Dc conductivity and High Field Behavior of $Se_{100-x}Te_x$ Alloy

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***Abstract*—** The dc conductivity has been carried out in vacuum-evaporated thin films of amorphous $Se_{100-x}Te_x$(x = 4, 8, 12, 16) in the temperature range of (317-378 K). It is found that dc conductivity increases and the activation energy (ΔE) decreases with increase of Te concentration. The conduction is explained on the basis of tunneling of carrier in the band tail of localized state. The high field measurement has been observed at various fixed temperature, a dc voltage (0-400 V) was applies across the sample. I-V characteristic data show that at low electric fields an ohmic behavior is observed. However, at high electric field super ohmic behavior is observed. Analysis of the data show the absence of space charge limited conduction (SCLC) in all glassy alloys as ln I/V versus V curves are not found to be straight lines. Instead ln I/V versus $V^{1/2}$ are found to be straight line, with high correlation coefficient. This suggests the conduction process is either of the Pool-Frenkel or Schottky emission. A detailed analysis show that dominant mechanism is Pool-Frenkel type conduction.

Keywords —Amorphous semiconductor, DC conductivity, High field conduction.

I. Introduction

Chalcogenide glasses have great potential applications in photonics. Four kinds of applications are commercially available or used practically [1-4]. These rely upon the unique features of chalcogenide glasses: quasistability(metastability), photoconductive properties, infrared transparency and ionic conduction. They have been regarded as the most promising for implementing switching and memory due to ability to repeatedly transform between glassy (disordered) and crystalline (ordered) atomic structures. SeTe amorphous semiconductor have gain much importance because of their higher crystallization temperature, greater hardness, higher photosensitivity and small aging effects as compared to pure a Se. Doping, being one of the most common technique used in amorphous semiconductor, but not applicable in case of pure a-Se because of pinning of the Fermi level (E_F) by D^+ and D^- states in the band gap [5]. To modify the optical and electrical properties of a-Se. Certain additives are used [6,7] like, Te, Ge, Bi, Cd etc., which produces its characteristic effect on either hole or electron transport or both. There the method of alloying can be considered as an effective tool of modifying the electrical transport properties of a-Se film.

Because of high resistivity amorphous semiconductor is use for high field conduction. In low field conduction the mobility and the free charge carrier concentration are constant with field, however at high field free carrier system may be influence by both mobility and charge carrier concentration.

The present paper reports the measurement of temperature dependent dc conductivity to understand the conduction in these glasses. High field effect has been studied in amorphous semiconductor and result has been interpreted in term in term of space charge limited conduction [8-11] or in term of high field conduction due to pool-frenkel or Schottky effect [12-15].

II. Experimental Detail

Glassy alloys of $Se_{100-x}Te_x$ (x = 4,8,12,16) were prepared by Melt-quenching technique with high purities (99.99%) materials were weighed according to their atomic percentage and sealed in a quartz ampoules (length~5 cm and internal diameter ~ 8 mm) with a vacuum~ 10^{-5} Torr. The ampoules containing the constituent materials were heated to 600 ^{0}C and held at a temperature of 3-4 ^{0}C/min. All the ampoules were constantly rocked while heating by rotating a ceramics rod to which the ampoules were connected in the furnace so as to obtained a homogeneous glassy alloys

The ampoules were removed from the furnace after rocking for about 12 hours and the obtained melt were quenched in ice-cooled water to obtained glassy nature. The quenched samples were removed by breaking the quartz ampoules. The thin films of glassy alloy were prepared on a glass substrate by vacuum evaporation technique using a standard thermal evaporation technique unit at a base pressure of 10^{-5} torr. The predeposited indiums of different electrode gaps are used as a substrate. The materials to be deposited were placed on molybdenum boat inside the chamber from where it was thermally

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