Effect of 50MeV Li^{3+} ion Irradiation on Structural, Optical and Electrical properties of Amorphous $Se_{95}Zn_5$ Thin Films

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Abstract. Present work focuses on the effect of swift heavy ion (SHI) irradiation of 50MeV Li^{3+} ions by varying the fluencies in the range of 1×10^{12} to 5×10^{13} ions/cm^2 on the morphological, structural, optical and electrical properties of amorphous$Se_{95}Zn_5$ thin films. Thin films of ~250nm thickness were deposited on cleaned glass substrates by thermal evaporation technique. X-ray diffraction (XRD) analysis shows the pristine thin film of$Se_{95}Zn_5$growsin hexagonal phase structure. Also it was found that the small peak observed in XRD spectra vanishes after SHI irradiation indicates the defects of the material increases. The optical parameters: absorption coefficient (α), extinction coefficient (K), refractive index (n) optical band gap (E_g) and Urbach's energy (E_U) are determined from optical absorption spectra data measured from spectrophotometry in the wavelength range 200-1000nm. It was found that the values of absorption coefficient, refractive index and extinction coefficient increases while the value optical band gap decreases with the increase of ion fluence. This post irradiation change in the optical parameters was interpreted in terms of bond distribution model. Electrical properties such as dc conductivity and temperature dependent photoconductivity of investigated thin films were carried out in the temperature range 309-370 K. Analysis of data shows activation energy of dark current is greater as compared to activation energy photocurrent. The value of activation energy decreases with the increase of ion fluence indicates that the defect density of states increases.Also it was found that the value of dc conductivity and photoconductivity increases with the increase of ion fluence.

Keywords: Thin films, chalogenides, Swift heavy ion irradiation; Optical band gap, Activation energy.

INTRODUCTION

Amorphous selenium is considered to be technologically important material because of its potential applications in optoelectronic devices such as photo rectifiers, Xerography, and solar cells [1-3] etc. Mostly a-Se is used as photoconductor for high-definition television (HDTV) [4], digital radiography (DDR) [5] etc. This is because of low thermal noise, high spatial resolution, and high sensitivity against wide variety of wavelengths from visible to ultraviolet [5] as well as x-rays [6-7] as compared to silicon based photoconductors. In photoconductors, x-ray photons hits the imaging plate attenuated by selenium causing excitation of electrons throughout the a-Se layer leads to the generation of electron-hole pairs. These charge carriers are collected by the charge collecting electrodes and then converted into an electrical signal via by thin film transistor (TFT). This electrical signal is converted into a digital signal via analog-digital-signal (ADC). Thus the efficiency of this device will depend on the absorption of incident x-ray photons. For obtaining large absorption, if we increase the thickness of the layer without the risk of the increasing noise but the problem here is that the thicker layer requires large voltage to capture the electrons. Practically 1000 μm requires 10,000 volts [8].This requirement of high voltage system makes the detector relatively complex and bulky. However the reported study shows increase of optical band gap of amorphous selenium from 1.48eV–2.07eV and decrease of absorption coefficient with increasing the film thickness from 100nm to 385nm [9].

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