Optik 126 (2015) 3501–3505

Contents lists available at ScienceDirect

Optik

journal homepage: www.elsevier.de/ijleo

Effect of gamma irradiation on the structural and optical properties of thin films of a-CdSe

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ARTICLE INFO

Article history:
Received 4 September 2014
Accepted 27 August 2015

Keywords:
Thin films
Gamma irradiation
Absorption coefficient
Optical band gap
Refractive index

ABSTRACT

Thermal quenching technique was used for the preparation of bulk sample of amorphous CdSe (50:50 composition) (a-CdSe) and the thin films were fabricated by thermal evaporation technique on glass substrates. The thin films of a-CdSe were irradiated by ^{60}Co gamma-rays of different doses. XRD patterns of as-deposited and gamma irradiated thin films show phase transformation from amorphous to crystalline state after gamma irradiation. FT-IR spectrum shows strong asymmetric stretch and indicates that the bond strength increases after gamma irradiation. PL study confirms the defect concentration decreases and also supports the change in optical properties occurs due to gamma irradiation. The optical characterization of as deposited and gamma-ray irradiated thin films of CdSe were carried out by using UV-vis-spectrophotometer. It was found that the value of optical band gap increases and other optical parameters like extinction co-efficient (K), refractive index (n), Urbach's energy (E_u) and absorption co-efficient (α) changes accordingly.

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1. Introduction

Chalcogenide glasses are promising materials for various solid state devices like solar cells, optical limiting, infrared power delivery and manufacture of filters, optical rewritable data, antireflection coating, IR detector, gratings, IR emitter and optical recording media [1–7]. Many efforts have been made in recent years for making optical data storage based on chalcogenide glasses. Due to the presence of large number of defects and short range order of amorphous semiconductor materials have a large number of localized states in mobility gap. The refractive index of chalcogenides semiconductors under the illumination of light is useful for record magnitude and optical phase of the illumination. This can also be used for optical data storage and fabrication of many optical devices [8,9]. CdSe is a direct and wide band gap semiconductor among II, VI systems [10]. Selenium based semiconductors has many disadvantages like low photosensitivity and short life time. To overcome these disadvantages different dopants or compositions have been used. The addition of group (II) materials to Se (IV) has received considerable attention because of their potential applications in optoelectronics, thermoelectric, and photoelectric diodes [11–13]. CdSe is one of the most promising semiconductors for optoelectronic and photovoltaic devices. CdSe has been studied for application in solar cells, light emitting diodes, photo detectors, lasers and photo electrochemical cells [14,15]. The optical properties like optical band gap (E_g) and extinction coefficient (K) are very important parameters and can be utilized from optical behavior of transmission, absorption, and reflection. The researchers throughout the world are trying to change the properties like optical structural and electrical properties of materials by using different techniques like deposition techniques, irradiation and ion implantation techniques etc. for improving the industrial use of the materials. The reported study regarding CdSe shows various modification of properties by laser irradiation [16], annealing [17] but there is no work regarding the effect of gamma-ray irradiation on a-CdSe thin films. Previous studies show enhancement in crystallnity and electrical conductivity after annealing of CdSe thin films. Ausama et al. [16] showed a decrease of optical band gap after laser irradiation. In this study the effect of gamma-ray irradiation on structural and optical parameters of CdSe thin films has been studied.

2. Experimental studies

Bulk sample of CdSe (50:50 composition) was prepared by melt quenching method. First of all the composition of Cd and Se has been taken according to their atomic percentages. The mixtures

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http://dx.doi.org/10.1016/j.ijleo.2015.08.196
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