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Title of Thesis: Optical and Photo-Induced studies on Thin Film of Chalcogenide Glasses

Abstract

The present thesis entitled study of optical and photo-Induced studies on thin film of Chalcogenide glasses is divided into VI chapters:

Chapter 1 gives the introduction of amorphous semiconductors, their structure, models of amorphous semiconductors (Davis- Mott, Cohen-Fritzche-Ovshinsky, small Polaron), Chalcogenide glasses and their preparation, defects in chalcogenide glasses, photoconductivity (Steady State and transient) and selection of problem.

Chapter 2 outlines the experimental techniques used for the synthesis of chalcogenide glasses and their thin films. This chapter also includes the characterization techniques like X-ray Diffraction Analysis (XRD), UV Visible Spectroscopy, DC Conductivity and photoconductivity measurements.

Chapter 3 outlines the effect of annealing on optical properties like absorption coefficient, optical band gap, Urbach energy of Se-Te based thin films. Absorption coefficient value (α) increases with increase in photon energy for all the samples (Se-Te-Hg, Se-Te-Zn, Se-Te-As, Se-Hg, Ga-Se-Pb) and indirect transition is allowed in all the samples. In Se - Te alloys with Hg and Zn additive, the optical band gap (E_g) decreases and Urbach energy (E_e) increases, in Se – Te alloys with As additive, the optical band gap (E_g) increases and Urbach energy (E_e) decreases. Optical band gap first increases with increase in annealing temperature then decreases with further increase in temperature for all samples.

Chapter 4 gives the study of photo-induced effect on Se-Te thin films. In all the samples, the dark dc conductivity and photoconductivity increases exponentially with increase in temperature, this shows that the conduction is through thermally activated process. The conduction is by hopping in localized states in samples of Hg and As additives, and by extended states in sample of Zn additive and Ga-Se-Pb. Activation energy decreases for all the samples. Conductivity decreases in Hg and As additives, and increases in Zn additives. Value of carrier life time increases up to 10 % of Hg and then decreases with further increase in Hg concentration, carrier life time decreases with increase in composition of Zn, As and Pb. The value of γ shows the bimolecular recombination in Hg, Zn additives and Ga-Se-Pb and bimolecular and monomolecular in samples having As additive. Decay curves do not have same slope and slope goes on decreasing as decay time increases in all samples.

In Chapter 5 the photo-effect on crystallization Kinematic of Se-Te based Chalcogenide thin films are studied. In all samples (Se-Te-Hg, Se-Te-Zn, Se-Te-As, Se-Hg, Ga-Se-Pb), results fit well with the Avrami equation. Value of order parameter (n) for all samples is nearly equal to 1.00 at all temperatures. $n = 1$, represents one dimensional growth of crystallites in glassy system. Value of (n) decreases with the increase in temperature of the film. Value of (n) is greater in case of transformation under photo

illumination. Activation energy of crystallization (ΔE_c) has been calculated which decreases with increase in Hg concentration, increases with increase in Zn and As concentration.

Chapter 6 includes the result and discussion.