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Study of Variation of Band Gap Energy and Thickness with Temperature of II-VI Solid-Solution of Copper Selenide Thin Films by Spray Pyrolysis

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Abstract: ***CdSe thin films have grown by spray pyrolysis method at different temperature. It shows that thickness of the films increases and band gap decreases. When the temperature increases uptooptimised temperature 350^{0}C. After increase the temperature thickness decreases and band gap increases. It shows the direct allowed transition.***

Keywords: CdSe thin films, Spray pyrolysis, Optical band

1. Introduction

The study of polycrystalline II-VI compound semiconductor is an important due to their application in semiconductor device technology. CdSe is a very promising ternary system in this category. Thin films of CdSe are used inthe fabrication of transistors, solar cells, photoconductors etc. They have other applications also include variable gap structures vidicons and photodetector. There are very few work published on CdSe. However some workers have reported the dependence of electrical resistivity and Hall mobility on the percentage selenium present in the compound. However Kalinkin and sanitarow have concluded studies on resistivity and Hall mobility dependence on temperature of the films deposited on mica by heat screen method.

CdSe is an important and usefull materials for opto-electronic applications because its expected gap emission lies very close to the highest sensitivity of our eye. CdSe deposited by various method such as vacuum evaporation, flash evaporation chemical vapor deposition and spray pyrolysis (1-3). We are chosen spray pyrolysis method to depositeCdSe thin films due to it is cheap, inexpensive simple formed on large substrate area.

In this paper we have reported effect of temperature on band gap and thickness of CdSe thin films.

2. Preparation of Sample

Aqueous solutions of cadmium chloride and selenium dioxide were prepared of 0.02 M of each in double distil water. Chemical were used as AR grade. Biological glass slides of 1.33 mm thick used as a substrate. These two solutions was mixed in one and then insert in a sprayer. Now spraying was done in air atmosphere. The sprayer move to and fro to avoid the formation of the droplets on the substrate. Aqueous solution of cadmium chloride and selenium dioxide was taken in the ratio 1:2.2 by volume. The films shows the selenium deficiency (1-3) if we take the ratio 1:1 by volume. The temperature of the substrate vary from 300^{0}C,325^{0}C,350^{0}C & 375^{0}C and was measured by pre-calibrated copper constantan thermocouple. Thickness of the films was measured by Michelson interferometer. Transmission was recorded by UV-1800 shimandu spectrophotometer.

3. The Optical Study

The optical absorption of the was recorded in the spectral region 350 nm -1100 nm for the temperature (a) 300^{0}C, (b) 325^{0}C, (c) 350^{0}C and 375^{0}C shown in figure.1 It was observed that onset of decreases of transmission shifted with the change in optical band gap energy with change in temperature.

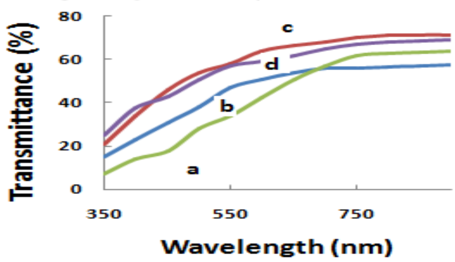

Figure 1: Transmittance verses Wavelength of as deposited thin films of CdSe temperature (a) 300^{0}C, (b)325^{0}C, (c) 350^{0}C and (d) 375^{0}C

The absorption coefficient (α) at various wavelengths for the sample of thickness (t) is given by the relation

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

Where t is the thickness of the films, I_0 and I are the intensities of incident and transmitted radiation respectively. The value of absorption coefficient (α) at each wavelength of each graphs was calculated from the transmission curve for different temperature.

To calculate the exact value of band gap a graph $(\alpha h\nu)^2$ versus hv was plotted for region above and near the absorption edge (fig.2).

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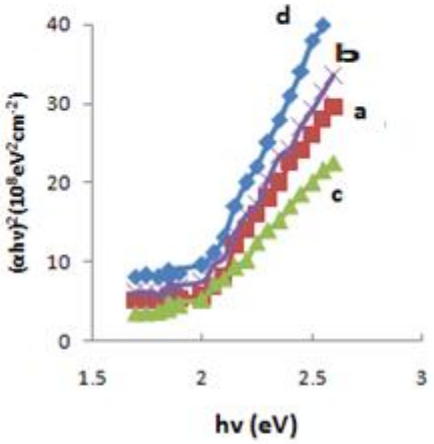

Figure 2: Shows $(\alpha h\nu)^2$ vs hv of as deposited thin films of CdSe temperature (a)300^0C, (b)325^0C, (c) 350^0C and (d) 375^0C

It was observed that each graph has a linear portion above fundamental absorption edge. The optical band gap decreases from 1.88 eV, 1.85 eV,1.83 eV for the increases of temperature 300^0C, 325^0C, 350^0C, and further increase in substrate temperature, the band gap again increase. The band gap 1.83 eV at optimsied temperature 350^0C with nearly stoichiometry. The transition shows direct allowed Table 1. Shows the variation of optical band gap and thickness with temperature of as deposited thin films This direct allowed transmition band gap are well agree with the results reported by Reddy for CdS_xSe_{1-x}(5) by vapour phase grown technique. The similar results are also reported by Sawant & Bhosle (4) for $CdIn_2S_4$ thin films and, Tembhurkar (,6,7,8).The similar results are well agreed with the results reported by other workers (9,) for bulk In_2O_3. This shows that spray pyrolytically deposited thin films are of good quality which makes a good material for optp-electronic devices.

Table 1: Shows the value of band gap and thickness with temperature of CdSe thin films

Temperature (^{0}C)	Band gap (eV)	Thickness (μm)
300	1.89	0.165
325	1.87	0.173
350	1.83	0.187
375	1.85	0.180

4. Conclusion

CdSe thin films prepared by spray pyrolysis at different temperature. It is conclude that as temperature increases the thickness of the films increases and band gap value decreases upto optimised temperature 350^0C. After increases this temperature, the thickness of the films decreases and band gap increases. They show the direct allowed transition.

5. Acknowledgement

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