PREFACE

The transition from microparticles to nanoparticles can lead to a number of changes in physical properties. The major factors controlling this change in properties are the increase in the ratio of the surface area-to-volume, and the size of the particles falling in a realm where quantum effects predominate. Semiconductor nanoparticles or nanocrystals have been extensively studied in the past decades. The ability to fine tune their fundamental electronic and optical properties by simply varying the particle size, rather than composition, makes them highly attractive for a variety of applications. Among II-VI semiconductors, CdS is one of the most studied material. Bulk CdS is a direct band gap semiconductor with a band gap of 2.42 eV. Recently, nanocrystals of CdS have been studied extensively because they exhibit strongly size dependent electronic and optical properties and these characteristics make them suitable for applications including solar cells, photoconductors, laser materials, optical wave guide, photoconductive cells, photosensors, transducers, optical detectors, and nonlinear integrated optical devices.

In the present work, CdS nanoparticles of two different grain sizes of 2-3 and 3-4 nm were prepared using controlled chemical route and nanostructured CdS thin films were synthesized by chemical bath deposition technique. Structural and morphological characterization of as-prepared and annealed CdS nanoparticles was carried out by using X-ray diffraction (XRD), high resolution transmission electron microscopy (HRTEM) and thermo gravimetric analysis (TGA). Structural and morphological characterization of as-deposited and N⁺ ion implanted nanostructured CdS thin films was done by using X-ray diffraction (XRD), scanning electron microscopy (SEM) and Rutherford back scattering (RBS). Optical absorption (UV-Visible), photoluminescence, and Raman spectra of the samples were studied in detail. DC electrical conductivity of as-prepared and annealed samples of CdS nanoparticles was also investigated.
Chapter 1 of this thesis gives an introduction to nanostructured materials. A brief account of properties, classification, characterization techniques, methods of synthesis, and applications of nanostructured materials is given in this chapter.

Chapter 2 is devoted to the details of preparation of CdS nanoparticles of two different grain sizes using controlled chemical route and the preparation of nanostructured CdS thin films using chemical bath deposition technique. Structural and morphological characterization using different probing tools are detailed.

Chapter 3 contains the details of the study of optical absorption spectra of nanoparticles of CdS and the determination of their band gap energies. The blue shift in the absorption edge of the samples is attributable to the size dependent quantum confinement effect. A narrowing-widening behavior of band gap energy was observed for the samples of CdS nanoparticles annealed at different temperatures. The absorption spectra of as-prepared and $N^+$ ion implanted nanostructured CdS thin film was investigated in detail. The band gap energy of the samples was found to decrease with increase in implantation fluence.

In the chapter 4, photoluminescence (PL) spectra of CdS nanoparticles of two different grain sizes, the effect of annealing of the samples on their PL spectra, and PL spectra of as grown and $N^+$ ion implanted nanostructured CdS thin film are discussed in detail. Both band edge and defect emissions were observed.

Chapter 5 deals with Raman scattering studies of nanoparticles of CdS and nanostructured CdS thin films. The effects of annealing the nanoparticle samples on its Raman spectra are discussed. Raman spectra of as-deposited and $N^+$ ion implanted nanostructured CdS thin films are investigated. Also, the effect of annealing on the Raman spectra of unimplanted and implanted CdS thin films is discussed.

Chapter 6 gives a brief description of DC electrical conductivity of as-prepared and annealed samples of CdS nanoparticles.
Chapter 7 summarizes the results of the present investigation carried out on as-prepared and annealed nanoparticles of CdS, and on as-deposited and N⁺ ion implanted nanostructured CdS thin films. This chapter also discusses the future scope of research in this area.