them possible to be used as window layers in solar cells for as deposited CdS thin film at 250 °C [**5**]. However, CdS thin film exhibits transparency from 40 to 60 % in the visible region from 530 to 850 nm for as deposited CdS thin film at 200 °C.

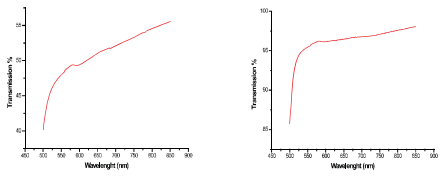


Figure 4. UV-Vis results of CdS thin film prepared at a)200 °C b) 250 °C

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[1] Deokjoon Cha,Sunmi Kim,N.K. Huang, Material Science and Engineering B, 106(2004)63-68
[2] Fei Li ,Wentuan Bi, Tao Kong, ChuanjinWang, Zhen Li, Xintang Huang Journal of Alloys and Compounds 479 (2009) 707–710
[3] Hui Zhang,Xiangyang Ma, Deren Yang, Materials Letters 58 (2003) 5-9
[4] V.Bilgin,S. Kose,F.Atay,I Akyuz, Material Chemistry and Physics 94(2005) 103-108
[5] J.Hiie, T.Dedova, V.Valdna, K.Muska Thin Solid Films 511-512 (2006) 443-447