CONCLUSION AND SUGGESTIONS FOR FUTURE WORK
The work reported in this thesis is concerned with the d.c. conduction in the amorphous \([\text{Se}_{0.7}\text{Te}_{0.3}]_{100-x}\text{Y}_x\) \((\text{Y} = \text{Zn, Cd, Pb, and Bi})\). The different samples of the above compositional formula have been prepared using quenching technique. These prepared samples have been studied for their structure using the "Jeol X-ray diffractometer (DX 5) fitted with a scintillation counter as a detector". All the samples have been confirmed to be amorphous. The electrodes on the opposite faces of these samples have been fabricated with the help of vacuum evaporation technique. The electrodes of different materials were fabricated. It has been observed that the experimental data is independent of the nature of the electrodes. The data for d.c. measurements has been obtained using standard two probe method. PID temperature controller has been used to control the temperature of the sample. The readings have been obtained when the samples acquired the temperature of their environment.

The variation of the logarithm of the d.c. conductivity \((\log \sigma)\) versus the inverse of the temperature indicate that the activation energy of the basic system \([\text{Se}_{0.7}\text{Te}_{0.3}]\) decreases as different types of metal additives are added to it. The decrease in the activation energy is large when Bi is added to the basic system and decrease is slow in case of Cd as a metal additive. Zn and Pb show the intermediate decrease. The activation energy has been observed to be field dependent, the dependence on the electric field is maximum in case of the basic system and least in case of Pb (0.5). The reversible threshold switching
has been observed for Zn (0.5, 1, 5, 10), Pb (1,5,10), Bi (0.2, 0.5, 1) samples. Threshold voltage depends on the temperature. It decreases with the increase in the temperature. Threshold switching has also been observed to be concentration dependent. It decreases with the concentration in all the cases. The decrease in the threshold voltage with the concentration is maximum in case of Bi added samples and minimum in case of Zn as a metal additive. The samples in which Cd has been added as a metal additives do not show the threshold switching. The threshold switching has been observed as a completely reversible process. All above observations have been explained on the basis of defect models [17,58,71].

Suggestions for the Future Work

Negative differential resistance has also been observed separating high resistance region and low resistance region. Negative differential resistance regions are thought to be unstable regions. The sample biased in the negative differential resistance region may emit electromagnetic radiations. It is proposed to study the emission characteristics of the samples biased in the negative differential resistance region. For this purpose electromagnetic techniques from d.c. to microwave region may be used.

Switching phenomenon has been studied from the I-V characteristic curves. Potential difference across the sample is considered to be d.c. As has been pointed out, different
types of electronic or thermal mechanisms may account for the positive feedback of the system. In a system combined contribution of the various mechanisms may give rise to positive feedback of the system. The switching behaviour of the sample may be studied by studying the response of the sample with the help of voltage pulses of various amplitude. From the knowledge of the delay time and recovery time various switching parameters may be evaluated. This study may throw light on the recombination process and feedback mechanisms in the system.

Threshold voltage depends upon the composition of the material and the temperature. In principle it is possible to fabricate constant voltage device by properly optimising sample composition and temperature based upon our studies. It is proposed to undertake the extensive developmental work for the development of constant voltage device of a wider threshold voltage range and the temperature range.

Threshold switching is found to be reversible in nature. Experiments were repeated with bulk materials of different thicknesses but still in all the samples threshold switching is found to be reversible in nature. This reversible nature has been explained on the basis of electronic theory. It is a very interesting observation. Reversible switching in thin chalcogenide films provided with a special mechanism for cooling show this type of behaviour. To our knowledge no one has reported reversible threshold switching in the bulk materials. On increasing the voltage across the sample beyond threshold value the system makes transition from high
resistance to low resistance value and the current in the system rises to high value. This rise in current may give rise to heat in the conducting path because of the Joule heating. Generally it is found that the sample in which Joule heating is not compensated, is not cooled by the cooling mechanism, reversible switching is not observed because of the thermal contributions to the feedback mechanisms. It seems that Se-Te network is offering an immediate cooling type of environment to the conducting path. System instantaneously takes out and absorbs heat energy generated because of Joule heating. Se-Te system because of the characteristic co-ordinated bonding has been recognised as pressure sensitive system. Microstructural clusters of the system may account for the cooling network of the system. It is proposed to undertake extensive ultrasonic studies and thermal studies of these systems so as to gain more insight into the elastic and thermal nature of the [Se-Te] system.

Switching properties have been observed in special metal added Se-Te system [Zn,Pb,Bi]. In the basic Se-Te system no such phenomenon has been observed. Added metal atoms seem to be influencing the basic chemical nature of the molecular clusters of the system. Metal additives in the system may cause the change in localized states near the mobility edges because of alloying process. The new alloyed material so formed may have decreased energy gap or the metal additives may compensate with the defect states near the Fermi level so as to unpin the Fermi level. It is proposed to undertake EXAFS, DTA analysis and time of light measurements so as to
give more insight into the nature of the basic molecular clusters of the system.

Basic two mechanisms (conduction of the charge carriers in the extended states and hopping conduction in the localized states) have been known to give rise to thermally activated d.c. conduction process. True in different temperature ranges the contribution from different mechanisms is dominant but the contribution from any mechanism is not zero at any temperature [59]. Polaron motion instead of the motion of the charge carriers may be account to explain the conduction mechanism. It is proposed to undertake extensive study in the field of decay photo-conductivity and time of flight measurements so as to further investigate the contributions due to different mechanisms.