CHAPTER-1

GENERAL INTRODUCTION

The II-VI compounds are rather special class of materials; they are not only important for advancing the basic understanding of the physics and chemistry of wide band gap solids but also they exhibit many interesting solid state phenomena and optoelectronic effects of varying practical importance. Some examples are found in electroluminescence (both majority carrier excitation and minority carrier injection types), image intensification and storage, photovoltaic effect, field effect transistors, etc.

In many cases these optoelectronic effects have been observed, studied and developed by utilizing a two dimensional thin film or layer. These films can be classified as (i) single crystal films or epitaxial films, (ii) polycrystalline films with both a considerable degree of preferred orientation and microcrystalline size, (iii) polycrystalline films of randomly oriented small crystals and (iv) amorphous films. Crystalline quality of the films largely depends upon the method of preparation and the substrate material. Although much of the interest in thin films and their optoelectronic studies exists for technological reasons, present investigation is not a direct study on thin film applications. However, the present investigation contains study of different important properties of $Cd_{1-x}Zn_xTe$ thin films which is essential for any device fabrication. Also many information concerning the device fabrications can be obtained from the numerous references given in this thesis.

The II-VI ternary semiconducting compound $Cd_{1-x}Zn_xTe$ ($0 < x < 1$) has attracted many researchers for its varying lattice parameter and optical band gap which can be easily tuned in the visible range (1.50 - 2.25 eV) simply by varying the zinc content (x) of the compound. Because of these two properties along with other desirable properties such as its high extinction coefficient above the band gap energy, high value of transmission from band edge to 30 μm etc., it has been used as infra red (IR) window [1], CO_2 laser window [2], solar cell [3-8], and substrate material for the epitaxial growth of $Hg_{1-x}Cd_xTe$ which is one of the leading IR detector materials [9].

The binary compounds cadmium telluride and zinc telluride have been under investigation for many years. Preparation, crystal growth, properties and device applications of CdTe have been extensively reviewed [1]. Being a direct gap semiconductor with a room temperature energy gap of 1.5 eV, CdTe is a promising photovoltaic material; single crystalline homojunction and heterojunction solar cells have been prepared and characterized. CdTe is particularly suited for thin film devices, since relatively short minority carrier diffusion length (1-2 μm) can be tolerated due to its short optical absorption length. The preparation and characteristics of single-crystalline and thin film solar cells have been reviewed by R.H.Bube [10]. Many researchers are still working on CdTe thin films for their use in solar cells [11 - 15]. CdTe is one of the most encouraging semiconductor materials in the field of room temperature γ-ray and x-ray spectroscopy due to its high resistivity. To improve the detector properties (low noise, high resolution, higher operating temperatures, high value of $\mu\tau$ product etc.) CdTe has been alloyed with ZnTe [16-19].

Device performance depends on different properties of the material. Some useful properties of the binary end compounds (CdTe and ZnTe) have been listed in Tables-1.1 - 1.3. Band structures of