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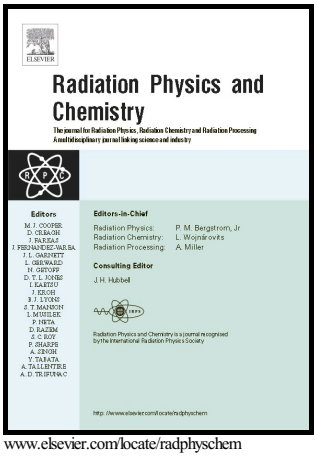

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γ irradiation induced effects on the TCO thin films

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Abstract

We report on gamma irradiation induced changes both in the optical and electrical properties of the Transparent Conductive Oxide (TCO) thin films. We used Co-60 radioisotope as a natural source of γ in our experiments. Applied total irradiation doses to the prepared samples change from 1 to 4 kGy. The dose rate is kept finely constant at 200 Gy/min. Optical transmissions in VIS-NIR region of electromagnetic spectrum and electrical conductivity (I-V) measurements on irradiated samples are conducted with respect to the total dose. Results show that regardless of the irradiation dose, there is no change in the current flow through the contacts on the TCO thin films after the irradiation. On the other hand, based on the on-line measurements, the current increases with the gamma irradiation and a threshold irradiation is detected in the optical properties of irradiated samples. Also, thin films are seen to preserve their initial amorphous structures at such a low irradiation doses according to XRD measurements. We propose that these thin films can be used in gamma sensors for both optical and electrical applications.

Keywords: Co-60, TCO, Gamma, irradiation
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1. Introduction

Due to their high transmittance in the visible region of electromagnetic spectrum and a good electrical conductivity, close to that of metals, semiconductor TCO thin films have been gathering noticeable attention in a variety of applications [1, 2, 3]. The Indium Tin Oxide (ITO) and Aluminum zinc oxide (AZO) are widely used members of TCO thin films family [4, 5, 6, 7, 8]. They also include a relatively higher density of free electrons in the conduction band when compared to other semiconductors. For example, ITO films coated on a glass substrate approximately posses an electrical conductivity of 10^{-4} Ω.cm and an optical conductivity of $\sim$90% in the visible region. These properties make TCO films a better candidate in the photovoltaic and electronic applications that are naturally exposed to irradiation in the outer space.

There are there types of natural radioactivity in the universe; the α, the β, the γ. The alpha and the beta are in the form of particles whereas gamma irradiation is of a high energetic form of electromagnetic wave. Among them, highly energetic photons can carry strong potential to change or at least to modify properties of materials via transferring their energy to electrons of the target material. The effect of gamma irradiation on the bare glass [9, 10], doped glass [11, 12] samples, nanowires [13] and on other different types of thin films [14, 15, 16, 17, 18] has been extensively studied in the literature. Even though the semiconductors are quite sensitive to gamma irradiation, widely used TCO films have been ignored

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