AN OVERVIEW OF THE PRESENT RESEARCH WORK

The evaluation of any material in its thin film form is complete and meaningful only when its structure and composition are precisely known. Thin films are known to exhibit a wide range of properties which are sensitive to the crystallographic state, defect content, chemical composition and homogeneity of phase in addition to the thickness parameter. The reliability factor, the most important one for the device application, can only be assured through a systematic and detailed study of the structural, electrical and optical properties of the grown films. Hence, due importance was given to these aspects in the study of In$_2$Te$_3$ thin film.

Direct thermal flash evaporation of grain powder of In$_2$Te$_3$ was used for the growth of thin films. Studies on these film reveal that the direct thermal flash evaporation technique provides deposits with reasonable reproducibility in structure composition, electrical and optical properties. However, it was observed that growth of In$_2$Te$_3$ thin film is critically dependent on the substrate temperature. In$_2$Te$_3$ films deposited on the glass substrate at the substrate temperature of 473K are found to be stoichiometric, FCC of ZnS type structure and polycrystalline in nature. At substrate temperature above 473K, In$_2$Te$_3$ films are non-stoichiometric and on increasing substrate temperature beyond 573K, no In$_2$Te$_3$ films could be deposited.
The electrical characterization studies further support the above results. The $\text{In}_2\text{Te}_3$ films deposited at the substrate temperature of 473K have minimum electrical resistivity, maximum carrier mobility, carrier concentration and maximum photoresponse. The changes in electrical resistivity, carrier mobility and carrier concentration with thickness have been attributed mainly to the improvement in the grain size and mean free path of the carriers. The optical energy bandgap obtained from the study of an optical absorption is found to be in good agreement with that reported by other researchers.

The Al/p-$\text{In}_2\text{Te}_3$ Schottky diodes were fabricated. The higher value of ideality factor of these diodes may be due to the interfacial layer, surface effect and image force effects. The barrier height of the Al/p-$\text{n}_2\text{Te}_3$ Schottky diodes are determined from the $I$-$V$, and $C$-$V$ characteristics at different temperatures and the barrier height is found to have almost the same value of 0.60eV at room temperature in all the three measurements.

The thermoelectric power of air exposed $\beta$-$\text{In}_2\text{Te}_3$ thin films was found to be positive and hence the films were p-type. From the present study it was found that the thermoelectric power in $\text{In}_2\text{Te}_3$ thin films is independent of temperature. In the temperature range corresponding to the impurity depletion the thermoelectric power is expected to rise with the temperature. However in the present range of temperature, due to the formation and ionization of defect levels in the system due to oxygen desorption, electrons are

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generated which contribute a compensating emf in the opposite direction, thereby resulting in a nearly constant nature of thermoelectric power with the temperature. It was also found from the present study that the thermoelectric power of $\beta$-In$_2$Te$_3$ thin films obeys the inverse thickness dependence predicted by the size effect theories.

The In$_2$Te$_3$ semiconductor TFSGs exhibit linear response to strain for both tensile and compressive strains and negligible hysteresis. The In$_2$Te$_3$ TFSGs are found to have a higher value of gauge factor and also good temporal stability. The electro-mechanical properties for their possible use as strain gauges in transducer applications.

In$_2$Te$_3$ thin films can be useful in monitoring the CO$_2$ concentration. With increase in the concentration, the sensitivity of the sensor is found to increase. The sensitivity of the gas sensor was found to be dependent upon the thickness of the film. The In$_2$Te$_3$ films deposited at the substrate temperature of 473K, having thickness of 100 nm showed the maximum sensitivity to CO$_2$ gas.