

Original Article

Investigation of Properties of Al Doped ZnTe Thin Films

Uddhao N. Ingle¹, Milind S. Kale²

¹Department of Electronics, Smt. G.G. Khadse College, Muktainagar Dist. Jalgaon

²Department of Electronics, D. N. C. V. P. S. Shirish Madhukarrao Chaudhari College, Jalgaon

Manuscript ID:
IJERSD-2026-020410

ISSN: 3067-2325

Volume 2

Issue 4

Pp. 55-58

August 2026

Submitted: 08 July 2026

Revised: 19 July 2026

Accepted: 12 Aug. 2026

Published: 31 Aug. 2026

Correspondence Address:
Uddhao N. Ingle
Department of Electronics, Smt.
G.G. Khadse College,
Muktainagar Dist. Jalgaon
Email:
uddhaoingle@gmail.com

Quick Response Code:



Web: <https://rlgjaar.com>

DOI: 10.5281/zenodo.23102117

DOI Link:
<https://doi.org/10.5281/zenodo.23102117>



Attribution-NonCommercial-
ShareAlike 4.0 International



Abstract:

The II-VI group compound has great attention for making solar cell. The properties of the compound can alter by the doping element. Here, Al (Aluminium) doped ZnTe thin films were deposited on to glass substrates by using thermal evaporation technique. The structure properties of the grown thin film were examined by XRD technique. The surface morphological analysis was carried out by using optical microscope. The optical band gap of material was calculated by UV-VIS spectrometry analysis. The XRD reveals that, the thin films are polycrystalline in nature. The crystal structure is found to be tetragonal shape. The microscopic images reveal that films are homogenous. The particles uniformly deposited on the substrate. Optical band gap, was calculated from the absorption spectra is found ~1.7eV.

Keywords: Al doped ZnTe, Thin films, XRD, FTIR, UV-VIS.

Introduction

The II-VI compound group semiconductor materials is an important semiconductor material for the development of various modern technologies of solid-state devices like blue light emitting diodes, solar cells, laser diodes, microwave devices, etc, the zinc telluride is one of them [1-4]. Various methods can be used for depositing Al doped ZnTe thin films like: physical vapor deposition under vacuum, molecular beam epitaxy, CBD, Sillar, Chemical vapor deposition, spray pyrolysis and Solution growth etc. [1, 5, 6, 7]. Properties of ZnTe can be enhanced by commonly doped material like Fluorine, Indium, Aluminum [8-12], Cobalt, Gallium, and Tin. When ZnTe is doped with Al, Al³⁺ substitutes Zn²⁺ site in the ZnTe crystal structure resulting in one more free electron to contribute to the electric conduction. Furthermore, Zn can be easily substituted by Al. Here, Al (Aluminium) doped ZnTe Thin films are grown by thermal evaporation technique having thickness of 3000 Å. The structural, morphological and optical properties are investigated of grown samples.

Experimental

Firstly, the Al doped ZnTe powder were prepared by using Al(NO₃)₃ with Telluride metal powder and ZnCl₂ by chemical synthesis technique, then the prepared powder compound of Al doped ZnTe was used for the deposition process. During the deposition, the pressure was kept at about 10⁻⁵ torr. The substrate distance to source was kept about 13 cm. The samples of different thicknesses were deposited under similar conditions. The thickness of the films was monitored by quartz crystal digital thickness monitor (Model No. DTM-101), provided by Hind-Hi Vac. The deposition rate was maintained 5 - 10 Å/sec throughout sample preparation. Before evaporation, the glass substrates were cleaned thoroughly using chromic acid, detergent, isopropyl alcohol, distilled water and at the end with acetone.

Results And Discussion

1. X-ray diffraction (XRD) Analysis:

Crystallographic, micro structural properties of Al doped ZnTe thin films on glass substrate have been studied in a coordinated manner within the thin films. Figure 1 shows the XRD pattern of Al doped ZnTe thin film having thickness of 3000 Å respectively. The XRD spectra were recorded with scanning angle ranging from 10° - 70°.

Creative Commons

This is an open access journal, and articles are distributed under the terms of the [Creative Commons Attribution NonCommercial-ShareAlike 4.0 International](https://creativecommons.org/licenses/by-nc-sa/4.0/). The Creative Commons Attribution license allows re-distribution and re-use of a licensed work on the condition that the creator is appropriately credited.

How to cite this article:

Ingle, U. N., & Kale, M. S. (2026). Investigation of Properties of Al Doped ZnTe Thin Films. *International Journal of Engineering Research for Sustainable Development*, 2(4), 55-58. <https://doi.org/10.5281/zenodo.23102117>

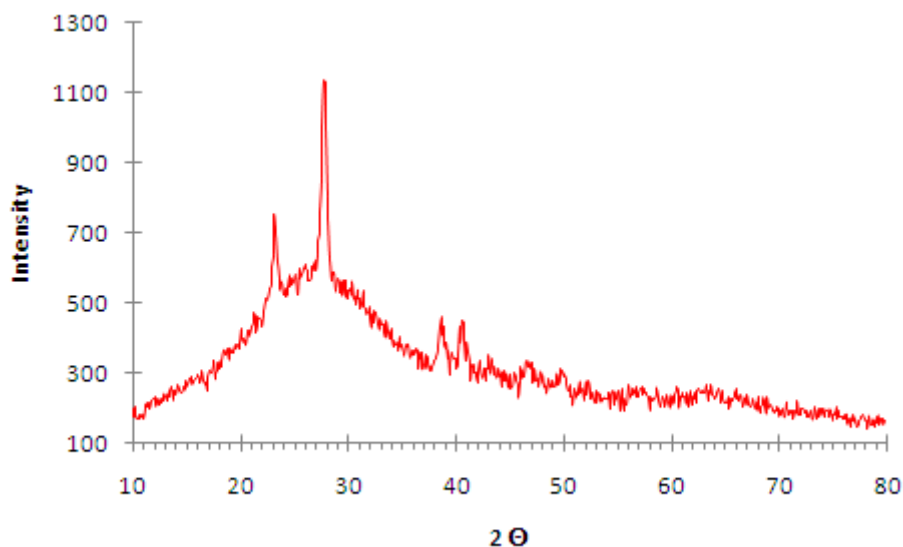


Fig.1: The XRD patterns of Al doped ZnTe thin film having 3000 Å Thickness.

The 2θ peak observed at 23.0° , 27.7° , 40.6° , 43.1° , 49.7° and 63.9° exhibit the formation of the tetragonal structure phase of Al doped ZnTe which correspond to the (110), (111), (002), (220), (202) and (023) planes of reflections. XRD analysis indicated material is polycrystalline in nature.

2. Morphological Analysis:

To study the surface morphological properties, the grown samples were observed under optical microscope. Figure 2 shows the optical microscopic images of grown Al doped ZnTe thin film having thickness of 3000 Å respectively.

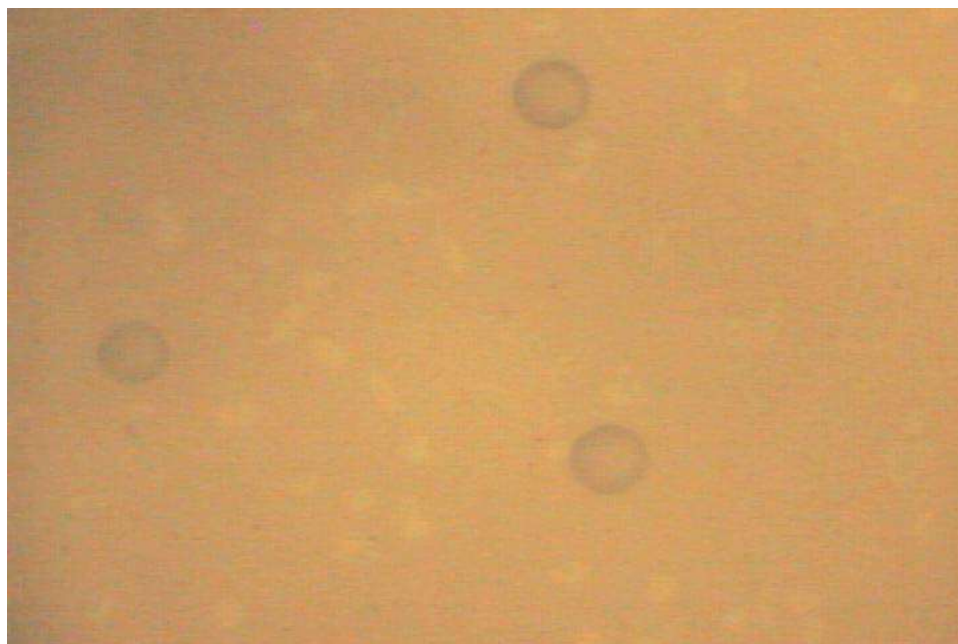


Fig.2: Optical microscopic image of Al doped ZnTe thin film having 3000 Å Thickness.

From the micrographic images, it is observe that the film is uniform. The particles are distributes uniformly on the substrate. The nano particles well cover on the substrate. The nano particles are found spherical in shaped. The sample is free from any microscopy defect like cracks or peeling.

3. Fourier Transforms Infrared Spectroscopy (FTIR)

The Fourier Transform Infrared Spectroscopy (FTIR) is an effective tool used to identify the functional groups present in the studied material. The modes of vibration of chemical bonds and functional groups present in the Al doped ZnTe thin films, were analyzed from the FTIR spectrum. Figure 3.shows FTIR spectrum of Al doped ZnTe. The FTIR spectrum of Al doped ZnTe is recorded in the spectral range of $4000 - 400 \text{ cm}^{-1}$. FTIR spectrum of the Al doped ZnTe material, peaks observed at lower frequencies (finger print region) at 762.2 cm^{-1} .

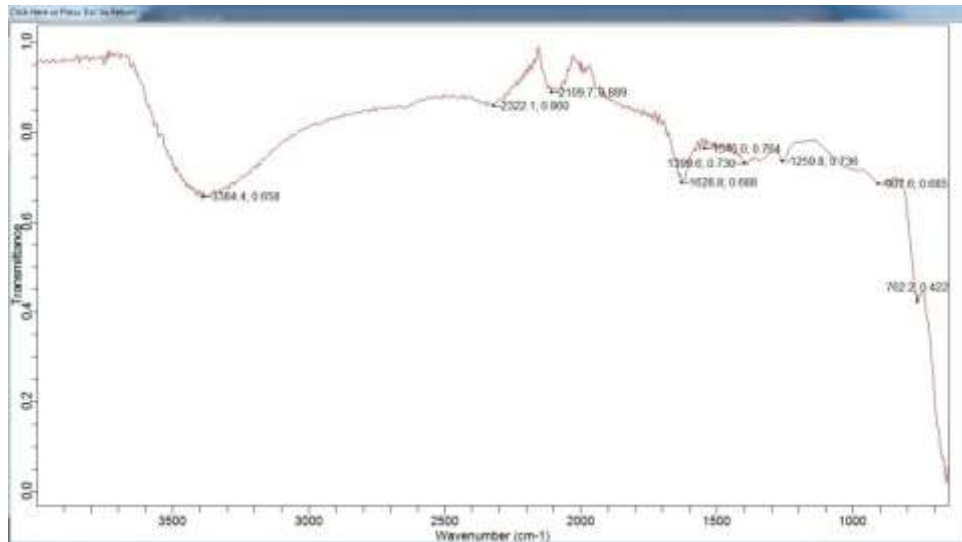
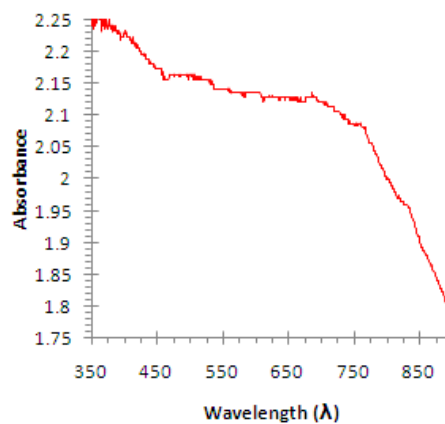


Fig.3: FTIR Spectrum of Al doped ZnTe.

4. UV-VIS Analysis

Optical properties of Al doped ZnTe samples were studied with the help of UV-VIS spectrometry. The optical absorption spectra were obtained in the wavelength range 350 nm to 900 nm by employing a Shimadzu 2450 UV-Visible model of the spectrophotometer. Figure 4 shows the absorption spectra of grown Al doped ZnTe thin film having thickness of 3000 Å.



Absorption Spectra of Al Doped ZnTe Thin Film having 3000 Å

According to absorbance spectrum it is clear the maximum absorbance was found in between the wavelength range 350 nm to 450 nm. It is found that the film is highly absorbing in nature. The optical band gap of these films has been calculated using the relation (Tauc 1974).

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

where, $h\nu$ is the photon energy, α is the absorption coefficient, E_g the band gap, A is constant. The plot of $(\alpha h\nu)^2$ versus E_g for Al doped ZnTe films is presented in Figure 5. This figure clearly shows the optical band gap is 1.7 eV.

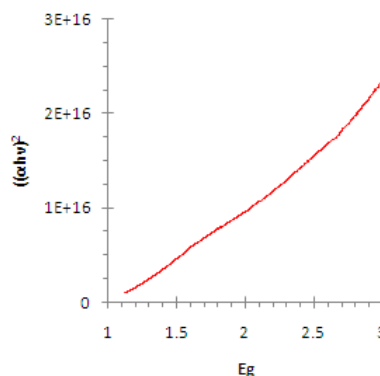


Fig. 5 :Band gap of Grown Al doped ZnTe Thin Film having thickness of 3000 Å

Conclusions

Aluminum doped Zinc Telluride (ZnTe:Al) thin films of 3000 Å thickness was deposited onto inert glass substrates by using thermal vacuum evaporation technique. XRD patterns confirm that the films have Tetragonal in structure. The optical microscopic images reveals that the sample is homogeneous and free from defects. The Fourier Transform Infrared Spectroscopy (FTIR) identifies the presence of functional groups in the material. The optical properties illustrates that, the samples have highly absorbent properties. The optical band gap of ZnTe:Al thin films was found near 1.7 eV.

Acknowledgement

The authors would like to express their sincere gratitude to the Principal and the Department of Electronics, Smt. G.G. Khadse College, Muktainagar, Dist. Jalgaon, for providing the necessary facilities and support to carry out this research work. The authors are also thankful to the Department of Electronics, D.N.C.V.P.S. Shirish Madhukarrao Chaudhari College, Jalgaon, for their valuable guidance and encouragement. The authors gratefully acknowledge the support received during the preparation, deposition, and characterization of the Al-doped ZnTe thin films using XRD, optical microscopy, FTIR, and UV-VIS spectroscopy. Finally, the authors sincerely appreciate all those who directly or indirectly contributed to the successful completion of this work.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

References

1. Bhargava R.(ed), (1997) Properties of Wide Bandgap II-VI Semiconductors, Inspec. London.
2. Schall, M., Walther, M., & Uhd Jepsen, P. (2001) Phys. Review, **B64**, 94301.
3. Jain, M. (1993) II-VI Semiconductor Compounds, World Scientific, Singapore.
4. Wu, Q., Litz, M. & Zhang, X. C. (1996) Applied Physics Letters, **68**(21), 2924.
5. Massel, L. I. & Glang R. (eds) (1980) Handbook of Thin Film Technology (New York: McGraw-Hill).
6. Georgobiani, A. N. & Sheinkman, M. K. (Eds.), (1986) Physics of A_2B_6 Compounds, Nauka, Moscow, (in Russian).
7. Sharma, D. C. (2013) Preparation and characterization of the chromium doped Al doped ZnTe thin films, Advance Material Letters **4**(1), 68-70.
8. Xue, S. W. Zu, X. T. Zheng, W. G. Chen, M. Y. & Xiang, X. (2006) Physica B **382**, 201-204.
9. Ding, J. J. Chen, H. X. & Ma, S. Y. (2010) Applied Surface Science, **256**, 4304-4309.
10. Zi-qiang, X. Hong, D. Yang, L. & Hang, C. (2006) Materials Science in Semiconductor Processing **9**, 132-135.
11. Mondragon, H. Suarez, A. Maldonado, M. De la L. Olvera, A. Reyes, R. Castaneda-Pérez, Torres-Delgado, G. & Asomozo, R. (2002) Applied Surface Science **193**, 52-59.
12. de la M. Olvera, L. Maldonado, A. Vega-Pérez, J. & Solorza-Ferri, O. (2010) Materials Science and Engineering, **B174**, 42-45.