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Structural and optical analysis of ^{60}Co gamma-irradiated thin films of polycrystalline $Ga_{10}Se_{85}Sn_5$

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The present study focuses on the effects of gamma irradiation on structural and optical properties of polycrystalline $Ga_{10}Se_{85}Sn_5$ thin films with a thickness of ∼300 nm deposited by the thermal evaporation technique on cleaned glass substrates. X-ray diffraction patterns of the investigated thin films show that crystallite growth occurs in the orthorhombic phase structure. The surface study carried out by using the scanning electron microscope (SEM) confirms that the grain size increases with gamma irradiation. The optical parameters were estimated from optical transmission spectra data measured from a UV–vis-spectrophotometer in the wavelength range of 200–1100 nm. The refractive index dispersion data of the investigated thin films follow the single oscillator model. The estimated values of static refractive index n_0, oscillator strength E_d, zero frequency dielectric constant ε_0, optical conductivity $\sigma_{optical}$ and the dissipation factor increases after irradiation, while the single oscillator energy E_o decreases after irradiation. It was found that the value of the optical band gap of the investigated thin films decreases and the corresponding absorption coefficient increases continuously with an increase in the dose of gamma irradiation. This post irradiation changes in the values of optical band gap and absorption coefficient were interpreted in terms of the bond distribution model.

Keywords: thin films; gamma irradiation; structural properties; optical properties

1. Introduction

Interest in the properties of compound semiconductors has recently increased as these have different properties than that of the elemental semiconductors and also have the advantage of tuning the energy gaps and mobility to a wide range to meet specific requirements. For example, the optimum band gap for producing maximum efficiency in solar cells is 1.5 eV for terrestrial power generation (AM1.5 spectrum) which is very close to the energy band gaps of compound semiconductors (*1*). In the last several decades, these compound semiconductors have found potential applications in optoelectronic fields such as displays (*2*) sensors (*3*) microwave communication (*4*) solar cells (*5*) optical communication (*6*) radiation detector (*7*) and so on. Due to the technological importance, the optical properties of compound semiconductor thin films have been extensively studied (*8–10*). Optical transmission spectra help us to understand and develop the energy band diagrams of both amorphous and crystalline materials. In recent years,

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