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Effect of Gamma Irradiation on Structural and optical properties of Thin Films of a-$Cd_5Se_{95-x}Zn_x$

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Abstract: We report the gamma irradiation effect on the structural and optical properties of a-$Cd_5Se_{95x}Zn_x$ (x=0, 2, 4) thin films. Thin films were prepared by thermal evaporation technique at a base pressure of 10^{-5} torr. The investigated thin films of ~ 200 nm thickness are then irradiated by 25-100 kGy doses of ^{60}co gamma rays. The elemental composition of as-deposited thin films of $Cd_5Se_{95-x}Zn_x$ (x=0, 2, 4) were verified by RBS spectrometry shows good agreement with the actual elemental composition. XRD, PL and FT-IR study confirms the crystallinity of the investigated thin films increases after gamma irradiation. The optical parameters were estimated from optical absorption spectra data measured from UV-vis-spectrophotometer. It was found that the value of optical band gap of investigated thin films decreases and the corresponding absorption coefficient increases up to 75 kGy dose of gamma irradiation. This post irradiation change in the values of optical band gap and absorption coefficient were interpreted in terms of increase in crystallinity of the material after gamma irradiation.

Keywords: Thin films; Chalcogenides; Gamma irradiation; Structural properties; Optical properties.

1. Introduction

Amorphous natured chalcogenide semiconductor materials have revolutionized the world of optoelectronics owing to their low phonon energy, photo-induced anisotropy, high linear refractive index, chemical stability and possibility of variation in physical properties with composition. Now-a-days chalcogenide glasses are considered as an attractive material for high energy irradiation detector in dosimetric system for wide industrial applications due to a close relationship of irradiation induced effects with absorbed doses [2]. These kinds of irradiation detectors allows a low barrier of information bleaching temperature (< 350 ℃) as compared to widely used closed oxide glasses (< 500 ℃). In particular the ternary alloy of CdSeZn is an attractive candidate for all these important technological applications like laser screen materials in projection color TV's [3, 4], Laser diodes, Electroluminescent, Photovoltaic's, Photolumniscent diodes, LED's and nuclear radiation detectors [5-9].

The properties of materials are further modified by using different irradiation techniques like laser irradiation, swift heavy ion irradiation, gamma-ray irradiation etc in order to enhance the performance of various devices. The main job of these irradiation techniques is to dissipate much more energy into to the localized region of the material. This dissipation of the energy is responsible for micro-structural change occurring in the material that in turn changes the other properties of the material. The present study deals with the effect of gamma-rays irradiation on structural and optical properties of thin films of a-$Cd_5Se_{95-x}Zn_x$(x=0, 2, 4). Gamma irradiation of solid materials produces microstructural changes which intern changes the optical and other properties of the material [10-13]. When gamma radiation interacts with the material, two processes occurs at the same time i.e., defect creation and defect annihilation. Thus the changes in the properties of the material will depends up on these two processes or on the other hand one can say depends on the irradiation dose of gamma radiation. This is because at higher doses of gamma radiation the number of defects created becomes more than the number of defects annihilated, the reverse is true at lower doses of gamma radiation. Thus gamma irradiation of materials may cause re-crystallization or amorphization depends on the nature of the material and irradiation dose of gamma radiation. From above discussion it becomes clear that the probability of recrystallization is more at lower doses of gamma radiation whereas the amorphization of the material is more at higher doses of gamma radiation. The relative

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