Structural and Optical Properties of $\text{Zn}_x/\text{Te}_{1-x}$ Layered Thin Film on Glass Substrate

Abstract
This work, results on the Annealing effects, optical and structural study of $\text{Zn}_x/\text{Te}_{1-x}$ thin films of 200 nm obtained by the vacuum evaporation technique. The layers are grown and then annealed for various temperatures and characterized by XRD, SEM and photo absorbance studies. Band gap of $\sim 2.1\text{eV}$ has obtained by optical measurements. SEM micrographs clearly indicate cluster growth at the surface of a thin film of $\text{Zn}_{0.5}\text{Te}_{0.5}$ composition. However no prominent cluster growth has been observed at other stoichiometry ratios.

Keywords: ZnTe thin films; I-V characteristics; Surface morphology; Optical band gap

Introduction
ZnTe is the most attractive semiconducting materials of II-VI group. The material has various applications in selection of devices optoelectronic and microelectronic devices [1-5]. $\text{Zn}_x/\text{Te}_{1-x}$ thin films has analyzed and characterized for electrical, optical & structural properties because of above applications. Cluster growth at the surface of thin film of $\text{Zn}_{0.5}\text{Te}_{0.5}$ composition with annealing shows that the cluster growth becomes uniform with increase in temperature. Results carried out with systematic investigations on these properties of evaporated $\text{Zn}_x/\text{Te}_{1-x}$ thin films.

Experimental
Thin films has deposited at vacuum of $10^{-5}$ torr on clean glass substrates by vacuum coating unit [6]. Stoichiometry ratio of pure Zn (99.99%) granules and Te (99.99%) powder has taken to prepare $\text{Zn}_x\text{Te}_{1-x}$, where $x=0.5,0.2$ and 0.8. electronic balance has used to weigh these materials and found resolution of $\pm 0.0001 \text{g}$, in accordance with the percentage of composition used [7]. The material to be coated is placed in a tungsten boat. After reaching the high vacuum ($10^{-5}$ mbar) in the chamber, the material is heated indirectly by passing the current slowly to the electrodes [8]. Thin Films has prepared at room temperature, thickness and evaporation rate of deposited films measured by quartz crystal monitor which is fixed to the unit [7]. Initially deposited Zn layer then Te layers was deposited with $x=0.5,0.2$ and 0.8 respectively to obtain stacked layers, and thin film thickness has measured through “Hind Hivac” Digital Thickness Monitor Model-DTM-101 [6, 8].

Results & Discussion
Surface morphology
SEM micrographs shown clearly indicate cluster growth at the surface of thin film of $\text{Zn}_{0.5}\text{Te}_{0.5}$ composition in Figure 1(a) annealed at 373 K. Figure 1(b) 423 K and Figure 1(c) 573 K shows that the cluster growth becomes uniform with increase in annealing temperature. However no prominent cluster growth has been observed at other stoichiometry ratios.

Optical properties
An absorbance spectrum of $\text{Zn}_x\text{Te}_{0.5}$ thin films has been taken at different temperatures through Systronics spectra photometer.
117. Thin film material’s energy band gaps has calculated by absorbance spectra, by means of relation $\alpha \hbar \nu = A(\hbar \nu - E_g)^n$, here $\hbar \nu$ is energy of photon, $\alpha$ is the coefficient of absorption, $E_g$ is band gap, $A$ is constant is 0.5. Figure 2 shows spectral variation for Zn$_x$/Te$_{1-x}$ deposited on glass substrate these extrapolating lines gives optical gap [9]. It is observer that annealing decreases the band gap and confirms the mixing of Zn and Te to form Zn$_x$/Te$_{1-x}$ film. The band gap obtained for annealing temperature 573K is very close to reported values.

**Figure 2:** Spectral variation for Zn$_{50}$/Te$_{50}$ thin films.

Energy dispersive X-ray analysis (EDAX) graphs of Zn$_x$/Te$_{1-x}$

The EDAX values Figure 3 show the signatures of Zn$_x$/Te$_{1-x}$ present in the glass substrate on which the films are grown. The photographs shown represent thin films of various stoichiometry ratios without annealing.

**Figure 3:** Energy Dispersive X-ray Analysis graphs of Zn$_x$/Te$_{1-x}$

(a) Zn (50): Te (50),
(b) Zn (20): Te (80),
(c) Zn (80): Te (20).

**Conclusion**

It is concluded that thin film of 200 nm Zn$_x$/Te$_{1-x}$ for $x=0.1$ and 0.2 have prepared by thermal evaporation technique. The grown layers are annealed at different temperatures and then characterized by XRD, SEM and photo absorbance studies. Band gap of $\sim 2.1\text{eV}$ has obtained using optical measurements. Optical band gap was calculated as 2.1 eV from the absorption data which is close to the room temperature of 2.25 eV or Zn$_x$/Te$_{1-x}$ EDAX of thin film reveal phase mix of Zn$_x$/Te$_{1-x}$ SEM micrographs clearly indicate cluster growth at the surface of thin film of Zn$_{50}$/Te$_{50}$ composition. However no prominent cluster growth has been observed at other stoichiometry ratios.

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**Conflict of interest**

NO conflict of interest.

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