INTRODUCTION

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The amorphous semiconductor is a class of non-crystalline material which displays many typical semiconducting properties at low applied electrical fields and a bonafide switching effect at critical conditions [1]. These materials have been widely used in switching and memory devices in computers, optical memory disks, holograms, inexpensive photovoltaic cells, IR filters, thermoelectric power generators etc.

Solids can be classified as crystalline and amorphous. The concept of density of states is equally valid for both crystalline and non-crystalline materials. In case of amorphous semiconductors, though long range order is absent, they are not completely disordered on the atomic scale. The short range order, present in amorphous semi conductors is directly responsible for observable properties. Unlike amorphous metals, the amorphous semiconductors do not consist of close packed atoms. They contain covalently bonded atoms.

Normally the amorphous solids are prepared by two ways :

1. By evaporation, sputtering, or similar methods of deposition.
2. By cooling from a melt (quenching).

The first method produces thin films and second bulk materials. There must be some structural differences between the same material prepared by different methods, and hence care is necessary for comparison of properties.

Generally, most amorphous solids that can be prepared by cooling from the melt are insulators or wide gap semiconductors. In this case the mobility gap is greater than 1 eV. The examples are Se, SeTe, As_2Se_3 and similar chalcogenide compounds or multicomponent systems.

It has been shown by Gubanov [2] that near the edges of conduction or valence band in noncrystalline materials the states are localized and the concept of localization plays an important role. This concept was first introduced by Mott [3]. The well known band models, for the band structures of amorphous semiconductors, have been proposed by Cohen-Fritzsche-Ovshinsky [4], and Davis-Mott [5]. They all used the concept of localized states in the band tails. However, opinions vary as to the extent of this band tailing.

Emin [6] suggested slightly different approach for the understanding of the electrical properties of amorphous semiconductors. He suggested that the charge carriers in some amorphous materials might be small polarons. He was able to analyze experimental data of dc conductivity, thermoelectric power, and Hall mobility obtained on some chalcogenide glasses. The hopping of small polarons is the mechanism responsible for electrical transport in oxide glasses, in which the major constituent is the transition-metal.

The enormous work has been done on the chalcogenide glasses. The systems such as Se-Te-In, Ge-Se-In, Ge-Se-Pb, Ge-Se-Sn etc. have been studied widely. But relatively small work has been done on the system As-Se-Sn. Hence we have selected this system to study its transport properties.

Chapter I concerns with the various theoretical approaches such as structure of amorphous solids, band models, electronic transport properties and origin of magnetic susceptibility in amorphous material.

The section 1.1 deals with fundamental approach. In this section, the comparison between crystalline and amorphous materials and structure of amorphous material is explained. The amorphous structure is confirmed from diffraction pattern of an amorphous solid, which consists of broad halos or rings without any evidence of spots. Chemical structure is also explained in the same section.

Section 1.2 concerns with the band structure of amorphous semiconductors. The concept of localized states and Anderson localization is explained. In section 1.3 various band models describing the electronic density of states are presented.

The mobility shoulder and the defects in amorphous material are discussed in detail in Sections 1.3 and 1.4 respectively. The original proposal of Street [7] is also discussed. Chemical-bond description given by Kastner et al. [8] is followed by Anderson proposal. In amorphous semiconductors there is a strong tendency for electrons to be paired in bonding configurations, the coulomb repulsion between electrons at the same site being outweighed by a negative term in the energy due to electron-phonon interaction which leads to configuration changes in the local atomic structure.

Section 1.6 describes the transport properties of amorphous semiconductors. On the basis of Davis-Mott model there can be three channels of conduction. All these conduction mechanisms are discussed

with appropriate mathematical relations. Formulae describing various transport coefficients are presented and are compared with crystalline formulation. Emin's ideas of small polaron formation and conduction due to motion of small polaron is also discussed. Holstein's [9] fundamental concept of "coincidence event" is explained which characterizes the hopping mechanism.

Section 1.7 is devoted to the magnetic properties of the materials. The origin of diamagnetism is discussed in detail.

Chapter II is concerned with the experimental studies such as preparation of sample, X-ray diffraction pattern, I-V characteristics, dc conductivity, thermoelectric power measurements and magnetic susceptibility. The experimental observation tables and formulae used for calculations are listed in the same chapter. The corresponding curves are also shown in the same chapter. The values of E_Q, Q(T) and Q_o are calculated by using Overhof and Beyer [10] approach.

Chapter III deals with results and discussion of above mentioned studies. In this chapter the non-linear I-V behaviour, dependence of conductivity on temperature and on Sn concentration, variation of thermoelectric power with Sn concentration and magnetic susceptibility variation with Sn concentration are discussed.

The dependence of diamagnetic susceptibility on Sn concentration has been discussed on the basis of R.H.White et al. [11] findings.

The variation of magnetic susceptibility with temperature is also discussed.

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