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Behaviour of optical properties of $Cd_{1-x}Zn_xSe$ thin films prepared by vacuum evaporation

Sarita and *Gulbir Singh
Department of Physics, Govt. (P.G.) College, Hisar
*Department of Physics, S.G. (P.G.) College, Saroorpur Khurd, Meerut (UP)

ABSTRACT
The ternary system of Cd, Zn and Se provide a possibility of tailoring their optical properties as per device fabrication requirements e.g. band gap .Thin films of $Cd_{1-x}Zn_xSe$ with a variable composition (0 ≤ x ≤ 1) have been deposited onto highly clean glass substrates by vacuum evaporation technique. The band gap of different $Cd_{1-x}Zn_xSe$ thin films comes out as E_g = 1.72, 1.87, 2.03, 2.25, 2.40, 2.76 eV, respectively.

Key Words: *Ternary semiconductor, Band gap, Vacuum evaporation, Optical properties.*

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INTRODUCTION

II–VI semiconductor compounds are widely used in the fabrication of solar cells and optoelectronic devices [1, 2]. Their optical band gap coupled with high absorption coefficients is a direct consequence of the utilization of cadmium chalcogenides in various electronic and optoelectronic devices [3]. Cadmium zinc-selenide [(CdZn)Se] is one of the important ternary materials used in electroluminescent, photo luminescent, photoconductive and photovoltaic device applications because of its interesting size-dependent properties as well as a high stability and wide optical band gap which covers the maximum electromagnetic spectrum [4, 5]. $Cd_{1-x}Zn_xSe$ thin films have been prepared by thermal vacuum evaporation technique.

EXPERIMENTAL

The thin films of $Cd_{1-x}Zn_xSe$ alloy with a variable composition (0 ≤ x ≤ 1) have been deposited onto highly cleaned glass substrates by using vacuum evaporation technique (Vacuum Coating Unit Model 12A4). The optical absorption characterization of as- deposited $Cd_{1-x}Zn_xSe$ thin films has been done by "Hitachi Spectrophotometer" model U-3400 for the characterization of band gap at room temperature.

RESULTS AND DISCUSSION

Absorption Spectra:

The optical band gaps of these films are determined with the help of absorption spectra given in figure 1 and by using equation (1)

$$\alpha h\nu = A(h\nu - E_g)^n \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

The spectra shows two regions, one for higher wavelength with practically lower absorption and other for lower wavelength in which absorption increases steeply. Due to incorporation of Zn in CdSe, the absorption decreases at higher wavelength. As the parameter composition 'x' decreases, absorption shows a decreasing trend with the wavelength and the fundamental edge shifted towards short wavelength (or higher energy) region. This is because zinc selenide has a wider band gap.

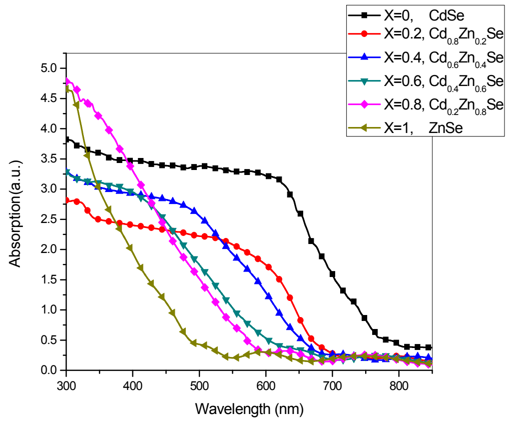

Figure 1: The Optical Absorption Spectra of $Cd_{1-x}Zn_xSe$ Thin Films

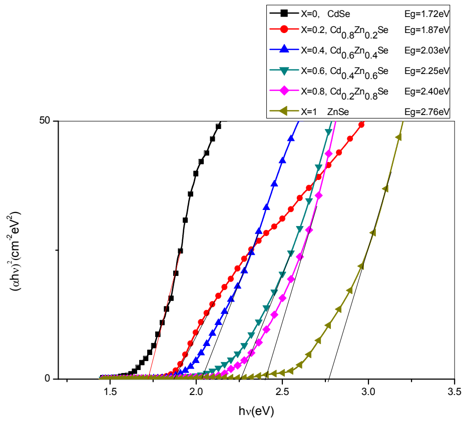

Figure 2: The Optical Band gap Spectra of Vacuum Evaporated $Cd_{1-x}Zn_xSe$ Thin films.

The spectra shows two regions, one for higher wavelength with practically lower absorption and other for lower wavelength in which absorption increases steeply. Due to incorporation of Zn in CdSe, the absorption decreases at higher wavelength. As the parameter composition 'x' decreases, absorption shows a decreasing trend with the wavelength and the fundamental edge shifted towards short wavelength (or higher energy) region. This is because zinc selenide has a wider band gap. The band gap of different $Cd_{1-x}Zn_xSe$ thin films comes out to be as E_g = 1.72, 1.87, 2.03, 2.25, 2.40, 2.76 eV calculated from graph given in figure 2.

CONCLUSIONS

The result indicates that the optical band gap increases with increase of ZnSe concentration. These results show that we can change the band gap of ternary alloy according to our requirements.

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