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Study of Optical Properties of CdSe Thin Films by Spray Pyrolysis

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Abstract: ***The films of CdSe have been prepared on preheated glass substrate at 350^{0}C. From the reflectance and transmittance studies, the band gap (Eg) is calculated and was found to be 1.83 eV. This shows the direct allowed transmission. The colour of the thin films was found to be slighly yellow-radish.***

Keywords: Spray pyrolysis, CdSe thin films, Optical Properties

1. Introduction

Transport phenomenon in II-VI compound are most important of their optical properties and provide valuable information regarding the nature of carrier, band structure and scattering phenomenon. The hall mobility of charge carriers in the binary compounds are known to be piezoelectric, optical and impurity scattering in different degree at low temperature(1). CdSe material have band gap less than 2 eV, high refractive index and high effective dielectric constant. The wide band gap of CdSe has been used as a window materials together with several semiconductor. However, due to the high cost of such material, studies were developed toward polycrystalline semiconducting and particularly thin polycrystalline thin films of ZnS,CdS,CdSe and ZnSe have been considerable commercial applications as phosphors and photo conduction. Large number of phosphors contains mixtures of these compounds fired at various temperature (2).Different techniques have been reported for the production of thin films such as r.f. sputtering, vacuum deposition, chemical bath deposition, flash evaporation and spray pyrolysis.

Spray pyrolysis is a simple method specially for a substances which are water soluble salts and films so produced have good adherence to moderately heated substance (3-5). So we have used this method to obtain CdSe thin films on glass substrate. In this paper, results obtained from optical absorption and reflectance of CdSe thin films have been discussed.

2. Preparation of the Samples

The CdSe thin films were deposited on highly clean glass substrates. Aqueanssolution of cadmium chloride and selenium dioxide were prepared in double distilled water of 0.02 M of each. The chemical were used as AR,grade. Biological glass slides have been used as a substrate. The proportion of cadmium chloride and selenium dioxide was adjusted in the ratio 1:2:2 by volume for spraying the mixture so as to obtaineddesired CdSe thin films. Selenium deficiency (2,3) was obtained if we take proportion ratio is 1:1 by volume. Temperature of the substrate was maintained at 350^{0}C and was measured by pre-calibrated copper constantan thermocouple. The spray rate was maintained at 3.5 ml/minute and spraying was done in air at 12 kg/cm^2. Thickness of the films was calculated by Michelson-interferometer. The thickness so obtained was of the order of 0.195 μm. The colour of the film was slightly yellow-radish.

3. Optical Study

Transmittance and reflectance spectra were recorded at room temperature on double beam spectrophotometer (UV-visible varian spectrophotometer) in the wavelength range 900 nm to 350 nm glass plate identical to the substrate used and was placed in the path of the reference beam and substrate with deposited films was placed in the path of the sample beam for recording the transmittance, while recording the reflectance a BaO was usedas a standard (i.e. 100% reflectance). The absorption coefficient (α) at various wavelength was calculated from the transmission curve and it is given by the relation,

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

where Io and I are the intensities of incident and transmitted radiation respectively.
Transmittance (T) and reflectance (R) are related to each other by the relation,

$$T=(1-R)^2\exp(-\alpha t) / 1-R^2\exp(-2\alpha t) \quad (2)$$

The equation (2) is valid in the vicinity of fundamental absorption edge
When $R^2\exp(-2\ \alpha t)<<1$.

The equation (2) is used to calculate the value of absorption coefficient α. The value of transmittance (T) and reflectance (R) are taken from UV-visible varian spectrophotometer.Fig.1 shows Transmission versus Wavelength of as deposited CdSe thin films. Fig.2 shows Reflectance versus Wavelength of as deposited CdSe thin films.

4. Study of Transmission

From the Fig.1. It was observed that transmittance increases with the wavelength. The rise in steep for the wavelength between 350 nm to 900 nm. The onset of decrease of transmittance gives the approximate value of optical band gap energy (6,7).

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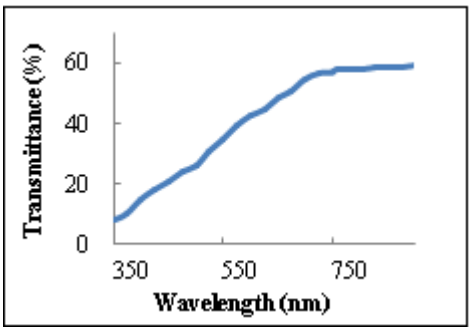

Figure 1: Transmittance Verses Wavelength of as deposited CdSe thin films

5. Study of Reflectance

From Fig.2, it is was observed that as the wavelength increases there is deep decrease of the reflectance gives the approximate value of band gap (8). Knowing the approximate region of band gap from the reflectance curve, α is calculated by using equation (2), from the knowledge of T,R and t.

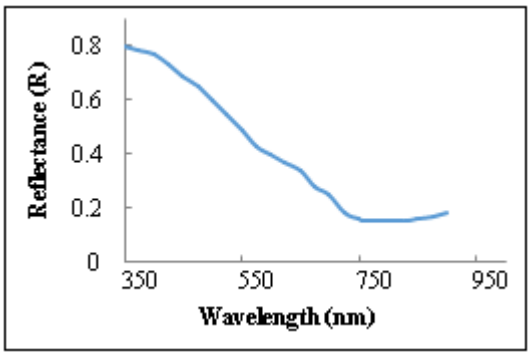

Figure 2: Transmittance Verses Reflectance of as deposited CdSe thin films

To calculate the exact value of band gap a graph is plotted between $(\alpha h\upsilon)^2$ versus hυ shown in Fig.3.The straight portion of graph the intercept on hυ axis gives value of band gap (Eg.) and wasfound to be 1.83 eV. The Transition takes place known as direct allowed transition. This value are well agree with the other workers. This shows that spray pyrolytically deposit films are of good quality which makes it a good material for electronic devices (9).

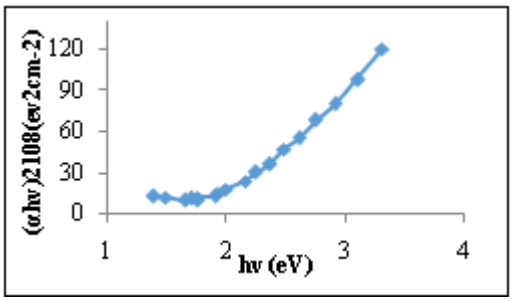

Figure 3: Shows (αhv)2 v/s hv of as deposited CdSe thin films

6. Conclusion

The CdSe thin films prepared on glass substrate at 350^0C. Theband gap was obtained as 1.83 eV showing direct allowed transition. Which makes it is a good material for opto-electronic devies.

7. Acknowledgement

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