Study of Optical Constant and Thickness of $ZnIn_2Se_4$Thin Films by Spray Pyrolysis

Y. D. Tembhurkar

Department of Physics, S.K. Porwal College Kamptee (M.S) India-441002

Abstracts: ***Spray Pyrolysis is a simple and inexpensive method to prepare thin films on large area. Transmission decrease as the thickness of the films increase. From the transmission curve, the refractive index and extinction efficient calculated and it is decrease as wavelength increases. This result must be fitted to the single-oscillator model.***

Keywords: Spray Pyrolysis, optical constant n and kof $ZnIn_2Se_4$thin films

1. Introduction

II-III_2-$VI_4$is a ternary group of semiconducting material. These Compound is very important due to its application, in opto-electronic devices, solar cells and problem is to solving the technological application. These groups of compound have high transparent region and high value of nonlinear susceptibility. These compounds allow preparing quaternary system in which the band gap of the alloy can be optimized by suitable compositions within the miscibility range. Several authors had prepared *$ZnIn_2Se_4$* single crystal by using chemical transport reaction and chemical power deposition. These two methods are very good tools to obtained single crystal. But they have some disadvantages of the transporter into the crystal as an impurity is inevitable. It is impossible to obtained high purity of the crystal by this method. Some of the authors reported the value of optical constant from transmittance and reflection spectra near the fundamental absorption edge.There are several method to prepared thin films of ternary group of compound, such as R.F. sputtering, flash evaporation vacuum evaporation, chemical bath deposition and spray pyrolysis method [2-7].

In this paper we have reported optical constant and the thickness of the $ZnIn_2Se_4$thinfilms. The transmittance study. Temperature of the substrate was maintained at 325^0cand measured by pre-calibrated copper constantan thermo-couple. Transmission was taken on Hitachi-330 spectrophotometer. Thicknesses of the films were calculated by Michelson-interferometer.

2. Experimental

Aqueous solution of Zinc chloride, Indiumtrichloride and selenium dioxide of 0.02 M of each prepared. Chemicals were used of AR-Grade. Biological glass plates were used as a substrate. Aqueous solution of Zinc chloride, Indiumtrichloride and selenium dioxide were used in the ratio 1:2:5:2 by volume to prepare thin films of *$ZnIn_2Se_4$*.They shows the selenium deficiency [5, 6] if we take the ratio of 1:2:4 by volume. These solutions mixed in one and then spray on pre-heated glass substrate which was maintained at 325^0C. Sprayer is mechanically move to and fro to avoid the formation of the droplets on the substrate. The distance between the sprayer nozzle and substrate was kept at 30 cm. The sprayer maintained at 3.5 ml/minute of pressure 12 kg/cm^2

3. Study of Optical Constants

Fig.1. Shows transmission spectra of two different thickness of as deposited $ZnIn_2Se_4$ thin films. It was observed that each curve have particular maxima and minima. The refractive index n, of the films can be calculated by using the relation (8)

$$n_1=(N+(N^2-n^2_2)^{1/2})^{1/2} \quad (1)$$

where

$$N=2n_2.T_{max}-T_{min}/ T_{max}.T_{min} + \frac{n_2^2+1}{2} \quad (2)$$

where T_{max} and T_{min} are the transmission of maximum and corresponding minimum on the envelope per sat a particular wavelength and $n_2$be the refractive index of the substrate. Here n_2 =1.5, refractive index of the glasssubstrate.

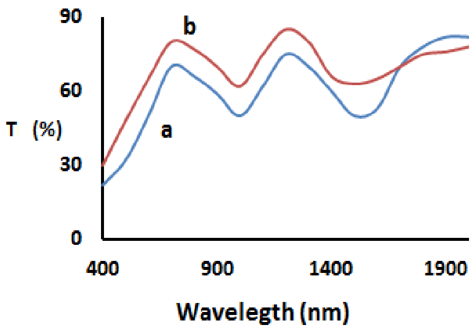

Figure 1: Figure 1: Transmission vs Wavelength (a) t = 0.195 μm (b) t = 0.183 μm.

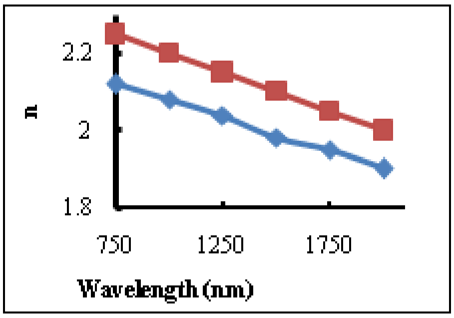

Figure 2 (a): Refractive index (n) as a function of wavelength (a) t = 0.195 μm (b) t = 0.183 μm.

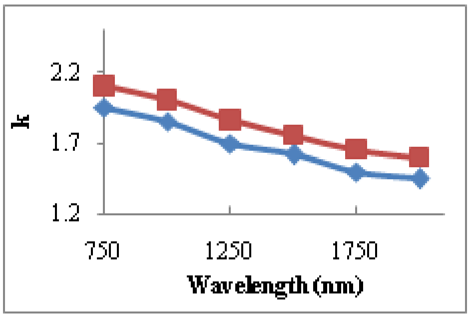

Figure 2 (b): Extinction coefficient (k) as a function of wavelength (a) t = 0.195 µm (b) t = 0.183 µm.

Fig.2.(a,b) shows th calculated refractive index n and extinction coefficient k as a function of wavelength for two different thickness (i) t=0.195 µm and (ii) t=0.183 µm of the films.Calculated our result of refractive index (n) and extinction coefficient (k) are well agreed with the result reported by (9).It was observed that refractive index and extinction coefficient of the films decreases with the wavelength. This result also well fitted with Single Oscillator Model.

$$n_0^2-1 = s_0\lambda_0^2 / 1-(\lambda_0/\lambda)^2 \quad (3)$$

Where s_o and λ_o are oscillator and position respectively the parameter s_o and $\lambda_o$can calculated from the plot $1/n^2-1$ verses $1/\lambda^2$ .The slope of the curve gives $1/s_0$andits intercept ony-axis gives the value of $1/s_o\lambda_o^2$.From this plot $s_o$and λ_o value can be determined for different films thickness of the films. When the value of λ_o and s_o substituted in equation (3), then plot of refractive index (n) versus wavelength λ is obtained. This result is in good agreed with the experimental value. This Show that Single – Oscillator Model can be adequately descries the refractive index dispersion in $ZnIn_2Se_4$thin films.

4. Conclusion

Spray pyrolysis method is a simple and inexpensive for the production of thin films on large area of the substrate. The Variation of refractive index and extinction coefficient decreases with wavelength increases. This is in fitted with single oscillator model.

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Author Profile

Dr. Y. D. Tembhurkar received the M.Sc, B.Ed and Ph.D in Physics in thin Solid Films from Institute of science Under the Guidance of Dr. J. P. Hirde madam in the year of 1996. He has presently worked as teacher in the post of Associate Professor in Department of Physics, Seth Kesarimal Porwal College of Arts, Science and Commerce Kamptee, Nagpur Maharashtra (India).