Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

International Conference on Momentous Role of Nanomaterials in Renewable Energy Devices

Volume 5, Special Issue 07, April-2018 (UGC Approved)

SYNTHESIS AND CHARACTERISATION OF ANTIMONY TELLURIDE AND TIN TELLURIDE THIN FILM

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Abstract - *Antimony Telluride and Tin Telluride films were successfully deposited on glass substrate under optimized condition by spin coating technique. The films were uniform and had well adherence to the substrate without any pores. As the annealing temperature increases, the orientation of the crystallites was more randomized than in the as prepared film. The structural, optical and morphological properties of the film were investigated by XRD, UV-Visible PL and SEM. The XRD pattern indicates that this film was crystallized in the structure.*

Keywords: *Antimony Telluride, Tin Telluride, spin coating, UV, XRD*

I. INTRODUCTION

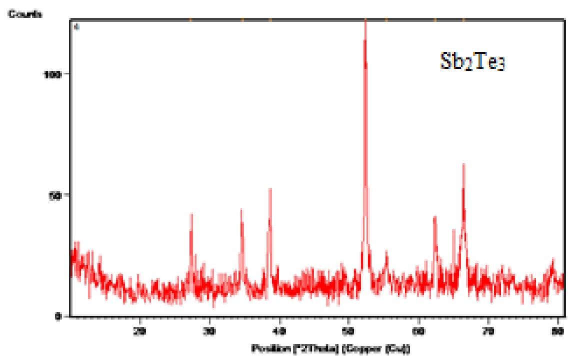
Antimony Telluride and Tin Telluride have attracted considerable attention due to their interesting properties and potential applications. Antimony Telluride (Sb_2Te_3) and Tin Telluride (SnTe) are interesting semiconductor compounds of IV- VI group, that are widely used as holographic recording systems, optical and optoelectronic materials in infrared electronic and memory switching devices and in photoelectrical cells [1]. Antimony Telluride and Tin Telluride are interesting metal chalcogenide semiconductor materials [2]. The purpose of present study is to explore and report in detail the structural properties and optical properties of Antimony Telluride and Tin Telluride thin films were prepared by spin coating technique.

II. EXPERIMENTAL PROCEDURE

Antimony telluride thin films were prepared by spin coating technique from 0.02 gm of Antimony Sulphate and 0.03 gm of Tellurium Oxide were dissolved in dilute H_2So_4. Tin telluride thin films were prepared by spin coating technique from 0.02 gm of Tin Chloride and 0.03 gm of Tellurium Oxide were dissolved in dilute H_2So_4.The solution was kept in magnetic stirrer for about 30 minutes. After the stirring process films were coated on cleaned glass substrates at the deposition rate of 3000 rpm for 60 seconds. The glass substrates were dried. The samples of Antimony telluride and Tin telluride films were annealed at 100°C and 200°C. The color of the films were white. Well adherent with the surface. All chemicals were of AR grade.

III. RESULTS AND DISCUSSION

A. XRD Analysis



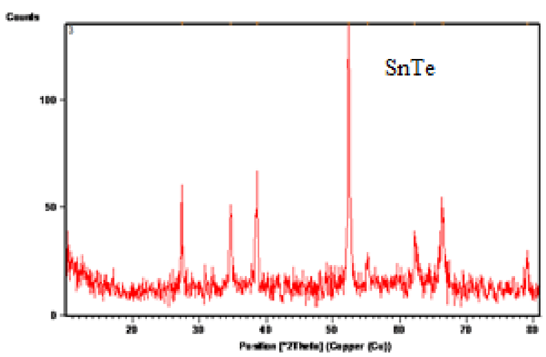


Figure 1. XRD pattern of Thin Film as deposited

Figures 1. Shows the X-ray diffraction pattern of the spin coated Antimony Telluride and Tin Telluride thin films. The XRD pattern obtained correlated well with the standard JCPDS data card files [03-65-3679] and [00-27-0901] for above the mentioned films.

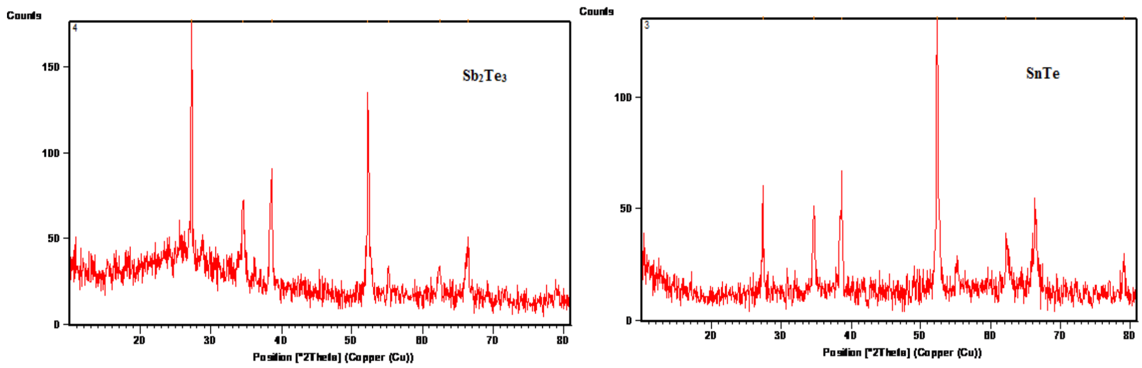


Figure 2. XRD pattern of Thin Films (annealed at 100 °C)

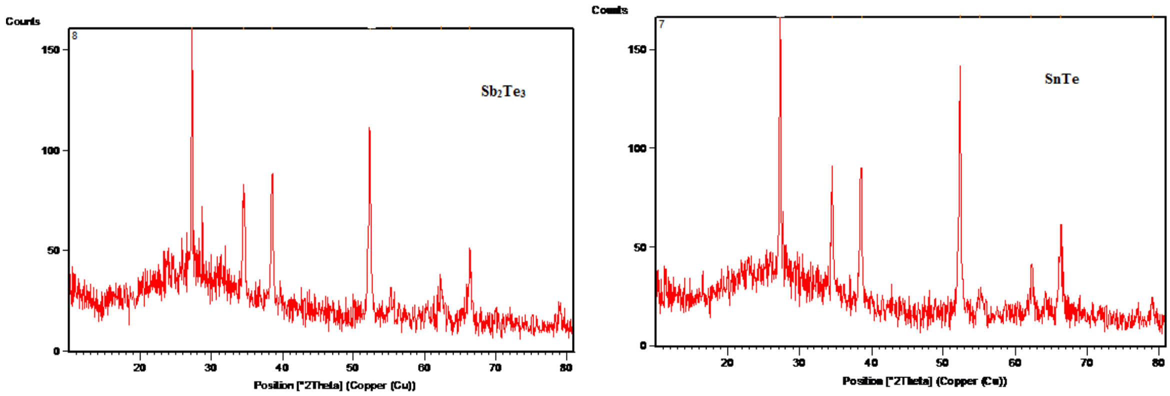


Figure 3. XRD pattern of Thin Films (annealed at 200 °C)

Crystallite size (D) was calculated using Debye-Scherrer's formula [3],

$$D= \frac{0.9*\lambda}{\beta*cos\theta}$$

Where D is the crystallite size, λ is the wavelength of the k_α line, β is the full width at half maxima (FWHM) in radians and θ is the Bragg's angle. The crystallite grain size was increased from 22.28 nm to 36.67 nm for Antimony Telluride as the annealing temperature increased [4]. But in the crystallite grain size decreased from 22.28 nm to 36.67 nm for Tin Telluride as the annealing temperature increased 33.46 nm to 21.36 nm. Corresponding strain and dislocation density were also measured.

B. OPTICAL ABSORPTION, TRANSMITTANCE AND REFLECTANCE MEASUREMENT

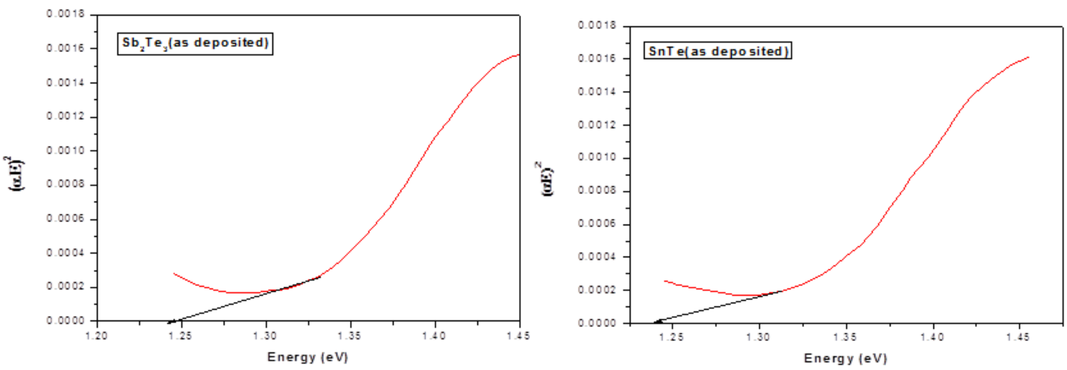


Figure 6. Tauc plot of Sb_2Te_3 and SnTe as deposited

The Optical absorbance Sb_2Te_3 and SnTe thin film were studied in the wavelength range 200-1100 nm using JASCO v-530 model spectrophotometer. All measurements were made in the laboratory at room temperature.

The Optical band gap was calculated using Tauc and Davis Mott relation $\alpha h\gamma = (h\gamma - E_g)^n$, where hγ is the incident photon energy[4], n is the exponent that determine the type of electronic transition. n = 1/2 , direct allowed transition, n = 1, non – metallic materials, n = 3/2 , direct – forbidden transition, n = 2, indirect allowed transition, n = 3, indirect forbidden transition. An extrapolation of the linear region of a plot of the graph gives the value of the optical band gap. The indirect allowed transition band gap of Sb_2Te_3 and SnTe thin films were found to be in the range of 1.1 eV and 1.25eV respectively. All these optical band gap values are close to that reported earlier for the material used for solar cells, which means that these materials have good chance to be used for this purpose [5].

3.4. PHOTOLUMINESCENCE SPECTRUM

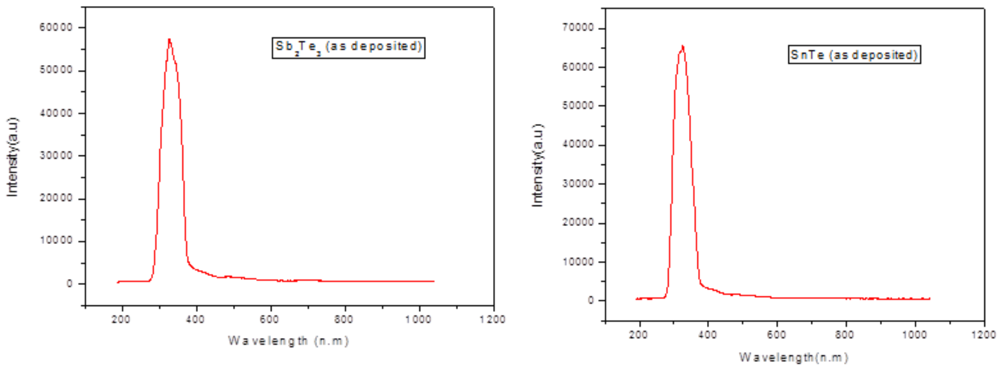


Figure 7. Excitation Spectra

The photoluminescence spectra of Sb_2Te_3 and Sn Te thin films are shown in Figures.7. The calculated band gap using the Photoluminescence spectrum ranges from 3.89 eV to 3.91 eV as the annealing temperature increases for Sb_2Te_3 . Similarly for Sn Te thin films increases the band gap from 3.82eV to 3.85eV.

IV. CONCLUSION

Antimony Telluride and Tin Telluride thin films were successfully deposited on glass substrates by spin coating technique. The films were uniform and had good aherence to the substrate. The XRD of Antimony Telluride films formed a rhombohedral structure and Tin Telluride formed as a cubic structure . The crystalline size of the films were determined by scherrer’s formula and it increases from 22.28 nm to 36.67 nm as the annealing temperature increases. The energy gap values of the films were determined and compared with the reported one. The emitted and excited wavelength were determined from the photoluminescence spectra. The structural properties and optical properties of Antimony Telluride and Tin Telluride thin films were investigated and reported.

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