International Journal of Nanoscience
(2024) 2450008 (12 pages)

DOI: 10.1142/S0219581X2450008X

World Scientific
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Investigation of Physical Properties of Nanostructured Selenium-Based Compound Semiconductors

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Received 12 September 2023
Accepted 29 January 2024
Published 4 May 2024

The study of physical properties of compound semiconductors plays a vital role in the device fabrication point of view. Different investigations suggest that one can tune these properties by impurity dopants, irradiation techniques, adopting different synthesis techniques, etc. In this study, the physical properties of nanostructured thin films of Se–S compound were tuned by different Hg dopant concentrations. X ray diffraction spectra clarify the preferred crystallite growth occurs in the cubic phase of the corresponding Bravi's crystal system. The particle size calculated from Bragg's reflection spectra by using Scherrer's analytical formula illustrates an enhancement of crystallite size in highly concentrated Hg doped sample. Similar consequences are found in surface morphological micrographs. The optical band gap reduced from 1.65 eV to 1.54 eV on increasing the doping concentration of Hg, according to the computed optical parameters using optical transmission spectra in the wavelength range 200–1100 nm. The thin film refractive index dispersion data fits well in accordance with the single oscillator model. Investigation of electrical properties tells that there is significant improvement in electrical conductivity in highly concentrated Hg doped samples. Therefore, the apparent tuning as observed in the physical properties of the investigated material may have practical uses in industry for a variety of optoelectronic devices.

Keywords: Nanostructures; thin films; optical properties; electrical properties.

1. Introduction

Selenium-based compound semiconductors are a specific type of semiconductor, defined by their higher value of absorption coefficient than Silicon, typically of the order of $10^4\,cm^{-1}$. Typical semiconductors of this category are mainly CdSe, SeHg, CIGS, etc. Chalcogenide materials displayed interesting optical properties like high refractive index, high absorption, nonlinear optical behavior and photosensitive[1,2] in nature. The corresponding physical properties of such materials are tuned by the addition of different dopant elements, using different preparation techniques, by illuminating them through external stimulation like irradiation techniques, etc., in order to enhance their performance requirement in optoelectronic device

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