AMERICAN SCIENTIFIC PUBLISHERS

Advanced Science Letters
Vol. 20, 1430–1432, 2014

Effect of Gamma Irradiation on Optical Parameters of Thermally Evaporated Thin Films of $Cd_5Se_{89}Zn_6$

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Thermal quenching technique was used for preparation of bulk samples of amorphous and the thin films of $Cd_5Se_{89}Zn_6$ were papered by thermal evaporation technique on glass substrates. The thin film of $Cd_5S_{89}Zn_6$ were irradiated by $^{60}C0$ gamma-rays of 50 KGy dose. The elemental composition of as-deposited film of $Cd_5Se_{89}Zn_6$ determined by RBS spectrometry show good stoichiometry and also film thicknesses shows good agreement with the thicknesses measured by ellipsometry technique. The optical characterization of as-deposited and gamma-ray irradiated thin films of $Cd_5Se_{89}Zn_6$ were carried out by using UV-spectrophotometer. It was found that the value of optical band gap is increased due to gamma-ray irradiation and other optical parameters like extinction co-efficient (K) and absorption co-efficient (α) changes accordingly discussed in this study.

Keywords: Thin Films of $Cd_5Se_{89}Zn_6$, Gamma-Ray Irradiation, Optical Properties.

1. INTRODUCTION

S, Se, and Te based chalcogenide semiconductors have many unique optical properties, they can be used for a wide variety of applications.[1] These are promising materials for the use of like solar cells, antireflection coating, optical limiting, and manufacture of filters, infrared power delivery, IR emitter, optical rewritable data, IR detector, gratings and optical recording media.[2–8] Over many decades Group II–IV materials as possible components in advanced optoelectronic devices. The ternary alloy of $Cd_5Se_{89}Zn_6$ is technology important because it can be used to fabricate the quantum wells of the active region of LED's and Lasers.[9] This alloy can grow in cubic phase on GaAs (100) in the full composition range. Numerous studies has been already done so for regarding the study of optical properties of chalcogenide glasses, because they play major role in opt-electronic device fabrication. The optical properties like extinction coefficient (k), absorption coefficient (α), optical band gap (E_g) and urbach's energy (E_e) are important parameters and can be utilized from absorption spectra, transmission spectra and reflection spectra. Large number of research groups through the world are trying to change the material properties (optical, structural, electrical etc.) for enhancing the device performance by using different techniques such as different deposition techeniques, irradiation techniques (laser irradiation, swift heavy ion irradiation, gamma-ray irradiation etc.) and dopping techniques etc. In this study the optical properties of $Cd_5Se_{89}Zn_6$ is presented. Optical absorption spectra provides essential information about the optical band gap band structure of semiconductor materials. Optical analysis of the present case was carried out by UV-visible photospectrometer and it was found that the optical band gap of present system was decreased and the other optical parameters change after gamma-ray irradiation.

2. EXPERIMENTAL STUDIES

Bulk sample of amorphous $Cd_5Se_{89}Zn_6$ as per atomic weight percentage was prepared by thermal quenching technique. The mixture of $Cd_5Se_{89}Zn_6$ from highly pure 99.999% Cd, Se and Zn was put into the quartz ampoule kept at pressure of 10^{-5} torr and then sealed. The ampoule is then placed in the furnace for 15 h at 900 °C temperature. The ampoule was continuously rotated in furnace that results homogeneous mixing of material. After 15 h, the ampoules was taken out of the furnace and quenched in ice cooled water for obtaining amorphous state. Thin films of amorphous $Cd_5Se_{89}Zn_6$ have been prepared by thermal evaporation technique on glass substrates at room temperature under a pressure of $\sim 10^{-5}$ torr through molybdenum boat. The glass substrates was first cleaned by ultrasonic bath and then by acetone. For achieving metastable equilibrium, the films were kept inside the deposition chamber for 24 h. The thickness was measured to be ~ 300 nm by using ellipsometry technique. The elemental composition and thickness measurement of as-deposited thin film of $Cd_5Se_{89}Zn_6$ was confirmed by Rutherford backscattering spectroscopy (RBS). A beam of 2 MeV from He^+ source was used. The thin film of $Cd_5Se_{89}Zn_6$ was irradiated by ^{60}Co gamma-rays. The optical characterization of these films (as-deposited

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1936-6612/2014/20/1430/003 doi:10.1166/asl.2014.5574