A comprehensive investigation of structural and optical properties of Mn:ZnS nanostructured thin films for optoelectronic applications

Anusha Rao[1], Raghavendra Bairy[1*], Pawan Nayak N[1], Neelamma B. Gummagol[2]

[1] NITTE (Deemed to be University), Department of Physics, NMAM Institute of Technology, Udupi - 574110, Karnataka, India.
[2] Department of Engineering Physics, K.L.E Institute of Technology, Hubballi, 580027, Karnataka, India

Abstract

Manganese (Mn) doped Zinc sulphide (ZnS) thin films were deposited at 350°C using Ultrasonic Spray-Pyrolysis instrument on glass substrate. Variation of Mn doping concentration was 0,2,4,6 and 10 wt. % on ZnS. Optical and Structural parameters on Mn doping were identified by means of UV-Spectrophotometer, Z-Scan technique, X-Ray diffractometer, Atomic Force Microscope respectively. XRD revelling hexagonal crystal structure, along with increase with average particle size on doping. The increase of dopant marginally changed the crystallite size and lattice parameters. Grain size was seen to vary on doping Mn from AFM. The direct energy band gap of the deposited film increases with the increase in Mn concentration in the films according to Tauc's plot. The extinction coefficient was also seen to vary with incorporation of Mn to Zn sites. Non-linear optical properties was studied by Z-Scan technique, using a DPSS continuous wave laser of 532 nm excitation. The third-order nonlinear optical susceptibility $\chi^{(3)}$ is found to be of the order of 10^{-3} esu. The overall results confirmed that the structural and optical results were dependent on Mn concentration in ZnS. Hence, the outcome of structural, linear, and nonlinear optical studies acknowledged the ability of $Zn_{1-x}Mn_xS_x$ thin films in the field of optoelectronic device applications

Keywords- ZnS thin films, Spray Pyrolysis, XRD, Z-Scan, NLO.

Corresponding authors: Dr. Raghavendra Bairy;*

Email: rbairy@nitte.edu.in;