INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

CdSe and ZnSe are among II-VI compounds, which are of interest to scientific researchers over the past several decades due to their promising properties for potential applications in thin film solar cells, optical coatings, light emitting diodes, sensors, etc. These compounds have properties such as direct bandgap (CdSe ~ 1.68 eV and ZnSe ~ 2.7 eV at room temperature), (b) high absorption coefficient, and (c) high thermal stability, which are suitable for most electronic applications. Among II-VI ternary alloy semiconductors, ZnS_xSe_{1-x} and CdS_xSe_{1-x} are important due to their ideal tunable range of bandgap in the visible spectrum and the dual phonon mode properties. By controlling their composition, optical bandgap of ZnS_xSe_{1-x} and CdS_xSe_{1-x} compounds can be tuned between ~ 2.7 – 3.68 eV and ~ 1.68 – 2.42 eV respectively. The compositional change is also accompanied by corresponding changes in structural properties, which is also essential in material designing to achieve most suitable material for heterojunction devices. These alloys are among few mixed crystal systems exhibiting two-mode behavior of the phonons in which vibrational characteristics of both end binary compounds appear in the first order Raman spectra. Spin orbit (SO) coupling is a very important phenomenon, which affect the band structure in some of the II-VI compound semiconductors. This effect splits the valence band at the zone center into Γ_7^v and Γ_8^v resulting in two direct optical transitions ($\Gamma_8^v \rightarrow \Gamma_6^c$) and ($\Gamma_7^v \rightarrow \Gamma_6^c$) between valence and conduction bands. The extent of this splitting depends on the size of the anion constituting the compounds. Since, ZnS_xSe_{1-x} and CdS_xSe_{1-x} consist of sulfur (small size anion) and selenium (larger anion); the alloys are expected to exhibit SO splitting of the valence band depending on the composition.

In this thesis work, we prepare CdSe and ZnSe nanostructures by solvothermal process. Ternary alloy thin films, CdS_xSe_{1-x} and ZnS_xSe_{1-x} are prepared by thermal evaporation of solvothermally synthesized composite powders, viz., CdS-CdSe and ZnS-ZnSe. The dependence of structural, morphological, optical properties and thermal stability of nanostructures of CdSe and ZnSe are studied. The compositional dependence of SO splitting energy in ternary alloy thin films has been experimentally verified. Dual phonon mode behavior observed in these alloys follow theoretical prediction and gap mode vibration of a small fraction of Se in the ZnS lattice is observed in ZnS_xSe_{1-x} ternary alloy thin films as theoretically predicted.