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Tuning of optical and magnetic properties of nanostructured CdS thin films via nickel doping

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ABSTRACT

Redesigning the properties of a non-magnetic semiconductor with a magnetic impurity is a recent research attraction due to its potential in optoelectronics and spintronics devices. Semiconductors, especially II–VI group, are very sensitive to external perturbations through which their optical and electronic properties can be tailored. Here we discuss the fabrication of CdS thin films by chemical bath deposition technique and elaborate their structural, morphological, optical and magnetic properties. Structural studies show that the as-prepared films exist in hexagonal form, while the morphological analysis provides clear evidences of smaller grains disseminated over the surface of the thin film. Higher band gap obtained in all samples hints towards the grain size-induced quantum confinement effect. The pristine CdS thin film has a blue shift in the band gap of 0.218 eV compared to their bulk cousins. The magnetic response of the films recorded using SQUID shows that the incorporation of Ni induces a tunable magnetization in CdS thin films with maximum magnetization of 7.3 emu/cc for 10 % of Ni doping. Thus, the incorporation of Ni can tailor the optical as well as magnetic properties of CdS, and the outcomes extend their application potential both in luminescent, photovoltaic and spintronic devices.

Introduction

Semiconductor nanoparticles are gaining considerable research attention owing to their potential application in fabricating next-generation nanoscale photonic and electronic devices. Among the different groups of semiconductors, easy synthesis and low material cost make II–VI group attractive in the field of semiconductor device physics, chemical engineering/bio-medical engineering, etc. Researchers are now focusing to sharpen their theoretical concepts determining the properties of the II–VI group semiconductors, as well as to explore its optical and electrical properties.

Cadmium sulphide (CdS) is one among the most encouraging semiconductor material among the II–VI group owing to its applications in optoelectronic devices. Recent findings on the size-dependent optical and electrical properties made them a successful contender for optoelectronic applications. Size-

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