SUMMARY AND CONCLUSIONS

Amorphous semiconductors have been extensively studied in recent years, particularly on their electrical switching and memory. The nature of electron transport in these materials has attracted much attention during recent years.

In case of chalcogenide glasses, when the applied electric field is low the current is Ohmic. The application of sufficiently high electric fields to these materials results in deviations from linearity in observed current voltage characteristics. The resistivity of the material lies typically in the range 10^8 - 10^{10} Ω cm at room temperature.

For our sample the resistivity is found to lie between 10^8 - 10^9 Ω cm at room temperature. In this dissertation, the studies of I-V characteristics, DC electrical conductivity, thermoelectric power and magnetic susceptibility measurements are carried out.

The current voltage (I-V) characteristics show that the current at low voltages is linear and follows Ohm's law. As the voltage increases it becomes non-linear. This non-linear I-V behaviour has been explained on the basis of charged defect states.

From electrical conductivity measurements it is found that the conductivity decreases with increasing Sn concentration in the sample i.e. activation energy increases with increasing Sn concentration in the sample. It is seen that the activation energy for $As_{33}Se_{67}$ is

0.64 eV and increases to 0.71 eV for $As_{33}Se_{60}Sn_7$. This type of behaviour is unusual. Because in the literature it is reported that the activation energy decreases with increasing metal content in the chalcogenide glasses. This unusual result may be due to the widening of band-gap as a result of :

1. Electron-electron or electron-impurity scattering.
2. The smearing effects due to local deformations of a lattice because of randomly oriented Sn ions.
3. The compositional disorder and deeper potential fluctuations associated with incorporation of Sn in chalcogenide glasses.

The values of pre-exponential factor σ_o have been computed. The σ_o values are found to decrease with increasing Sn concentration in the sample. The deviation in σ_o values from reported value may be due to the large extrapolation involved in calculation.

The variation of thermo e.m.f. with temperature difference has been studied. The thermo e.m.f. varies linearly with temperature difference. As the observed thermo e.m.f. is +ve, the carriers are holes and the samples are p-type in nature. The thermoelectric power measurements showed that the thermoelectric power increases with increasing Sn concentration in the sample. The activation energies calculated from conductivity and thermoelectric power measurements differ by 0.13 eV. This difference in activation energies has been explained on the basis of long range potential fluctuations existing in the bulk of the material due to the random distribution of charge centres. The difference is in agreement with the results reported

by Overhof and Beyer for chalcogenide glasses. The Q_o factor in our case is found to increase with increasing Sn concentration in the sample. The Q_o values are seen to be less than those reported in the literature. This may be due to the large extrapolation involved in obtaining these values.

From magnetic susceptibility measurements it is observed that all samples have negative magnetic susceptibility. This shows that the samples are diamagnetic in nature. The diamagnetic susceptibility is found to increase with increasing Sn concentration in the sample. This has been explained by assuming that there are two mechanisms as a possible sources of the diamagnetic enhancement of the susceptibility of amorphous semiconductors. One of these is the presence of large orbits associated with localized states close to the mobility edge. The other is the reduction in the paramagnetic Van Vleck contribution arising from the loss of long range order. The study of variation of magnetic susceptibility with temperature showed that the susceptibility is independent of temperature.

Thus, for our system, we conclude that

1. The current-voltage characteristics are non-linear.
2. The activation energy increases with increasing Sn concentration in the sample i.e. conductivity decreases with increasing Sn concentration in the sample.
3. The thermoelectric power increases with increase in Sn concentration in the sample. The samples are p-type in nature.

4. Magnetic susceptibility is negative and it increases with increasing Sn concentration in the sample. Magnetic susceptibility is indepndent of temperature.

Suggestions for Further Research :

Extension of this work may be done :

1. To understand the physical mechanism for the role played by the defect states, pinning of the Fermi energy and conduction mechanism.

2. To prepare the semiconducting devices for technological uses.

Two research papers from this work have been communicated for publication.

1. "Transport Properties of Amorphous Semiconducting As-Se-Sn System".
   Journal - Applied Physics A (Germany) .....

2. "Compositional and Temperature Dependence of Magnetic Susceptibility of As-Se-Sn System"
   Journal - Material Science (UK) .....

Table No. 3.1

Values of activation energies E^*_σ, E^*_s, room temperature conductivity ($\Omega^{-1}cm^{-1}$), Intercept on lnσ axis, Energy difference E_Q, the factor Q_o, Pre-exponential factor σ_o for bulk of the sample $As_{33}Se_{67-x}Sn_x$

Glass Composition	Concentration X in % atomic weight	Activation Energy E^*_σ (eV)	Activation Energy E^*_s(eV)	Room Temperature conductivity ($\Omega^{-1}cm^{-1}$)	Intercept ln σ ($\Omega^{-1}cm^{-1}$)	Energy difference $E_Q=E^*_\sigma-E^*_s$	Factor Q_o	Pre-exponential factor σ_o($\Omega^{-1}cm^{-1}$)
$As_{33}Se_{67}$	0	0.64	0.50	1.78×10^{-9}	4.70	0.14	5.90	108.00
$As_{33}Se_{66}Sn_1$	1	0.66	0.53	1.45×10^{-9}	4.62	0.13	5.20	104.00
$As_{33}Se_{64}Sn_3$	3	0.66	0.54	1.15×10^{-9}	4.58	0.12	5.44	97.40
$As_{33}Se_{62}Sn_5$	5	0.69	0.56	0.87×10^{-9}	4.56	0.13	6.80	95.50
$As_{33}Se_{60}Sn_7$	7	0.71	0.60	0.67×10^{-9}	4.50	0.11	6.95	89.90

REFERENCES

1. H.K.V. Lotsch : IEEE Trans. ED-15, 294-307 (1968).

2. M.A.Lampert, P.Mark : Current Injection in solids (Academic Press, New York 1970) Chap. 4.

3. R.M.Hill : Phil. Mag. 23, 59 (1971).

4. R.T.Johnson, Jr., R.K.Quinn : J.Non-cryst. Solids 28, 369 (1978).

5. J.K.Zope : Ind. J. Pure and Applied Phys. 20, 774 (1982).

6. B.D.Muragi, M.J.Zope and J.K.Zope : Appl. Phys. A 46, 299 (1988).

7. M.Kastner and S.J.Hudgens : Phil. Mag. B (GB), 37, 665 (1978).

8. Magid,C.A. : Phil. Mag. B 49, 1 (1984).

9. P.Nagels : Phys. Status Solidi A 59, 505 (1986).

10. H.Sakai, K.Shimakawa, Y.Inagaki and J.Arizumi : Jap. J. Appl. Phys. 13, 500 (1974).

11. F.Kosek, Z. Cimpl., M.Q. Mikhoilov and E.A.Karpova : J. Non-Cryst. Solids 86, 265 (1986).

12. Kazuo ABAI, Takao KUWAHATA, Hiroshi NAMIKAWA and Shogo SAITO: Jap. J. Appl. Phys. 11, 1080 (1972).

13. A.B.Gadkari and J.K.Zope : J.Non-Cryst. Solids 103, 295 (1988).

14. I. Hamberg, C.G.Grangvist, K.F.Berggrem, B.E.Sernelins and L. Engstrom : Phys. Rev. B 30, 3240 (1986).

15. Z.M.Zarzebski : Phys. Status Solidi A 71, 13 (1982).

16. Y.Ohhata, F.Shinoki and S.Yoshida : Thin Solid Films 59, 255 (1979).

17. R.V.Kruzelecky, C.Ukah, D. Racansky and S.Zukotynski : J.Non-Cryst. Solids 103, 234 (1988).

18. M.H.Brodsky : Solid State Commun. 36, 55 (1980).

19. R.Strunk : J.Non-crys. Solids 12, 168 (1973).

20. H.Fritzsche : J.Non-cryst. Solids, 6, 49 (1971).

21. H. Overhof and W.Beyer : Phil. Mag. B 49, L 9 (1984).

22. P.Nagels, A. Colloerts and M.Denayar : Proc. Eleventh Int. Conf. on Phys. of Semicond. ed. by M.Maisek (Elsevier Amsterdam) P. 540 (1972).

23. S.Mahadevan and K.J.Rao : J.Non-cryst. Solids 34, 53 (1973).

24. C.H.Segar, D.Emin, and R.K.Quinn : Phys. Rev. B 8, 4746 (1973).

25. V.A.Funtikov, L.A.Baidakov : Inorg. Mater. (USA), 846 (1974).

26. R.M.White, P.W.Anderson : Philo. Mag. (GB), 25, 737 (1972).

27. M.Matyas : J. Non-Cryst. Solids, 8-10, 592 (1972).