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Study of Band Gap Energy of Solution II-VI of CdTe Thin Films by Spray Pyrolysis

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Abstract: ***CdTe thin films prepared by spray pyrolysis by using aqueous solution of cadmium chloride and Tellurium tetrachloride of 0.02 M of each on the preheated glass substrate at 350^{0}c. Onset of decrease of transmittance gives the value of optical band gap energy. The value of band gap calculated from the plot of $(\alpha h\upsilon)^2$ verses $h\upsilon$ was of 1.49 eV. It show the direct allowed transition.***

Keywords: CdTe thin films optical band gap

1. Introduction

Recently more researcher attracted toward the solid-solution of II-VI compound due their use in upto electronic devices and use in the fabrication of heterojunction solar cells cadmium chalcogenides have received intensive attention since their band gap energy lies close to the range of maximum efficiency. They also used in IR detection, luxmeter, switching devices and schottky barrier etc. The II-VI group compound particularly CdTe, are attracting a lot of attention due to their potential application in producing photovoltaic devices and wide use in the IR devices. Cadmium telluride is a semiconductor is an interesting material can be used in the solar cell because it has band gap energy less than 2 eV. Cadmium telluride is a unique among II-VI series of semiconducting compounds as it shows both n-type and p-type conducting.

There are several method to prepare CdTe thin films such as screen printing, vacuum evaporation metal-organic chemical vapour deposition, anodic and cathodic deposition, solution growth technique and spray pyrolysis (1-3). We have chosen spray pyrolysis because it is easy and inexpensive method to prepare thin films on large substrate area.
In this paper we have report the optical properties of CdTe thin films by spray pyrolysis method,

2. Preparation of the Sample

Aqueous solution of cadmium chloride and tellurium tetrachloride of 0.02 M of each were prepared in double distilled water. The chemical were used of AR grade. Here for preparing CdTe thin films, we have mixed the solution in the proportion of solution was 1:2.3 by volume. The films deposited shows the tellurium deficiency (1-3) if the ratio of the solution taken as in the proportion of 1:1. The temperature of the substrate, measured by pre-calibrated copper constantan thermocouple and was maintain at 350^{0}C which was the most optimise temperature of the preparation of the CdTe thin films. The spraying rate of 3.5 ml/min was maintained at the pressure 12 kg/cm^2 . The distance between the sprayer nozzle and substrate was kept at 30 cm. The sprayer move to fro to avoid the formation of droplets on the substrate and insure instant evaporation. Optical absorption was taken on UV-1800 Shimadzu Spectrophotometer in the wavelength range 350 nm to 1100 nm. Thickness of the films measured by Michelson interferometer.

3. Optical absorption analysis

Fig.1 shows the transmission verses wavelength of as deposited CdTe thin films.

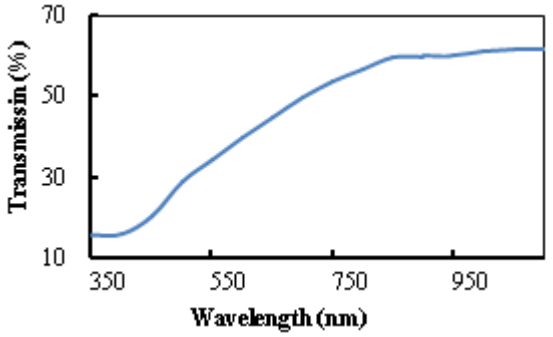

Figure 1: shows the transmission verses wavelength of as deposited CdTethin films

From the transmission curve it was observed that onset of decrease of transmission gives the optical band gap value. The absorption coefficient (α) can be calculated by using the relation,

$$\alpha = l/t \ln (I_0/I) \quad (1)$$

Where t-thickness of the films, I_0 and Ibe the incident and transmitted radiation respectively.

The nature of the transition (direct or indirect) is determined by using the relation,

$$\alpha = A/h\upsilon (h\upsilon\text{-}Eg)^n \quad (2)$$

is probable responsible for the absorption edge. Where A and n are constant, Eg-the band gap energy, for allowed direct transition n=1/2 and for indirect allowed transition n=2.

To calculate the exact value of band gap, plotting the graph $(\alpha h\upsilon)^2$ verses $h\upsilon$ Fig.2.

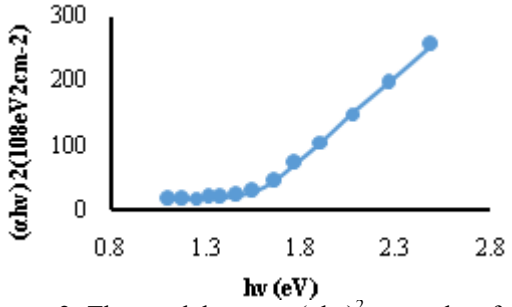

Figure 2: The graph between $(\alpha h\upsilon)^2$ verses hυ of as deposited CdTe thin films

The linear portion of the graph was extrapolated to meet hυ axis gives the value of optical band gap energy. The band gap energy is found to be 1.49 eV. This value well agree with et al (4) for successive ionic layer adsorption and reaction method of CdTe thin films. They have reported value 1.86 eV to 1.47 eV for different films thickness. Shreekanthan et al (5) have also reported the value of optical band gap 1.48 eV for vacuum deposited cadmium telluride thin films. Our calculate value is 1.49 eV which are very close the value reported by other preparation method, Thus spray pyrolysis is suitable method to produce CdTe thin films. The energy band gap shows the direct allowed transitions.

4. Conclusion

We conclude that the spray pyrolytically deposited CdTe polycrystalline films shows the direct allowed transition at 1.49 eV are present.

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