



Effects of temperature on structural and linear/nonlinear optical properties of CdS nanoparticles film deposited by chemical reaction method

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Abstract

The effect of annealing temperature on the structure and linear/non-linear optical properties of CdS-NPs was studied. The structural, optical properties and crystallite size were investigated using X-ray diffraction, Fourier Transform Infrared technique, ultraviolet–Visible absorption spectroscopy and scanning electron microscopy. The calculation shows that the CdS crystallized in cubic phase and formed NPs with average crystallite sizes of 17.2, 20.1 and 23.3 nm and the microstrain is about 0.034, 0.030 and 0.026, for CdS films annealed at 300 °C, 400 °C and 500 °C respectively. The non-linear refractive indices (n_2) of the CdS-NPs are determined using open and closed Z-scan techniques. The optical limiting (OL) behaviors have been also investigated. It has been shown that the OL efficiency depended on the CdS-NPs temperature. Under laser irradiation, self-diffraction rings were seen in CdS-NPs-300 °C, CdS-NPs 400 °C, and CdS-NPs 500 °C as increased input power, each pattern is created by a rise in the number of rings and the diameter of the outermost rings. The assessment of the figure of merit ($W > 1$) and thermal figure of merit demonstrates that, the CdS-NPs films are highly sufficient for use in nano-optical technology. The potential of CdS-NPs can be used in photonic and holographic devices as shown by this studying. The aim of the present study is to find fresh applications for CdS-NPs in the world of optical modulators.

Keywords CdS-NPs · Optical properties · Energy band gap · Figure of merit · Extinction coefficient

1 Introduction

The nanoparticle materials of II–VI group semiconductors have received considerable attention recently according to the manifestation of new physical phenomena with potential for future device applications (Althobaiti et al. 2022a, b; Ali et al. 2022a, b). Low-dimensional semiconductors have novel properties that offer new ideas in excellent technological

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