Name of the Ph.D Scholar: Mr. Mohd.Nasir

Name of the Supervisor: Prof. Mohd. Zulfequar

Department of Physics, F/o. Natural Sciences

Jamia Millia Islamia

New Delhi-110025 (India)

Thesis Title: **"Thermal and High Field Conduction Studies in Chalcogenide Glasses"**

Abstract

Chapter 1 gives an introduction to the applications of chalcogenide semiconducting alloys and a brief introduction of basic introduction of chalcogenides glassy materials, thermal properties of chalcogenides glasses, crystallization kinetics in chalcogenide glasses, conduction in chalcogenides glasses, and dielectric properties of chalcogenides glasses. In addition, a review of past work has been added to this chapter for comparison of our results with the results obtained by earlier workers. The Bulk and Thin films of II-VI group semiconductor materials have been investigated by material scientists due to their excellent thermal, structural, electrical, dielectric and optoelectronics properties. Se, S, and Te are the important members of II-VI group. These materials play key role in micro electronics, optoelectronics, solar cell and various industrial applications. The present investigations are focused on the experimental studies of crystallization kinetics has been carried out for Se based glassy alloys, $Se_{100-x}Zn_x$ (x=2,5,10 and 20), $Se_{95-x}S_xZn_5$ (0.2,2,5and 10) under non-isothermal and Isothermal control modes respectively. For all of the investigated compositions the glass transition and crystallization process behave in markedly kinetic nature. In view of the obtained results the following conclusions can be drawn:

Chapter 2 gives a detailed description of the experimental methods used for preparation of chalcogenide glasses, preparation of thin films by thermal evaporation technique, differential scanning calorimetry, space charge limited conduction properties of materials. This chapter also includes the brief descriptions of different characterization techniques like powder XRD, SEM, thermal, electrical and dielectric measurements, which were used by us to characterize the synthesized chalcogenide nanoparticles/ nanocrystals.

Chapter 3 deals with the study of crystallization kinetics has been carried out for Se based glassy alloys, $Se_{100-x}Zn_x$ (x=2,5,10 and 20), $Se_{95-x}S_xZn_5$ (0.2,2,5and 10) under non-isothermal temperature control modes respectively. For all of the investigated compositions the glass transition and crystallization process behave in markedly kinetic nature. The thermal stability on the basis of experimental data is highest for the glassy $Se_{90}Zn_{10}$. The rate of crystallization constant is high because of the highest difference of T_c-T_g in $Se_{90}Zn_{10}$ furthermore it indicates that thermally is most stable this glass in the range of composition. Therefore, the glass $Se_{94.8}S_{0.2}Zn_5$ is most stable than other glasses in the system. It has been seen that the crystallization is to deliberate for the chalcogenide glasses by taking the maximum thermal stability.

Chapter 4 deals with the study of electrical and crystallization kinetics has been carried out for the dc conductivity (σ_{dc}) and the activation energy (ΔE) are decreases due to increases defect states in the mobility gap, increases respectively with increase of Zn concentration in the glassy $Se_{100-x}Zn_x$ system.The pre-exponential factor (σ_0) in first is decreases and further more increases with Zn concentration. According to Author Mott, the conduction is mostly likely in the extended states. Therefore, the present short range order system is directly accountable for such observable properties of semiconductors activated electrical conductivity. The kinetics parameters in isothermal measurements are measured by annealed samples at fix set temperatures above the glass transition temperatures and below the crystallization temperatures and conductivity with time during crystallization.

Chapter 5 deals with the study of high field conduction has been carried out for Charactrization of XRD and SEM micrograph picture the crystallinity is increases, crystallize size and increases the numbers of nanocryst with increases of Zn concentration in $Se_{100-x}Zn_x$ and $Se_{95-x}S_xZn_5$ glassy system. An ohmic behaviours is observed at low fields and non-homic behavior is observed at high fields (~10^4 V/cm) $S_{100-x}Zn_x$ and $Se_{95-x}S_xZn_5$. The density of localized states g_0 near the Fermi-level is estimated by fitting the data into the theory of space charge limited conduction (SCLC).

The activation energy (ΔE) are decreases due to increases defect states in the mobility gap, increases respectively with increase of Zn concentration in the glassy $Se_{100-x}Zn_x$ system. According to Author Mott, the conduction is mostly likely in the extended states. The electrical parameters, the dc conductivity (σ_{dc}) and the activation energy (ΔE) both are increases due to the Fermi level shifted near to the band tails. The defect states are increases with increase of Sulfur in the mobility gap and the band gap are decreases with sulfur in glassy $Se_{100-x}S_xZn_5$ system. According to Mott, has been suggested that the conduction mostly likely in the extended states.

The density of localized states $N(E_F)$ near the Fermi-level is increases with increase the concentration of sulfur(S) in $Se_{95-x}S_xZn_5$ system on temperature range (313 -353 K).

The study of dielectric dispersion is occurring as dipolar-type in present glassy alloys without observed the peak. The dielectric parameters with Zinc can be understood in terms of decrease the density of defect states on adding Zn content and increase the band gap in $Se_{100-x}Zn_x$ system. A detailed analysis also suggested the possibility of dipolar type relaxation in the glassy $Se_{100-x}Zn_x$ alloy, after the incorporation of Zn. The ac conductivity (σ_{ac}) is found to obey Universal power law. According to Mott's, parameters the conduction is most likely in the localized state.

Chapter 6 deals with the study the dielectric dispersion is occurring as dipolar-type in present glassy alloys without observed the peak. Dielectric constant and dielectric loss increase with temperature and as well as increases with increase of Zn content. The dielectric parameters with Zinc can be understood in terms of decrease the density of defect states on adding Zn content and increase the band gap in $Se_{100-x}Zn_x$ system.

The dc conductivity (σ_{dc}) and the activation energy (ΔE) are increases linearly due to shift of Fermi level incorporation of Sulfur concentration in the system. It can be due to concentration of sulfur which increases the defect state associated and consequently decreases the band gap in $Se_{95-x}S_xZn_5$ system. According to Mott's, parameters the conduction is most likely in the localized state.

Chapter 7 deals with conclusion and future Scope of above studies.