

Structural and Optical Properties of Zn_x/Te_{1-x} Layered Thin Film on Glass Substrate

Research Article

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Abstract

This work, results on the Annealing effects, optical and structural study of Zn_x/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 $Zn_{50}:Te_{50}$ 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]. Zn_x/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 $Zn_{50}:Te_{50}$ 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 Zn_x/Te_{1-x} thin films.

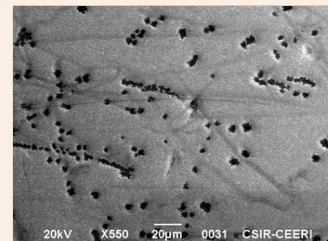
Experimental

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 Zn_xTe_{1-x} where $x=0.5, 0.2$ and 0.8 . electronic balance has used to weigh these materials and found resolution of ± 0.0001 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].

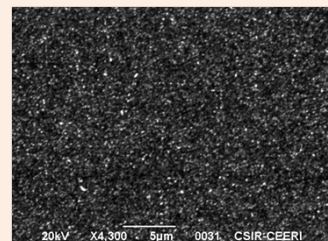
Results & Discussion

Surface morphology

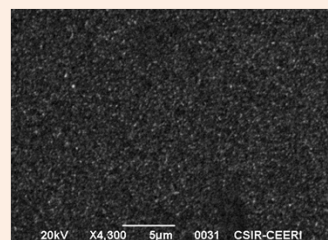
SEM micrographs shown clearly indicate cluster growth at the surface of thin film of $Zn_{50}:Te_{50}$ composition in Figure 1(a) annealed at 373K. Figure 1(b) 423 K and Figure 1(c) 573 K shows that the cluster grown becomes uniform with increase in annealing temperature. However no prominent cluster growth has been observed at other stoichiometry ratios.



(a) At 373 K.



(b) At 423 K.



(c) At 573 K.

Figure 1: SEM of Zn_{50}/Te_{50} at different temperatures.

Optical properties

An absorbance spectrum of $Zn_{50}:Te_{50}$ 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 $\alpha h\nu = A(h\nu - E_g)^n$, here $h\nu$ is energy of photon, α 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.

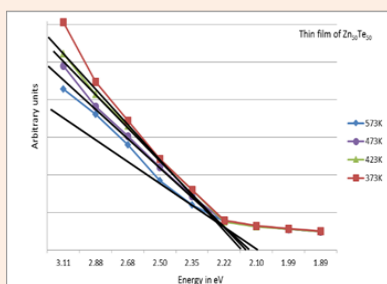
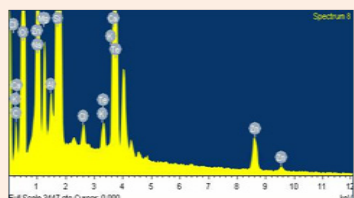


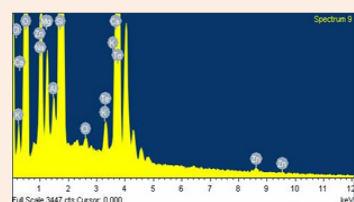
Figure 2: Spectral variation for Zn₅₀/Te₅₀ thin films.

Energy dispersive X-ray analysis (EDAX) graphs of Zn_x/Te_{1-x}

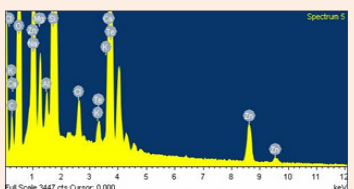
The EDAX values Figure 3 show the signatures of Zn_x/Te_{1-x} present in the glass substrate on which the films are grown. The photographs shown represent thin films of various stoichiometry ratios without annealing.



(a) Zn (50): Te (50).



(b) Zn (20): Te (80).



(c) Zn (80): Te (20).

Figure 3: Energy Dispersive X-ray Analysis graphs of Zn_x/Te_{1-x}.

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 ~2.1eV has obtained using optical measurements. Optical band gap was calculated as 2.1eV from the absorption data which is close to the room temperature of 2.25eV or Zn_x/Te_{1-x}. EDAX of thin film reveal mix phase of Zn_x/Te_{1-x}. SEM micrographs clearly indicate cluster growth at the surface of thin film of Zn₅₀:Te₅₀ composition. However no prominent cluster growth has been observed at other Stoichiometry ratios.

Acknowledgement

No acknowledgement.

Conflict of interest

NO conflict of interest.

References

- Sinaoui A, Trabelsi I, Chaffar Akkar F, Aousgi F, Kanzari M (2014) Study of Structural, Morphological and Optical Properties of Sb₂S₃ Thin Films Deposited by Oblique Angle Deposition. *Int J Thin Fil Sci Tec* 3(1): 19-25.
- Pattar J, Sawant SN, M Nagaraja, Shashank N, Balakrishna KM, et al. (1986) Structural Optical and Electrical Properties of Vacuum Evaporated Indium Doped Zinc Telluride Thin Films. *Materials Science* 58: 307.
- Mathew X, Enriquez JP, Sebastian P, Pattabi M, Sanchez-Juarez A, et al. (2000) *Energy Mater. Sol Cells* 63: 355.
- RShaaban E, Ishu C, Mohammed SH, Joes MFF (2009) Micro structural parameters and optical constants of ZnTe thin films with various thicknesses. *Physica B: Physics of Condensed Matter* 404(20): 3571-3576.
- MS Vingradov, DLVasilevski, *Inorg Mat* 21 (1985).
- Dinesh CSharma, Srivastava S, Vijay YK, Sharma YK (2012) Preparation and Optical Properties of ZnTe/ZnTe: Cr Bilayer Thin Films, *International Journal of Recent Research and Review* II: 1-5.
- Singh M, Arora JS, Vijay M Sudharshan YK (2006) Optical, electrical and thermoelectric power studies of AlSb thin film bilayer structure. *Bulletin of Materials Science* 29(1): 17-20.
- Aboraia AM, Ahmad EA M, Abdel Wahab H Shokry Hassan, Shaaban ER (2015) Structural and optical properties of ZnTe thin films induced by plasma immersion ion implantation. *International Journal of New Horizons in Physics* 2(1): 11-20.
- T Hino, Y Ken (1974) Space Charge Limited Currents and Thermally Stimulated Currents in ZnTe and CdSe Films. *Jpn J Appl Phys* 13(6).
- Patel SM, Patel NG (1983) Optimization of Growth Conditions for Zn-Te Films. *Mater Lett* 2(2): 131-133.
- Salem SM, Seddek MB, Salem AM, Saleh HA (2011) Structural characterization and electrical properties of thermally evaporated ZnTe films treated with AgNO₃ solution. *J of App Sc Res* 7(5): 698-705.
- Shinde UP, Patil AV, Dighavkar CG, Patil SJ, Kapadnis KH, et al. (2010) Photoconductivity study as a function of thickness and composition of Zn-Te thin films for different illuminated conditions at room temperature. *Optoelec and Adv Mate Rapid Comm* 4: 291.