JOURNAL OF OPTOELECTRONICS AND ADVANCED MATERIALS Vol. 8, No. 5, October 2006, p. 1823 - 1830

Effect of *Sn* additive on the electrical properties of *Se-Te* glassy alloy

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The changes in electrical conductivity on the incorporation of *Sn* additive in *Se-Te* binary alloy has been studied in the present work. The electrical measurements have been carried out on $a\text{-}Se_{85-x}Te_{15}Sn_x$ (x = 0, 2, 4, 6 and 10 at. %) thin films. Dark conductivity (σ_d) increases upto x = 6 at. % and then decreases. Activation energy (ΔE_d) decreases upto x = 2 at. % of *Sn* addition, but it increases on further *Sn* addition. Photoconductivity (σ_{ph}) also following the same trend as the dark conductivity measurements. Photosensitivity (σ_{ph}/σ_d) decreases sharply after the *Sn* incorporation. The charge carrier concentration (n_σ) is calculated with the help of dc conductivity measurements. The value of n_σ increases as the *Sn* concentration increases upto x = 6 at. % and then decreases as the concentration of *Sn* is increased. The results are explained on the basis of increase in the density of localized states present in the mobility gap and interms of the electron affinity values of the various constituents of the thin films.

(Received July 18, 2006; accepted September 13, 2006)

Keywords: Photosensitivity, Localized states, Electron affinity, Hopping

1. Introduction

There has been an increased interest in the properties of amorphous *Se* (a-*Se*) rich semiconducting glassy alloys due to their current use as photoconductors in TV vidicon pick-up tubes and particularly in digital X-ray imaging. Amorphous selenium binary alloys with tellurium (*Te*), due to their electrophotographic applications such as photoreceptors in photocopying and laser printing, have been widely studied in both vacuum evaporated amorphous films and vitreous bulk forms. The most extensive use of amorphous *Se-Te* alloys is in the xerographic photoreceptor (PR) industry [1]. The *Se-Te* alloys have been found to be more useful from the technological point of view due to their greater hardness, higher T_C, higher σ_{ph}/σ_d and smaller ageing effects as compared to a-*Se* [2]. Experimental results indicate that the properties of the *Se-Te* alloys are highly composition dependent.

If there exists a large band gap amorphous material, it results in low electrical conductivity. But, these materials can be chemically modified and by controlling the states in the gap, the conductivity changes over many orders of magnitude can be controlled. The Fermi energy level is quite effectively pinned by the valence alternate centres, however, the presence of charged additives greatly reduce this pinning effect. Such effects are expected to occur when the additives and valence alternation centres are not allowed to attain equilibrium. If the concentrations of charged additives exceed that of valence alternate pairs, the chalcogenide glasses behave similar to a partially compensated semiconductor in which charged additives act either as shallow acceptors or donors depending on their charge. Investigation of the temperature dependence of the conductivity, the effect of isoelectronic and non-isoelectronic impurities on the conductivity and activation energy is a subject of great interest as the result of these studies offers the ways to control and improvise effectively the conductivity of amorphous chalcogenide semiconductors. The measurement of the variation in properties of amorphous binary alloy semiconductors as a function of composition is valuable from the view point of tailoring materials with specific parameters. They are of particular interest when the electronic properties do not vary monotonically between those of the constituent elements. Transport properties of chalcogenide glasses strongly depend on the nature and degree of short range order and are not significantly affected by the loss of long range order. The chalcogenide glasses have poor thermo-mechanical properties, in order to enlarge their domain of application, it is necessary to increase their softening temperatures and mechanical strength from application and practical point of view. This leads to the necessity of changing the composition by incorporating the additives to affect the properties of binary systems as *Se-Te* glassy alloy system.

The investigation of steady state and transient photoconductivity is a valuable tool for the study of transport mechanism and defect states in chalcogenide glassy semiconductors. The common feature of these glasses is the presence of localized states in the mobility gap as a result of the absence of long range order as well as various inherent defects. In chalcogenide glasses, the localized states in the mobility gap are the D^+ and D^- states [3]. So, these measurements in chalcogenide glasses may be helpful in understanding the recombination mechanisms which in turn give information regarding the localized states present in the mobility gap of these materials.

The chalcogenide glassy semiconducting thin films have become a subject of systematic research because of the conduction properties of thin films are highly sensitive to the surface states [4,5]. The properties of thin films markedly depend upon the growing conditions, like substrate temperature during deposition, and on the method of preparation of the films. Information on the conduction phenomenon in amorphous *Se-Te* thin films is particularly lacking in spite of the increasing possibility of using *a-Se-Te* and its ternary alloys in photoconduction, switching and memory devices. Most of work has been done on thermal and optical properties, but not much work has been done on the electrical properties specially the photoconductivity properties.

The glassy alloys of the *Se-Te* system based on *Se* are widely used for various applications in many fields as optical recording media because of their excellent laser writer sensitivity, xerography, and electrographic applications such as photoreceptors in photocopying and laser printing, infrared spectroscopy, laser fibre techniques [6-8]. The effect of an impurity in an amorphous semiconductor may be widely different, depending upon the conduction mechanism and the structure of the material [9]. While in crystalline semiconductors, the effect of a suitable impurity is always to provide a new donor or acceptor state, this is not essential in amorphous semiconductor. Instead of providing a localized impurity level in the mobility gap, an impurity may merely alter the mobility of the charge carriers or may introduce structural changes [10] in the amorphous materials with or without modification of the localized states in the forbidden gap.

The addition of third element (*Sn*) expands the glass forming area and also creates compositional and configurational disorder in the system. The lattice perfection and the energy band gap of the material play a major role in the preparation of the device for a particular wavelength, which can be modified by the addition of dopants [11-12]. So, the influence of additives on the electrical properties has been an important issue in the case of chalcogenide glasses. In view of the above, we have started a systematic study of metallic additives on the electrical properties of some important chalcogenide glassy systems. The present paper reports the effect of *Sn* additive on the dark and photoconductivities in vacuum evaporated thin films of glassy $Se_{85}Te_{15}$. At this composition, the density of states is maximum and defect state density is minimum [13-15]. The additive has been incorporated in the melt during the preparation of the glassy alloys.

Section 2 describes the experimental details of sample preparation and photoconductivity measurements. The results are presented and discussed in section 3. The last section deals with the conclusions of the present work.

2. Experimental procedure

Glassy alloys of $Se_{85-x}Te_{15}Sn_x$ ($x = 0, 2, 4, 6$ *and* 10) are prepared by quenching technique. Materials (99.999% pure) are weighed according to their atomic percentage and sealed in quartz ampoules in a vacuum ~ 2×10^{-5} mbar. The sealed ampoules are kept inside a furnace where the temperature is increased upto 920 K at a heating rate of 2-3 ^{o}C/min. The ampoules are frequently rocked for 24 hours at the highest temperature to make the melt homogeneous. The quenching is done in liquid N_2. Thin films of the alloys are prepared by vacuum evaporation technique keeping substrates at room temperature and base pressure of ~$2x10^{-5}$ mbar using a molybednum boat. The amorphous nature of these thin films is confirmed by X-ray diffraction (XRD). The compositions of evaporated samples are measured by an electron microprobe analyzer (JEOL 8600 MX) on different spots (size ~ 2 μm) on the samples. The composition of a 2 × 2 cm^2 sample is uniform, within the measurement accuracy of about ± 0.1%. Pre-deposited thick indium electrodes on well-degassed corning 7059 glass substrates are used for the electrical contacts. A planar geometry of the film (length~1.78 cm; electrode gap ~ 8×10^{-2} cm) is used for electrical measurements. The thickness of the film is ~ 5000 Å. The films are kept in the deposition chamber in dark for 24 hours before mounting them in the metallic sample holder to attain thermodynamic equilibrium as stressed by Abkowitz et al. [16].

The photoconductivity of the amorphous films is studied by mounting them in a specially designed metallic sample holder where heat filtered white light (200 W tungsten lamp) can be shone through a transparent glass window. A vacuum of about 10^{-3} mbar is maintained throughout these measurements. The results are found to be the same in higher vacuum ~10^{-5} mbar also which are verified in the laboratory. Light intensity is measured by a digital Luxmeter (Testron, model TES-1332). The photocurrent (I_{ph}) is obtained after subtracting dark current (I_d) from the current measured in the presence of light. For measurement of transient photoconductivity, light is shone on the sample and rise of photocurrent is noted manually from a digital picoammeter (DPM-111 Model). The accuracy in I_{ph} measurements is typically 1pA. The films are annealed in the range 312-331 K for 2 hours in a vacuum of about 10^{-3} mbar for different samples and the dark and photoconductivity measurements are carried out.

3. Results and discussion

Fig. 1 shows the temperature dependence of dark conductivity (σ_d) for $a\text{-}Se_{85-x}Te_{15}Sn_x$ ($x = 0, 2, 4, 6$ *and* 10) thin films. The $\ln\sigma_d$ versus $1000/T$ curves are straight lines in the measuring temperature range (301-340 K). This indicates that the conduction in these glasses is through an activated process having single activation energy in the investigated temperature range. The σ_d can, therefore, be expressed by the usual relation

$$\sigma_d = \sigma_0 \exp\left(\frac{-\Delta E}{kT}\right) \qquad (1)$$

where σ_o is the pre-exponential factor and ΔE is the activation energy for conduction.

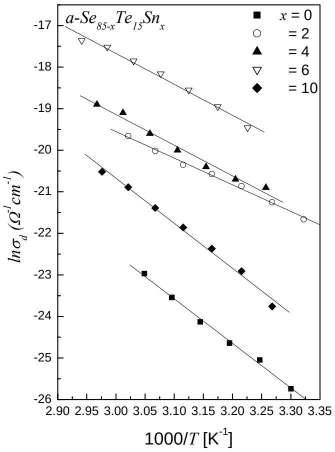

Fig. 1. Temperature dependence of dark conductivity for the thin films of a-$Se_{85}xTe_{15}Sn_x$ *glassy alloys.*

The values of ΔE_d, and σ_d at 301 K have been calculated from the curves plotted in Figure 1 and are inserted in Table 1. Table shows the composition dependence of σ_d at a particular temperature (301 K). The σ_d first increases from 5.22 × 10^{-12} $\Omega^{-1}cm^{-1}$ to 1.72 x 10^{-9} $\Omega^{-1}cm^{-1}$ as the *Sn* concentration increases from x = 0 to x = 6 at. % and then decreases from 1.72 × 10^{-9} $\Omega^{-1}cm^{-1}$ to 2.73 × 10^{-11} $\Omega^{-1}cm^{-1}$ as the concentration of *Sn* increases from x = *6 at. %* to x = *10 at %.* It is also clear from table 1 that the value of ΔE_d decreases from 0.93 eV to 0.61 eV and then remains fairly constant upto 6 at % of *Sn* addition followed by an increase to 0.94 eV on 10 at. % of *Sn* addition.

Table 1. Variation of electrical parameters with Sn concentration in a-$Se_{85-x}Te_{15}Sn_x$ *glassy alloys.*

x	σ_d	σ_{ph}	ΔE	σ_{ph} / σ_d	$\sigma_o(d)$	n_σ	τ_d
	($\Omega^{-1}cm^{-1}$)	($\Omega^{-1}cm^{-1}$)	(eV)		($\Omega^{-1}cm^{-1}$)	(cm^{-3})	(sec)
0	5.22×10^{-12}	5.66×10^{-9}	0.93	1084	1.54x10^{4}	8.53×10^{9}	56
2	2.90×10^{-10}	7.13×10^{-9}	0.61	25	4.83	4.74×10^{11}	125
4	5.02×10^{-10}	4.96×10^{-9}	0.63	10	22.04	8.19×10^{11}	200
6	1.72×10^{-9}	2.47×10^{-8}	0.64	14	96.06	2.81×10^{12}	250
10	2.73×10^{-11}	7.21×10^{-9}	0.94	264	1.25x10^{5}	4.46×10^{10}	100

Fig. 2 shows the temperature dependence of steady state photoconductivity (σ_{ph}) at a particular intensity (1035 Lux) for all compositions. The value of σ_{ph} increases with temperature in the measured temperature range (301 K to 340 K). A maximum in photoconductivity is observed for two samples added with *Sn* (x = 6 and x = 10 at. %). But, at lower *Sn* additive concentration (x = 2 and x = 4 *at. %*), the photoconductivity reaches a maximum with increase in temperature and saturates with further increase in temperature in the measured temperature range. The measurements at higher temperatures have not been possible due to low glass transition temperature (T_g) of these glasses. The photoconductivity maximum, which is generally observed in case of chalcogenide glasses, is absent incase of pure binary alloy of $Se_{85}Te_{15}$, i.e. at x = *0*. The photoconductivity for this sample simply increases slowly and monotonically with increasing temperature. This occurs due to the thermally activated process, which is explained on the basis of bimolecular recombination.

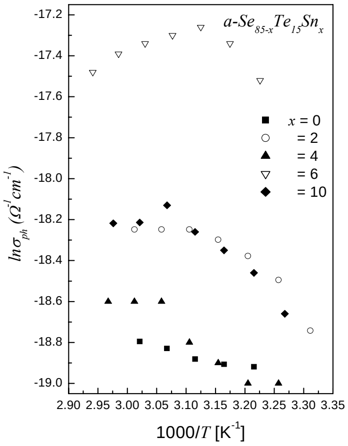

Fig. 2. Variation of photoconductivity with temperature for a-$Se_{85-x}Te_{15}Sn_x$.

The activation energy of photoconduction (ΔE_{ph}) is smaller than the dark conduction. The value of σ_{ph} have been calculated at 301 K and at intensity 1035 lux from the plots of Fig. 2 and are inserted in the Table 1. A maximum in the photoconductivity is a general feature of chalcogenide glasses and various theories [2,17] have been put forward to explain this maximum. Shiah and Bube [18] studied the photoconductivity in various types of chalcogenide glasses and found that the temperature at which the maximum occurs varies from 178 to 420 K. In some of the glasses, this maximum is not seen at all as incase of binary *Se-Te* thin film [19,20].

Fig. 3 shows the plot of dark and photoconductivity as a function of *Sn* concentration at a temperature 301 K. The dark and photoconductivity values attain a maximum at *x = 6 at. %* of *Sn* addition to the binary $Se_{85}Te_{15}$ binary alloy followed by decrease on increasing the *Sn* additive concentration to *x = 10 at. %.*

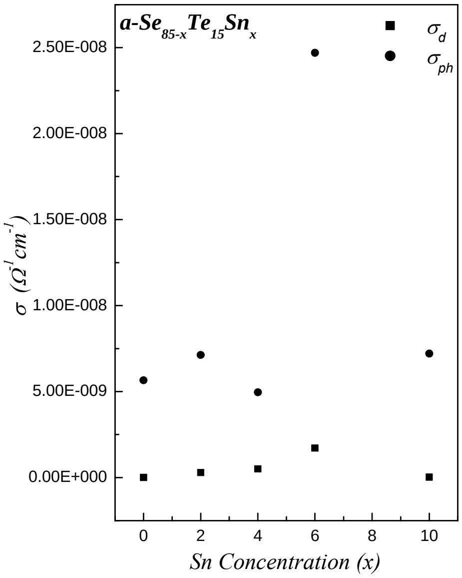

Fig. 3. Composition variation (x) of dark and photoconductivity in a-$Se_{85-x}Te_{15}Sn_x$ thin films.

Intensity dependence of photoconductivity has also been studied at room temperature (301 K) for all the samples used in the present analysis. Fig. 4 shows the plots of $ln\sigma_{ph}$ versus *lnF*. This figure indicates that σ_{ph} increases with intensity following a power law, $\sigma_{ph} \propto F^{\gamma}$. The power '$\gamma$' for all the samples has been calculated from the slopes of $ln\sigma_{ph}$ versus *lnF* curves. The value of 'γ' at room temperature has been found to be nearly 0.5 at all Sn concentrations except for the alloy added with *2 at. %* of Sn, where it is little more than 0.5 (i.e. ~ 0.72, indicating a combination of both mono and bimolecular recombination). The value γ = 0.5 indicates the bimolecular recombination due to the distribution of localized states in the mobility gap of these materials. At all intensities, the value of σ_{ph} increases as the concentration of *Sn* increases. These results can be explained on the basis of the model proposed by Main and Owen [21] and Simmons and Taylor [22]. This model provides the information for the energy location of discrete sets of localized states in the gap. The concept of the charged coordination defects with negative *U* could be responsible for such states [23]. The D^+ and D^- centers can act as discrete traps for photo-generated electrons and holes, thereby giving rise to neutral D^0 sites which, due to polaronic lattice deformation produce energy levels roughly midway between the band edges and the Fermi level.

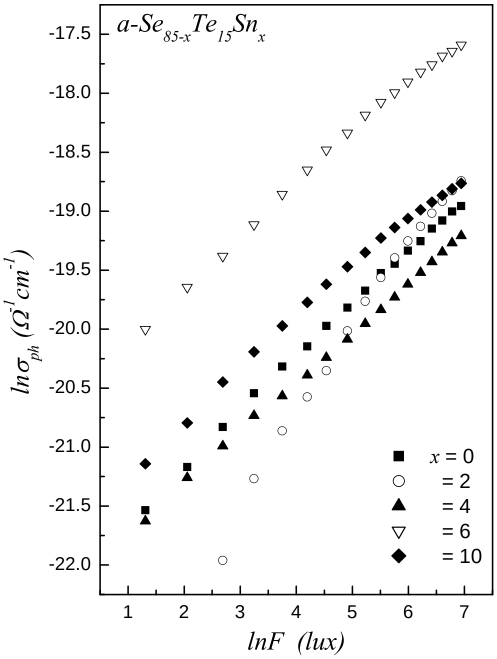

Fig. 4. Intensity dependence of photoconductivity for different a-$Se_{85-x}Te_{15}Sn_x$ glassy alloy thin films.

An important and useful parameter in the photoconductivity measurements is the photosensitivity (σ_{ph}/σ_d), which decides the use of that material in the photoconductive devices. From the measured values of σ_d and σ_{ph}, we have therefore calculated the σ_{ph}/σ_d for all the samples at a particular intensity (1035 Lux) using the results shown in Figs. 1 and 2. The results of these calculations are shown in Fig. 5 at room temperature (301 K) as a function of parameter *x* in the *a-*$Se_{85-x}Te_{15}Sn_x$. The σ_{ph}/σ_d decreases quite appreciably after the incorporation of *Sn* additive and having a minimum at *x = 4*. As the concentration of *Sn* is increased further, the value of σ_{ph}/σ_d increases. Similar results are also obtained at other temperatures.

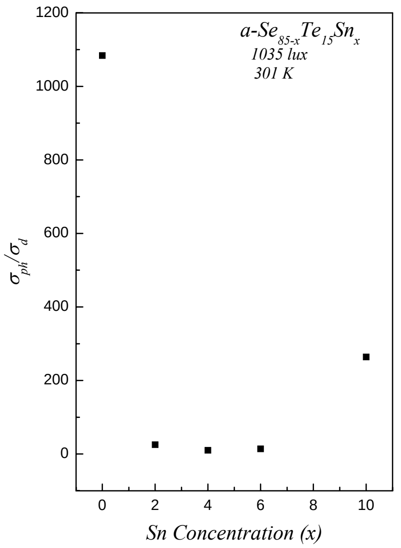

Fig. 5. Composition dependence of photosensitivity (σ_{ph}/σ_d) at room temperature for different a-$Se_{85-x}Te_{15}Sn_x$ glassy alloy thin films.

Transient photoconductivity measurements have been taken as a function of temperature and intensity of light in *a*-$Se_{85-x}Te_{15}Sn_x$ thin films (results not shown here). It is clear from the results that the decay of photocurrent is slow in amorphous thin films of *a*-$Se_{85-x}Te_{15}Sn_x$. A persistent photocurrent (the asymptotic value of the current in the decay) is also observed in all samples. This type of decay of photocurrent is observed in various kinds of chalcogenide glasses [24,25]. To simplify the analysis, we have subtracted the persistent photocurrent from the measured photocurrent and found that the decay of photocurrent is non-exponential even after subtracting the persistent photocurrent. In discussing the non-exponential decay process we prefer to use the concept of differential lifetime as described by Fuhs and Meyer [26]. According to these researchers, the differential life time can be defined as follows:

$$\tau_d = -\left[\frac{1}{I_{ph}}\cdot\frac{dI_{ph}}{dt}\right]^{-1} \qquad (2)$$

The values of τ_d are calculated at various times using the slopes of I_{ph} versus time curves. The corrected value of I_{ph} is used for these calculations.

To compare the rate of decay for various samples, we have chosen the value of τ_d at $t = 40$ *sec* and we expect that at this time the slow decay will be predominant in all samples studied. Fig. 6 shows the plot of τ_d versus '*x*', the *Sn* concentration, at room temperature. The value of τ_d first increases (upto $x = 6$ *at %*) and then decreases (from $x = 6$ *at. %* to $x = 10$ *at. %*) as the concentration of *Sn* increases. The higher value of τ_d after the *Sn* incorporation in *a*-$Se_{85}Te_{15}$ thin films indicates the slower decay in *a*-$Se_{85-x}Te_{15}Sn_x$ thin films and hence an increased density of localized sates. One can therefore expect a higher density of localized states in the mobility gap of *a*-$Se_{85-x}Te_{15}Sn_x$ ($x > 0$ *at. %*). Similar conclusions are also drawn from the steady state photoconductivity measurements.

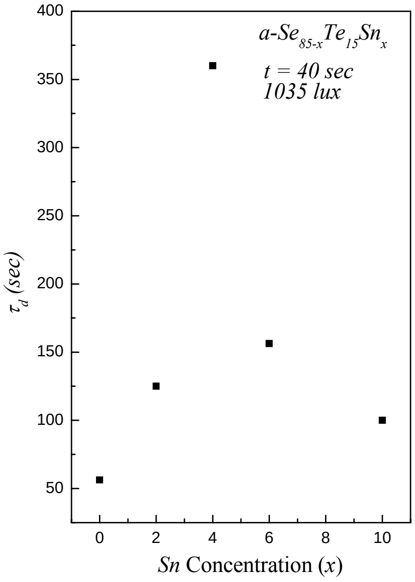

Fig. 6. Variation of differential life time constant (τ_d) for thin films of a-$Se_{85-x}Te_{15}Sn_x$ for $t = 40$ sec at room temperature.

An increase in dark photoconductivity with a corresponding decrease in activation energy is generally found to be associated with the shift of Fermi level in impurity doped chalcogenide glasses [27]. On the other hand, an increase in dark conductivity after impurity doping has also been explained interms of the increased hopping conduction in impurity induced states [28]. So, the increase in σ_d after *Sn* incorporation can be interpreted in terms of either of the two mentioned processes. The dark activation energy (ΔE_d) alone does not provide any indication as to whether conduction takes place in extended states above the mobility edge or by hopping in the localized states. According to the second interpretation, the density of localized states should increase which should lower the photosensitivity at a particular temperature and intensity, but in the first interpretation, the density of states should not increase. Since the photosensitivity (σ_{ph}/σ_d) decreases sharply after the *Sn* incorporation indicating an increase in localised state density, therefore, the first interpretation seems unlikely in the present case.

The charge carrier concentration (n_σ) for different samples can be calculated using the equation [29,30]

$$n_{\sigma} = 2\left(\frac{2\pi m k_B T}{h^2}\right)^{\frac{3}{2}} \exp\left(\frac{-\Delta E_{\sigma}}{k_B T}\right) \quad (3)$$

where ‘m’ is the mass of the charge carrier and ‘k_B’ is the Boltzmann constant.

But the much better approach would be to presuppose the fixed pre-exponential factor, to calculate the Fermi level position and then the carrier concentration, the procedure taken for other amorphous semiconductors [31]. Using this way, we have calculated the charge carrier concentration for these $a\text{-}Se_{85-x}Te_{15}Sn_x$ glassy alloys. For the calculation of the values of n_σ, we have taken the value of $\sigma_0 \approx 1.54 \times 10^4\ \Omega^{-1}\ \text{cm}^{-1}$ of the $a\text{-}Se_{85}Te_{15}$ glassy alloy. The calculated values of n_σ have been inserted in the Table 1. Fig. 6 shows the plot of $ln\ n_\sigma$ versus Sn concentration (x). The value of n_σ increases with the increase of Sn concentration with a maximum at $x = 6$ *at. %* and then it again decreases on increase in the concentration of Sn additive to $x = 10$ at. % of Sn.

The photosensitivity (σ_{ph}/σ_d) depends on the lifetime of the excess charge carriers which in turn depends on the density of localized states in a particular material. The higher the density of states, the lower will be lifetime, as these defect states may act as recombination centers in presence of light. This is found to be due to the formation of intimate valence alternation pairs (IVAPs) under illumination. The defects are converted by bond switching reactions to random pairs of charged defects, known as light induce metastable defects (LIMDs) [32-34]. Therefore, σ_{ph}/σ_d should decrease with the increase in the density of defect states. Such an increase in the density of defect states after incorporation of *Sn* additive may be understood interms of the electron affinity of *Sn* as suggested by Onozuka et al. [35]. Selenium and Tellurium belong to the same group (VI) of the periodic table. When tellurium is added to pure selenium, some of the tellurium atoms may not be incorporated in chains. So, some of the tellurium atoms would act as ionized impurities (the electron affinity of *Te* is lower than that of *Se*). Similarly, the addition of *Sn* will induce more and more positively charged localized states, since the electron affinity of *Sn* is much lower than that of *Se* and *Te*. So, an increase in defect states after putting *Sn* concentration in binary $Se_{85}Te_{15}$ alloy may be understood interms of lower electron affinity of *Sn* as compared to *Se* or *Te*.

Iovu *et al.* [36] have studied the effect of *Sn* doping on the photoconductivity properties of As_2Se_3 and AsSe films. They have found the kinetics of transient photocurrent in *Sn* doped films to be strongly dependent on the light intensity and temperature. They found the decay rate to slow down after *Sn* doping. The effect is caused by enhanced carrier trapping by relatively deep localized states that are apparently created in chalcogenide glasses upon *Sn* doping. Enhanced trapping leads to slower rise of photocurrent and delays the onset of recombination in doped samples thus increasing the life time of the photo excited state after switching off the inducing light. They used the concept of Seregin et al. [37] who, measured the Mossbauer spectroscopy in *Sn* doped As_2Se_3 and observed that the *Sn* is tetravalent (i.e. Sn^{4+}) in the As_2Se_3 glass matrix. All four valence electrons of *Sn* participate in chemical bonds with the matrix atoms and do not affect the electrical properties. However, in unannealed films some *Sn* atoms are present in the form of divalent tin (i.e. Sn^{2+}) and only 5*p* electrons participate in the formation of chemical bonds while the 5*s* electrons play the role of deep donors. They have given another possibility that the photoinduced charge transfer may take place in tin impurities [$Sn^{4+} \rightarrow Sn^{2+}$] with electron trapping by *Sn* induced centres.

Iovu *et al.* [38] also observed the presence of persistent I_{ph} in $a\text{-}As_2Se_3\text{:}Sn$ samples, and associated it with the deep states. They assumed it owing to the movement of quasi Fermi level, and the exposure to electromagnetic radiation changed the population of these centres resulting in the suppression of deep capture rate and an increase in the recombination rate. The addition of *Sn* additive in $a\text{-}As_2Se_3$ slowed down the relaxation rate of the I_{ph} during the transient photoconductivity measurements. The value of I_{ph} was also observed by them to decrease on the incorporation of *Sn* additive. In the samples incorporated with *Sn* additive, *Se* atoms have been assumed by Iovu *et al.* to form tetrahedral coordinated structural units such as $Sn(Se_{1/2})_4$, which can promote the occurrence of the new acceptor-like deep centres. According to them, the characteristic time constant of the carrier capture on deep traps is increased on doping of the As_2Se_3 sample with *Sn* additive and determines the rate of recombination. The incorporation of *Sn* additive results in occurrence of slow components in I_{ph} relaxation related to the phenomenon of persistent photoconductivity.

From the above arguments, it is clear that the number of defect centres are increased in the *Sn* doped As_2Se_3 and *AsSe* films. In the present case also, the charge carrier concentration increases (Fig. 7). These charge carriers will act as localized states due to which the dark conductivity and photoconductivity increases. As the photosensitivity (σ_{ph}/σ_d) depends on the density of localized states, it decreases after the incorporation of *Sn* into the $Se_{85}Te_{15}$ system. The increase in dark conductivity in the present case may therefore be interpreted interms of increased hopping conduction due to increase in the concentration of localized states. However, a decrease in dark conductivity, photoconductivity, carrier concentration and an increase in dark activation energy, photosensitivity can be understood interms of the structural changes which are taking place in the material at such a high *Sn* additive concentration ($x = 10$ *at. %*). The density of localized states increase on the incorporation of *Sn* additive, as shown by the transient photoconductivity measurements (results not shown here) by the increasing value of the differential life time constant (τ_d) in the *Sn* added alloys. The density of sates becomes low for higher concentration of *Sn* additive (i.e ~ $x = 10$ *at. %*), where the value of τ_d decreases after attaining a maximum at $x = 6$ *at. %* of *Sn* addition.

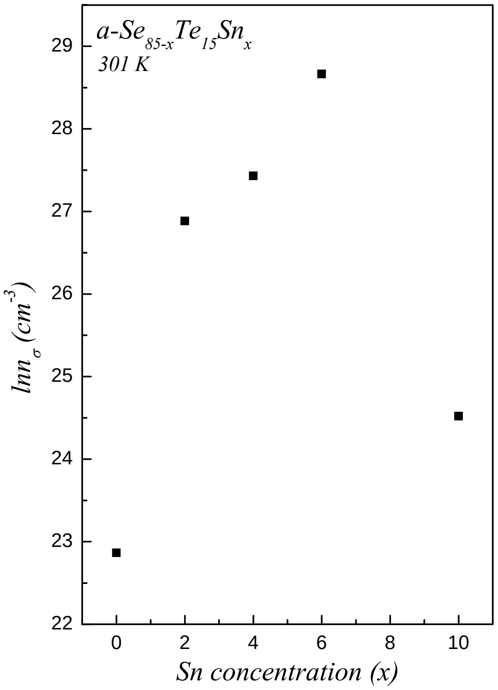

Fig. 7. Variation of the carrier concentration with change in Sn concentration in a-$Se_{85-x}Te_{15}Sn_x$ glassy alloy thin films.

4. Conclusions

The effect of *Sn* additive on the dark (σ_d) and photoconductivity (σ_{ph}) is studied in amorphous $Se_{85}Te_{15}$ binary alloy. Both σ_d and σ_{ph} increase after the addition of *Sn*. The photosensitivity (σ_{ph}/σ_d) decreases sharply after *Sn* incorporation. So, an increase in dark conductivity with a corresponding decrease in the activation energy as the *Sn* concentration is increased, indicates an increase in the density of localized states. A sharp decrease in the σ_{ph} / σ_d by two orders of magnitude and an increase in τ_d indicate an increase in the density of localized states.

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