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Original Research Paper

# Annealing Effect on Electrical Properties of Cds Thin Films by Spray Pyrolysis

Physics

**KEYWORDS :** -Spray pyrolysis, Electrical Properties, SEM Study.

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## ABSTRACT

*Spray pyrolysis technique to prepare CdS thin films on glass substrate has been used. Semiconducting CdS thin films have been deposited onto a biological glass substrate at temperature 3000C and films annealed for one hour. SEM study revealed that the grain size increases as the films annealed. From Hot probe method, the material has been found to exhibit p-type conductivity. Semiconducting nature of the films is observed from the four-probe resistivity measurement for the temperature ranging from 300 K to 573 K. the activation energy values calculated as 0.045 eV and 0.94 eV for the temperature range 300 K to 450 K and 450 K to 573 K respectively. The Arrhenius plot shows shallow levels from cadmium or sulphur interstials are found to extrinsic conductivity near room temperature, where as deep strap states influence at higher temperature. The annealed films indicate that the atoms are arrange in the crystal in regular manner. The SEM study shows that grain size of the films increases as films annealed.*

**Introduction**

Cadmium sulfide is an II-VI group semiconductor with a large direct band gap in the near UV region. The large band gap material is suitable for use in the blue light emitting diodes [1] and optoelectronic devices [2, 3]. The thin films of CdS are usually prepared by different technique such as sputtering, chemical bath deposition, vacuum evaporation technique, etc.

We are chosen spray pyrolysis method due to cheap, inexpensive method which is used to prepared on large area. In this paper we reported annealing effect on electrical properties of CdS thin films. Thickness of the films was measured by Michelson interferometer. Electrical resistivity of films was calculated by four probe method. Temperature of thin films was measured by pre-calibrated copper constantan thermocouple.

**Experimental Details:-**

Aqueous solution 0.1 M of cadmium dichloride and thiourea were used for spraying the films. The chemical used was of AR grade. Detailed preparation of CdS thin films were explain elsewhere [4].

**Electrical Properties:-**

The conductivity of the films as determined by the Hot-probe method was of p-type. The resistivity is determined for the temperature range 300 K to 573 K at atmospheric pressure by four probe method [5] of as deposited and annealed films for one hour.

Electrical conductivity (σ) with temperature is usually expressed as,

$$\sigma = \sigma_0 \exp\left(\frac{-E_a}{kT}\right)$$

Where, Ea- is the activation energy measured from the bottom of conduction band, K- is the Boltzmann constant and T- is the absolute temperature.

Fig. 1 (a), (b) shows a Arrhenius plot of conductivity vs inverse temperature for the above temperature range. In Fig. 1 (a) two distinct regions (I- 300 K to 450 K and II- 450 K to 573 K) of conductivity are seen.

The mechanisms that contributes to the conductivity. The conductivity of the films increases with increasing temperature indicating the semiconducting behavior of the films. The as deposited films fig. 1 (a) curve suggest that there are two type conduction mechanism that contribute to the conductivity. Activation energy calculated for these two regions are 0.045 eV and 0.94 eV for the temperature range 300 K to 450 K and 450 K to 573 K respectively. Arrhenius plot can yield the different levels which are responsible for different donor or acceptor mechanism [6, 7].

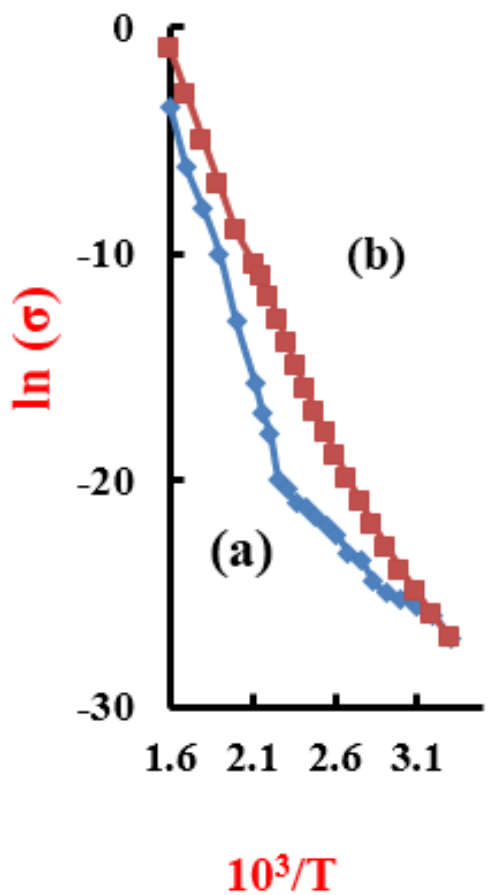


**Fig 1.Arrhenius plot of conductivity of CdS thin films (a) as deposited and (b) annealed for 1 hour**

The change in the carrier mechanism is indicated by the change in the slope of the curve [8].Curve (b) shows the Arrhenius plot of conductivity for annealed films for 1 hour, which shows the conductivity increases when films are annealed. This indicates that atom are in crystal are in regular manner in the crystal. Devi et al [9] has reported the activation energy of cadmium or sulphur interstials was between 0.06 eV and 0.82 eV for 308 K- 448 K and 448 K to

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523 K for these temperature range respectively, which is in fairly good agreement with our calculated values 0.045 eV and 0.94 eV activation energies indicating the cadmium or sulphur interstials.

**SEM Study**

**Fig.2 (a) shows the scanning electron microscope study of CdS thin films of as deposited. Fig.2. (b) Shows the SEM microscope study of annealed CdS films for one hour. It was observed that after annealed the grain size was increases.**

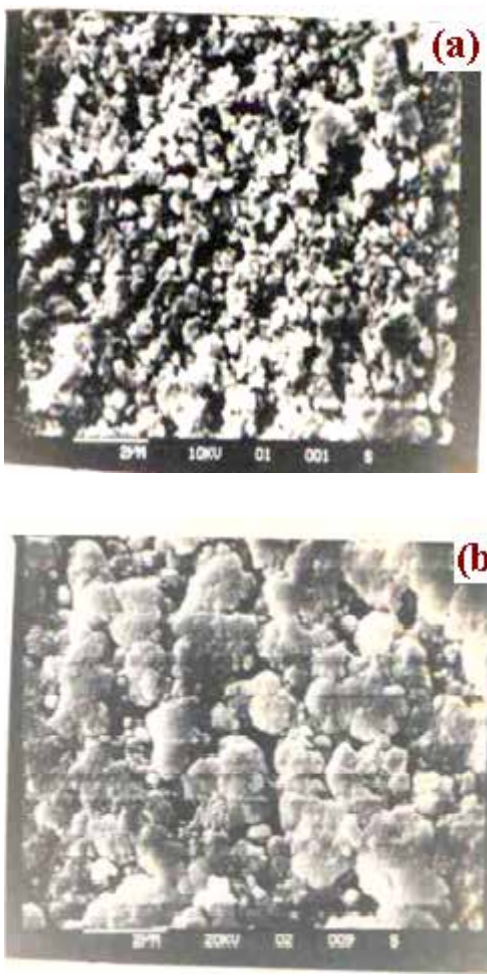


**Fig.2 SEM of CdS thin films (a) as deposited, (b) annealed for 1 hour**

**Conclusion**

Spray pyrolysis method for production of the solid films is a good method for preparation of thin films suitable for scientific studies and for many applications in technology and industry.

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