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Study of Band Gap Energy of Solid Solution of Zinc-Selenide Thin films Prepared by Spray Pyrolysis

Y. D. Tembhurkar

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

Abstract: ***Spray pyrolysis is a simple, inexpensive method to produce thin films. Zinc selenide thin films prepare by using aqueous solution of zinc chloride and selenium dioxide of 0.1 M of each. Optical band gap calculated from the transmission data was of 2.65 eV, which shows the direct allowed transition. The value of refractive index x(n) and dielectric constant (є) have been computed from the transmittance.***

Keywords: ZnSe thin films, band gap

1. Introduction

II-VI group of compound is the most important due to their application in optoelectronic devices. The production of thin with tailored optical properties is an important challenge for research. The zinc selenide thin films have received great attention due to various application in upto electronic application. They have been used as a wide-band-gap window material for heterjunction solar cells. The short wavelength opto electronic devices such as II-VI semiconductor laser dioxide, CdSe/CdZnSe, CdS/CdZnS, lasing at 500 nm. ZnSe thin films passes energy gaps higher than CdS thin films (Eg.=2.47 eV) [1] and ZnS thin films (Eg.=3.02 eV) [2]. Hence ZnSe can be assume to be ideal alternative to develop to prepare solar cell.

There are several method to prepare thin films, such as vacuum evaporation , Flash evaporation, r.f. sputtering, chemical vapour deposition and spray pyrolysis due to simple and inexpensive and easy to handle. Actually this method ruftuf method to prepared thin films on large substrate area [1-3].

2. Preparation of Sample

Thin films of ZnSe have seen prepared by using aqueous solution of zinc chloride and selenium dioxides. The molarity of each solution was 0.1M. Chemical were used as AR. Grade. The solution was taken in the proportion 1:2.2 by volume. Selenium deficiency [4,5] obtain if the ratio of proportion was taken as 1:1. Biological glass slide used as a substrate. The temperature of the substrate was maintained at 350^0C, which was measured by pre-calibrated copper constantan thermo-couple. Thickness of the films was of 0.1638 µm, calculated by using Michelson interferometer. Optical absorption were taken on UV-1800 Shimadzu spectrophotometer at room temperature in the wavelength range 350 nm to 700 nm. The detailed experimental technique already given elsewhere [1-3].

3. Optical Absorption Study

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

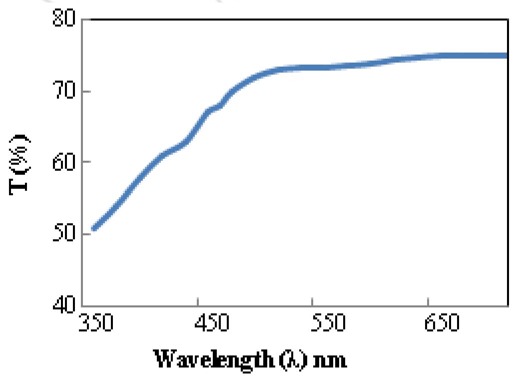

Figure 1: The transmission (T) verses wavelength (λ) of as-deposited ZnSe thin films.

From the plot it was observed that onset of decrease of transmittance below the absorption edge. The optical absorption (α) can be determined at various wavelength from the optical transmittance spectra and it is given by the relation,

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

Where Io and I be the incidence and transmitted radiation, t- the thickness of the films.

To calculate the exact value of band gap, plotting the graph between $(\alpha h\upsilon)^2$ against hυfor the region near and above the fundamental absorption edge (Fig.2).

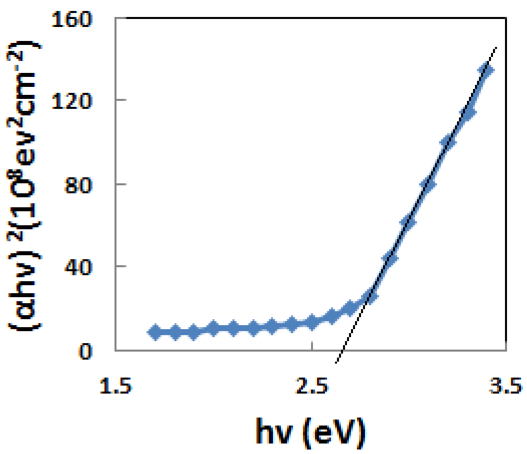

Figure 2: The graph between $(\alpha h\upsilon)^2$ against hυ of as deposited ZnSe thin films

The linearity of graph indicated that directly allowed transition describe by the relation,

$$\alpha = A/h\upsilon\ (h\upsilon\text{-}Eg)^{1/2} \quad (2)$$

is probably responsible for the absorption process.
Where A-is a constant, hυ-the radiation energy

Eg-is the optical band gap of semiconductor. The linear portion of the graph was extrapolated to meet hυ axis gives the value of optical band gap and was of 2.65 eV. The transition shows the direct allowed. This results are well agree with sharma et al [6] for chemical bath deposition technique. They reported the value of band gap varies from 2.13 to 2.68 eV by increasing in zin concentration from 0.1 to 0.9 for the $Zn_{1-x}Se_x$ thin films. They also stated that optical band gap value also depend on the annealing temperature. The value of refractive index (n) and dielectric constant (ϵ) calculated from the transmittance of the curve and was of 2.82 and 7.84 respectively at the particular wavelength 900 nm. These values also well agree with the chemical bath deposition technique of $Zn_{1-x}Se_x$ thin films [6].Thus spray pyrolysis method is the best to prepared thin films of ZnSe.

4. Conclusion

Spray pyrolysis is cheap and inexpensive method to produce a thin films of ZnSe. Band gap energy determined from the optical transmission data shows the direct allowed transition.

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