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Errata

The editor would like to announce the retraction of this paper from this journal for the reason of research misconduct.

This article was identified as having intentional plagiarism issues regarding it's content, by rewriting someone else's work without attribution.

The editorial staff of the journal would like to apologize for the misunderstanding and technical error that led to the publication of the article in this journal.

Managing Editor

Dr. Iosif - Daniel Şimăndan

Chalcogenide Letters Vol. 20, No. 5, May 2023, p. 325 - 331

Retracted article: Gamma irradiation effects on Ag based ternary and quaternary chalcogenide films

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In this work the effect of gamma irradiation (50 kGy and 100 kGy) on properties of $In_xSb_{20-x}Ag_{10}Se_{70}$ (x= 0,10,20) films has been discussed. X ray diffraction, Transmission Electron Microscopy, Optical properties and Electrical properties have been successfully studied. X Ray diffraction and TEM images reveal the amorphous nature of thin films. A change in the optical energy gap is observed after irradiation.The optical band gap increases accompanied with increase in tailing parameter.The value of N decreases with irradiation dose.It is found that crytallinity is higher for ternary system as compare to quarternary system. From electrical measurements it has been that conduction is in the localised state and the DC activation energy decrease upon gamma irradiations.

(Received December 30, 2022; Accepted May 3, 2023)

Keywords: Chalcogenide glasses, Thin films,X Ray diffraction, Gamma Irradiation

1. Introduction

Chalcogenide glasses belong to an important class of amorphous semiconductors category, which are prepared by the rapid cooling of the melt. They contain chalcogen element in large proportion and behave as semiconductor. These semiconductors have the energy band gap 1-3 eV.[1-3]Chalcogenide glasses transmits the longer wavelengths in the IR region than silica and fluoride glasses. There are numerous optoelectronic applications in the civil, medical and military areas. In the present research work some new selenium-based Chalcogenide glasses have been characterised to develop a promising material for the optical devices such as photonic devices, optical scanners, optoelectronic devices, optical printer, optical filters and optical memory effects[4-10].

They have flexible structure so they are very sensitive to gamma irradiations[11-13].Various micro structural changes have been observed due to the absorbance of gamma quanta in chalcogenide glasses hence these type of glasses have various applications in optoelectronic devices .Upon annealing or irradiation , these glasses can transform the phase from amorphous to crystalline hence they are suitable for optical memory or data storage devices.

Nowadays the effect of gamma irriadation on thin films are widely used to study structural transformation as well as physical properties.Because chalcogenide glasses are used as active component in particular devices so it must be thermally saturated.Since chalcogenide glasses is formed in non equilibrium thermodynamic state so it is possible that physical properties of glass is formed in non equilibrium thermodynamic state , so it may be possible that physical properties of glass may deteriorate when used below T_g .Also heavy doses of radiations on these material are useful for simulating the conditions for their application in fabricating different components of satelites. In this work the effect of gamma irradiation (50kGy and 100kGy) on properties of $In_xSb_{20-x}Ag_{10}Se_{70}$ (x= 0,10,20) films has been discussed.

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https://doi.org/10.15251/CL.2023.205.325

1.1. Gamma-irradiation of thin films

Thin films of In_xSb_{20-x} $Ag_{10}Se_{70}$ (x= 0,10,20) have been prepared by thermal evaporation technique .These films were gamma irradiated with different dosing rates (50kGy and 100kGy) using GAMMA CHAMBER 1200,BRIT,DAE, Mumbai ,India.

2. Results and discussion

2.1. X ray diffraction

Figure 1 (a),(b),(c) show X-ray diffraction pattern for pristine and gamma irradiated In_xSb_{20-x} $Ag_{10}Se_{70}$ (x= 0,10,20) films. The absence of any peak in pristine In_xSb_{20-x} $Ag_{10}Se_{70}$ (x= 0,10,20) films confirm their amourphous nature. The gamma irradiated thin films reveal polycrystalline character of the material. The diffraction peak at 23.52° (2ϴ) corresponding to Se (3 1 0) plane indicates growth of Se phase for both ternary and quarternary systems. It has been found out that peak intensity increases after after 100kGy of gamma irradiation dose which indicates the enhancement in crystallinity of the material. The crystallite size can be calculated by formula for the dominant peak (3 1 0) for ternary and quaternary system by using Schere's formula [14-15]

$$D= 0.94\lambda/\beta\cos\Theta$$

where λ is wavelength of CuK_α (0.154 nm),β is full width at half maximum in radians ,ϴ is Braggs angle in radians and D is crystalline size.

The other microscopic structural parameters such as lattice strain (ϵ) , dislocation density (σ) and number of crystallites per unit area (N) of the films is calculated by following relations to understand unit cell of Se[16-17]

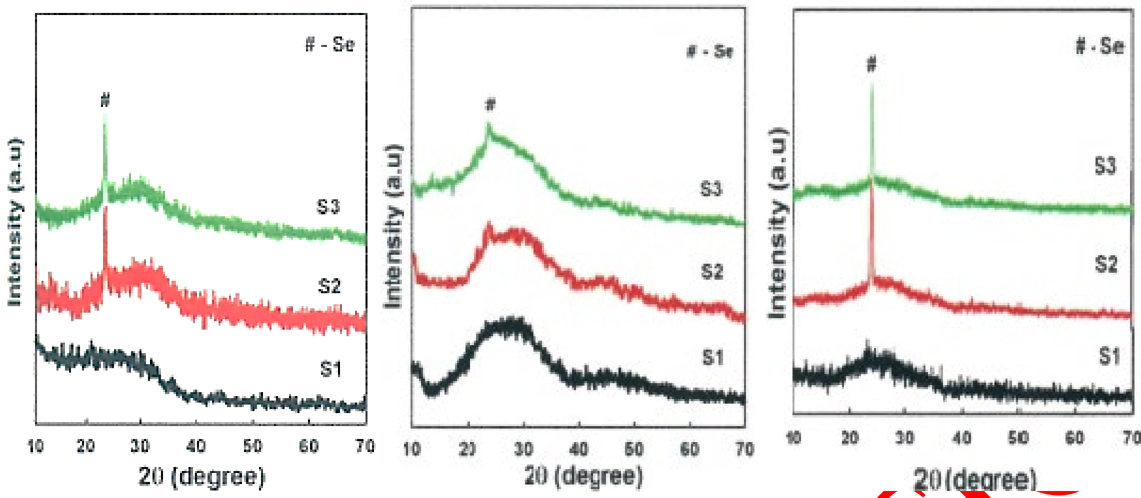
$$\epsilon=(\beta\cos\Theta)/4$$

$$\sigma=1/D^2$$

$$N= t/D^3$$

where t is thickness of film

All the structural parameters of gamma irradiated In_xSb_{20-x} $Ag_{10}Se_{70}$ thin films are tabulated as in Table 1.



(a) *(b)* *(c)*

Fig. 1. Diffraction patterns for S1,S2,S3 thin film (a) $Ag_{10}Se_{20}Sb_{70}$ (b) $In_{10}Sb_{10}Ag_{10}Se_{70}$ (c) $In_{20}Ag_{10}Se_{70}$ chalcogenides. Here S1,S2,S3 are the as prepared 50Gy and 100kGy Chalcogenides samples respectively.

Table 1. Calculated values of crystalline size D ,lattice strain (ϵ), dislocation density (σ) and number of crystallites per unit area (N) for Se (310) phase for gamma irradiated $In_xSb_{20-x}Ag_{10}Se_{70}$ (x= 0,10,20) thin films. Here S-1,S-2,S-3 are the as prepared ,50kGy and 100kGy Chalcogenide samples respectively.

x	Irradation dose	Sample code	2ϴ@(310)	D(nm)	ϵ($x10^4$)	σ($x10^4$ nm^{-2})	d(Å)	N=($x10^4$ nm^2)
0	As prepared	S1	------	------	------	------	------	------
	50kGy	S2	22.54	37.69	10.14	7.85	3.76	8.80
	100kGy	S3	22.57	39.76	9.58	7.01	3.76	7.43
10	As prepared	S1	------	------	------	------	------	------
	50kGy	S2	23.83	18.96	19.09	25.41	3.5	54.23
	100kGy	S3	23.78	21.34	16.98	20.23	3.5	41.20
20	As prepared	S1	------	------	------	------	------	------
	50kGy	S2	25.23	30.12	12.12	8.12	3.7	10.78
	100kGy	S3	25.23	34.45	6.86	6.23	3.7	6.10

With the increase in gamma irradiation dose, the crystallite size increases.The lattice strain and dislocation density (σ) decreases for gamma irradiated thin films that ensure an increase in crystallinity of the material [18-19].The value of N decreases with irradiation dose which may be due to change in structure nor growth /coalescence of smaller crystallites[20].It has been found that the crystallinity is higher for ternary system as compare to quarternary system.

Table 2. The optical band gap (Eg),tailing parameter B^{-1} , room temperature conductivity σ_{RT} ,activation energy (ΔE) and pre exponential (σ_0) for S1,S2and S3 thin films for $Sb_{20}Ag_{10}Se_{70}$, $Sb_{10}Ag_{10}In_{10}Se_{70}$ and $Ag_{10}In_{20}Se_{70}$ Chalcogenides. Here S-1,S-2,S-3 are the as prepared ,50kGy and 100kGy Chalcogenide samples respectively.

x	Irradation dose	Sample	Eg(Ev)	$B^{-1}(10^{-6}\ cm^{-1}eV^{-1})$	$\sigma_{RT}(10^{-6}\ S\ cm^{-1})$	ΔE	$\sigma_0(Scm^{-1})$
0	As prepared	S1	1.23	1.78	2.8	0.25	0.05
	50kGy	S2	1.03	0.75	5489	0.23	19.52
	100kGy	S3	1.02	0.87	0.05	0.20	0.00012
10	As prepared	S1	1.23	2.13	6.23	0.28	0.31
	50kGy	S2	1.14	1.46	0.05	0.25	0.002
	100kGy	S3	1.12	1.59	2.06	0.23	0.04
20	As prepared	S1	1.65	1.78	11.32	0.42	6.24
	50kGy	S2	1.45	0.89	0.18	0.27	0.005
	100kGy	S3	1.13	0.98	0.09	0.23	0.0005

2.2. Transmission Electron Microscopy

TEM,HR-TEM and SAED patterns of gamma irradiated $Sb_{20}Ag_{10}In_{10}Se_{70}$ film samples has been shown in Figure 2.These images clearly signify the particles of different sizes which have been obtained from a software .As the TEM samples were prepared by peeling off the thin film followed by bath sonication , so size obtained from TEM (5-16nm) is less than the size obtained by Scherer's approximation in XRD analysis .Figure 2 (a) and (b) display the high resolution (HR-TEM) and selected area electron diffraction (SAED) patterns of gamma irradiated films respectively.The presence of both ordered planes with disordered area confirms that the growth of crystallites have partial crystalline /amorphous.This is also evident from SAED image ,which shows that ring pattern with bright spots along with fading intensity.

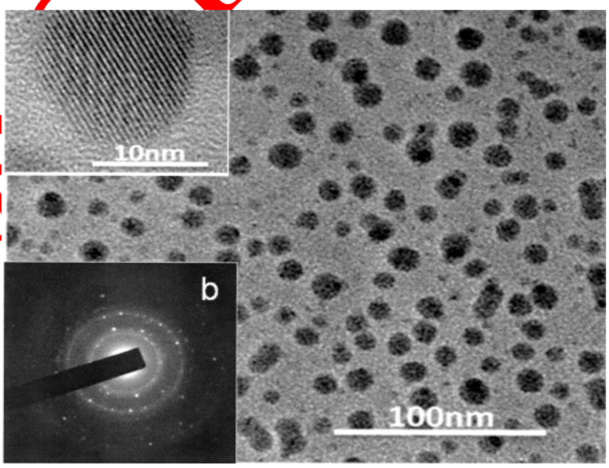


Fig. 2. Shows TEM images and inset pictures (a) HR –TEM and (b) SAED patterns for gamma irradiated quaternary) $In_{10}Sb_{10}Ag_{10}Se_{70}$ sample at 100 k Gy.

2.3. Optical properties

From Optical Transmittance and Reflectance for both as prepared and gamma irradiated thin films of $Ag_{10}Se_{20}$ Sb_{70}, $In_{10}Sb_{10}$ $Ag_{10}Se_{70}$ and $In_{20}Ag_{10}Se_{70}$, the absorption coefficient α has been calculated from measured values of Transmitance and Reflectance[20-21] by using following equation

$$T=(1-R)^2e^{(-\alpha d)}$$

where d is thickness of film.

Figure 3 shows absorption coefficient as a function of photon energy (hν).The structural rearrangement due to gamma irradiation results in a change in local structure of $Ag_{10}Sb_{20-x}Se_{70}In_xSe_{70}$ film samples.

For high absorption region, the relation between absorption coefficient and incident photon energy (hν) is as follows

$$\alpha h\nu = B (h\nu - E_g)^n$$

where n depends on nature of various electronic transitions in a particular range, hν is photon energy , B is quality factor which represents width of tailing material, n can be assumed to be 2 for indirect allowed transitions, ½ for direct allowed transitions and 3/2 for direct forbidden transitions.

The values of indirect band gap E_g and tailing parameter B^{-1} are given in Table 2.

Upon gamma irradiations the value of optical band gap decreases which may be related to formation of segregation of crystalline phase in the amorphous matrix for both ternary and quaternary systems[22] .The creation of defects or their annhihalation occurs at the same time upon the interaction of gamma irradiation with the material.At higher doses of gamma radiation , no of defects created becomes more as compared to number of defects annihilated.Hence band gap decreases with the increases in dose of gamma radiations.Whereas tailing parameter B^{-1} firstly decreases which may be due to phase transformation and then increase which indicates that the number of defects created becomes more as compared to the number of defects annihilated[23].

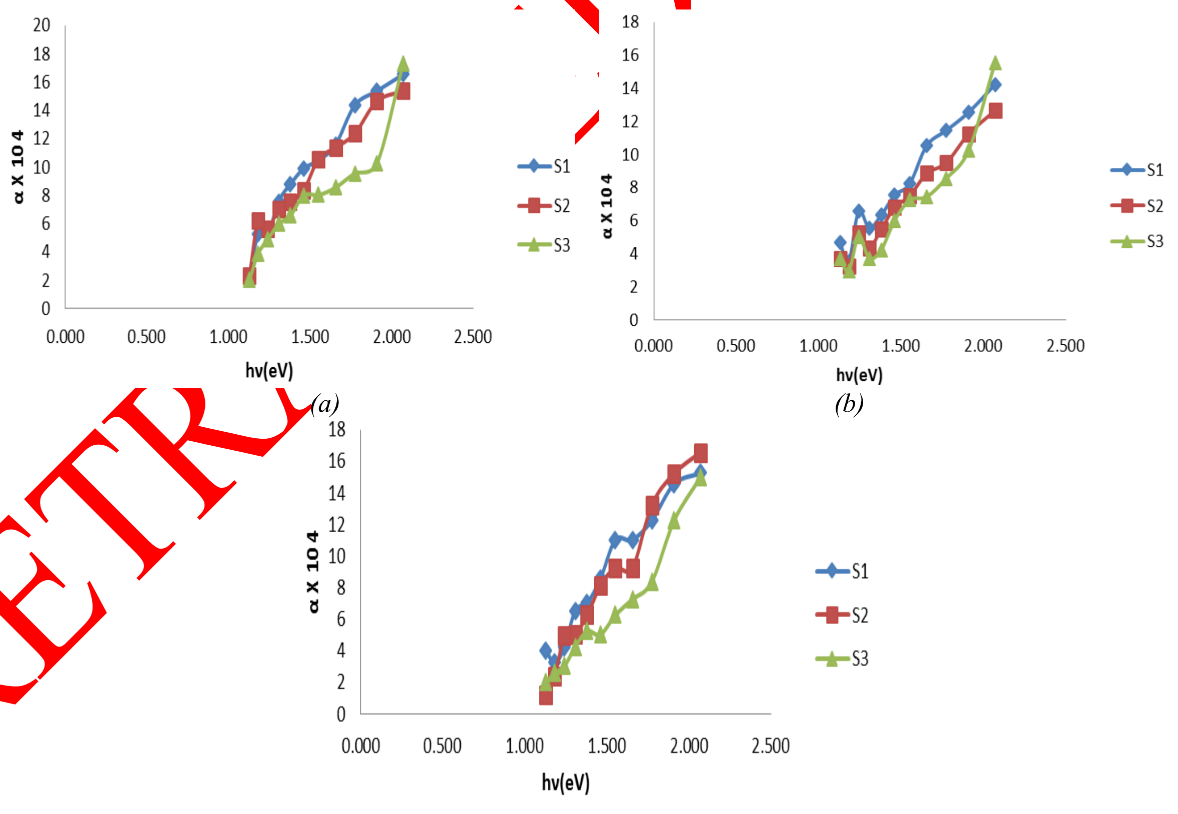


Fig. 3. (a) (b) (c) show Variation of absorption coefficient for S1, S2 S3 thin films for (a) $Ag_{10}Sb_{20}Se_{70}$ (b) $In_{10}Ag_{10}Sb_{20}Se_{70}$ (c) $Ag_{10}In_{20}Se_{70}$ chalcogenides .Here S1 ,S2 and S3 are the as prepared 50 kGy and 100 kGy chalcogenides samples respectively.

2.4. Electrical properties

Figure 4 shows dependence of Electrical conductivity σ on inverse temperature at 10 V bias for ternary and quaternary system .DC conductivity can be expressed as Arrhenius equation [24]

$$\sigma_{dc}=\sigma_0 \exp [-\Delta E/kT]$$

where ΔE is activation energy, σ_0 is pre exponential factor ,k is Boltzmann constant and T is absolute temperature.

The value of activation energy and pre exponential factor have been calculated from slope of the graphs and intercept with y .The values of σ_{RT} , σ_0 and ΔE are given in Table 2.

It can be seen that σ_{RT} values show non sequential dependence on gamma irradiations for In_xSb_{20-x} $Ag_{10}Se_{70}$ (x=0,10) and decreases for $In_{20}Ag_{10}Se_{70}$ Chalcogenides. It has been observed that value of ΔE decreases with the gamma irradiations dose for both ternary and quaternary for $In_xSb_{20-x}Ag_{10}Se_{70}$(x=0,10,20) Chalcogenide films. The value of pre exponential factor σ_0 can be used to make a difference , whether the conduction is in extended states(σ_0 ~ 10^3- 10^4 S/cm) or in localised states[25] (small value) .Since value of σ_0 is very small so hopping in localised states will be the dominant conduction mechanism for those ternary and quarternary Chalcogenide.

3. Conclusion

The effect of gamma radiation on ternary ($Ag_{10}Sb_{20}Se_{70}$ and Ag_{10} In_{10} Se_{70}) and quaternary ($In_{10}Sb_{10}$ $Ag_{10}Se_{70}$) Chalcogenide films has been studied.The growth of Se crystallites in amorphous film has been observed with the gamma irradiation.It has been found out the X ray diffraction peak intensity increases which gamma irradiations which indicate an enhancement in crystallinity.The crystallite size increases ,lattice strain and dislocation density decrease with gamma irradiation which ensure an increase in crystallinity of material.The value of N decreases with irradiation dose which may be due to change in structure or growth /coalescence of smaller crystallites.It is found that crytallinity is higher for ternary system as compare to quarternary system.

From TEM images , presence of both ordered planes with disordered area confirms that growth of crystallites have partial crystalline /amorphous domains.The variation of band gap and tailing parameter (B^{-1}) may be due to formation of Se crystallites to favour in enhancement in defect creation due to gamma irradiation.The optical band gap increases from 1.23 to 1.45 electron volt accompanied with increase in tailing parameter parameter upto 15 % of In , while further increase cause an increase in optical band gap and decrease in the value of tailing parameter for this system.From electrical measurements it has been that conduction is in the localised state and the DC activation energy decrease upon gamma irradiations. From electrical measurements it has been that conduction is in the localised state and the DC activation energy decrease upon gamma irradiations.

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