CHAPTER-I
INTRODUCTION

1.1. General  1
1.2. Scope of the Work  3
1.3. Aim and Objectives  4
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1.1. GENERAL

The II-VI compound semiconductors arouse great practical interest owing to their unique properties including their high photosensitivity to electromagnetic and particulate radiation and their almost 100% quantum yield. By virtue of their ability to form solid solutions it is possible to vary systematically the band gap, as for example Cd/Zn-Se/Te system from 1.45 to 2.7 eV and hence the spectral range of photosensitivity, emission characteristics etc. In addition they are also prospective candidates for photovoltaic energy conversion applications. In spite of all these advantages, the use of II-VI based devices on a commercial scale has been hampered, so far, by difficulties in obtaining single crystals of these compounds with controlled and reproducible properties.

However, recently thin films of cadmium chalcogenide have received much more attention for their applications in electro-optic devices, photoconductors, thin film transistors and photoelectrochemical solar cells. Even though CdTe has an optimum band gap for solar cell applications, it is very unstable in PEC cells which use polysulphide electrolytes, while CdSe is more stable than CdTe its efficiency is limited by its band gap. The ternary alloys, however, show a stability comparable to CdSe even in polysulphide electrolyte.
As regards to the usefulness in optoelectronic devices, though materials like GaAs, GaP, belonging to III-V compound semiconductors are available as good competitors, these compounds are very difficult to grow in single crystal form. Moreover, the efficient injection electroluminescence considering the indirect band gap values of GaP and its alloys is limited to certain band regions in the visible from orange to red only. Whereas II-VI compounds which are direct band gap semiconductors, have been actively studied by many workers for promising applications in photodetectors, optical sensors, photovoltaic devices etc. Moreover II-VI compounds can be prepared in the form of thin films at moderate temperatures with relatively low cost techniques. Though there are certain advantages such as ease of preparing thin films on large area substrates and developing desired solid solutions with suitable dopants for device applications, there are inherent disadvantages in the material preparation of certain II-VI compounds because of self compensation effects. II-VI compounds crystallize in a variety of polymorphic modifications, the principal structure types are zinc blende and wurtzite in which atoms are tetrahedrally bound in network arrangements similar to those of the group IV elemental semiconductors. In contrast to group IV elements (covalent bonding) the bonding in II-VI compounds are intermediate, i.e., mixed (covalent and ionic).

Cd(Se,Te) hold great potential for application in photoconductors, photovoltaic and PEC cells on account of the following:
(i) It has a large absorption coefficient in the visible and near infrared part of solar spectrum. Hence, very thin films can be used leading to material economy.

(ii) It possesses satisfactory electrical properties in terms of carrier mobility and lifetime.

(iii) It has the advantage of band gap tailoring, opening up the possibility of fabricating cascade (or) tandem type structures.

(iv) It possesses high stability in polychalcogenide redox solutions when used in PEC cells.

1.2. SCOPE OF THE WORK

Earlier publications were mostly on electrodeposited CdSe, CdTe, CdSeTe films, one or two publications concentrate on pulse plated films with duty cycles above 50% (ON time ≥ OFF time) with ON times of the order of minutes. In this investigation, thin films of CdSe, CdTe and CdSeTe were deposited by pulse plating technique using a microprocessor control with lower duty cycles and very short ON times of the order of secs.

Thin films were deposited on titanium and conducting glass substrates at room temperature. The films of CdSe, CdTe and CdSeTe have been characterized by x-ray diffraction, optical absorption measurements and photoelectrochemical studies. TEM and luminescence studies have been made on nano CdSe & CdSeTe films.
Another characteristic feature of this work is the preparation and studies on nanocrystalline films of CdSe, CdTe and CdSeTe. Earlier reports are on nanocrystalline CdSe and CdTe films deposited by chemical bath deposition or dc electrodeposition. To our knowledge this is the first report on the preparation and characterization of nanocrystalline CdSe$_{x}$Te$_{1-x}$ thin films. For the pulse electrodeposition of CdSe, CdTe and CdSeTe films a microprocessor control pulse plating unit was designed and fabricated in the laboratory and a patent based on the above has been submitted. In order to check the reproducibility of the results, five to six sets of films were prepared under each condition.

1.3. AIMS and OBJECTIVES

The present investigation aims at the preparation of CdSeTe, CdSe and CdTe films by the pulse plating technique and to study their structural, morphological, optical and PEC characteristics. CdSe, CdSeTe and CdTe films were prepared on conducting glass (SnO$_{2}$) and titanium substrates by the pulse plating technique with different duty cycles in the range 6.25% to 50%. The effect of annealing on the properties was studied. Effect of photoetching of the CdSe and CdSeTe photoelectrodes were studied and finally spectral distribution of PEC cells were studied. TEM studies and luminescence measurements were made on nano CdSe and CdSeTe films and the results are reported and discussed.