Chapter 5

CONCLUSION

The main motive was to study the effect of doping of lead and antimony on Indium Selenium glasses and study their electrical properties. Beginning with the sample preparation, melt-quench techniques was utilized to obtain bulk powders. These bulk samples were further processed in a vacuum thermal evaporation unit to obtain thin films on pre-cleaned glass substrates.

The as deposited pure InSe films were found to be amorphous in nature when characterized with X-ray diffraction (PAnalytical Highscore Plus with Cu Kα=1.24 A). As we introduced Pb or Sb in the host material, phase transformation from amorphous to crystalline took place. The doped samples were found to have crystalline peaks in the diffraction spectrum which increased with increment in the concentration of the dopant which suggests that crystallinity increased with concentration of dopant.

The optical characterizations (UV-Vis-NIR Spectroscopy) were performed to gain insight to the band-gap energy of the material. The band-gap was calculated with the help of tauc plot drawn from transmission spectroscopy data. It was found to lie in the visible region and the value decreased with increment in the doping concentration.

Various other characterizations were adopted to study the material properties deeply. These include FESEM, DSC, EDX, I-V, C-V and dielectric measurements. The FESEM micrographs revealed agglomeration of particles at highest concentration of dopants. Thermal stability of samples is studied with DSC/TGA and was found to be upto
EDX was performed to confirm the composition of thin films and powder samples. The dc conductivity was measured for entire range of temperature in steps of $10^0 \, C$ with the help of Keithley I-V setup. The photoconductivity as well as dark conductivity were found to increase with voltage and showed a perfectly ohmic behaviour. The activation energy was calculated for all samples. AC conductivity measurements for these materials obeys the power law $\sigma_{ac}(\omega) = A\omega^s$ where $\omega$ is the frequency, $A$ is the constant and $s$ is the frequency exponent. The value of frequency exponent decreases with increase in temperature for Pb and Sb doped samples. The variation of ac conductivity with frequency as well as temperature was studied. Modified Correlated Barrier Hopping model (CBH) was employed to explain these results. It is found that Bipolaron hopping is dominant than single polaron hopping in all the samples. It is clear from all the results that the value of defect states and dielectric constant appear to increase with increase in Pb and Sb concentration.

From the C-V and dielectric measurements, it was confirmed that both the dielectric constant and dielectric loss depends upon the temperature and frequency. With increase in frequency, real as well as imaginary part of dielectric constant follows a decreasing trend. However, there is a negligible change in the values at higher frequency regime. Maxwell-Wagner and Koops nomenological theory was used to explain this behaviour. At low frequencies, grain boundaries play predominant role while at high frequencies the conducting grains have the major role to play.