PREFACE

Elemental semiconductors viz. silicon and germanium have been universally accepted as highly potential materials as far as their applications in the field of microelectronics and photovoltaics are concerned. But these materials are found to fail miserably from the view point of their potential for utility in the field of various detection systems and the satellite communication systems due to some of their basic inherent properties like the value of the energy gap, the nature of transitions involved etc. Because of these shortcomings of silicon and germanium, the scientists were compelled to search for new materials, which can cope up with the requirements of these important fields. As a result, many interesting binary, ternary and even quaternary compounds have been discovered. Most of these compounds belong to the group III-V, group I-III-VI and group II-VI. Amongst these, group I-III-VI materials have shown their potentials in the field of solar photovoltaic applications. Group III-V materials are used in the fabrication of devices related to optoelectronics and other related fields.

Group II-VI compounds have been studied intensively during the last two decades because of their potential for many applications in both terrestrial as well as extraterrestrial fields like different kinds of sensors, detectors, photovoltaic devices, optical window etc. These compounds have been studied both in crystal as well as thin film forms. Many investigations have been done on cadmium sulfide and cadmium telluride among these groups to gauge their scientific and technological applications.

CdSe is a material belonging to group II-VI compounds possesses band gap of around 1.7 eV. The theme of the present thesis is centred around the preparation of CdSe thin film, its characterization and its photovoltaic applications.

In present thesis, the first chapter begins with a review of semiconducting materials. The limitations of single element semiconductors
and the importance of compound semiconductors have been discussed. This is followed by a review of the properties of group II-VI compounds. On the basis of these discussions, the choice of cadmium selenide, the semiconducting material for present investigations has been discussed. The important features and the brief survey of literature on CdSe have also been discussed in this chapter only.

The second chapter of this thesis is fully devoted to the preparation of thin films of CdSe. From the literature survey, it has been seen that there are various techniques, which have been used for the preparation of thin films of CdSe. Out of these different techniques, we have adopted the thermal evaporation technique. The thermal evaporation technique can be carried out in many ways using resistive heating, flash evaporation, arc evaporation, r.f. heating etc. Amongst these, the resistive heating method is known to be the most suitable, simple and convenient method from the requirements of facilities are concerned. The deposition of CdSe thin films having different thickness was carried out on pre-cleaned glass slides, which were used as substrates. The pressure at which the deposition process was carried out was kept at around 10^{-6} Torr. The preliminary characterization of CdSe thin films prepared was carried out using EDAX, XRD and TEM techniques to investigate the chemical, compositional and structural characteristics and the results of these investigations have also been presented and discussed in this chapter.

The chapter-3 of present thesis deals with the investigations on electrical characterization of CdSe thin films. Since, the electrical characterization of any material is extremely important to predict the behaviour of any material, various techniques have been adopted in present investigations to study the electrical behaviour of CdSe thin films. The details about these techniques have been covered in this chapter which is followed by the results obtained and the inferences drawn from them. Some of the parameters, like the carrier concentration, mobility, Hall coefficient and the
type of conductivity etc. have been evaluated in case of CdSe thin films using the Hall effect experiment of which, the results have been discussed here.

Since, the thin films of CdSe have been used to investigate their photovoltaic behaviour; it was essential to study the optical behaviour of these films. In view of this fact, the optical characterization of CdSe thin films has been carried out in UV-VIS-NIR range. The results of these investigations have been discussed in chapter-4. Using these results, the band gap value associated with the direct transition in CdSe have also been evaluated.

As mentioned earlier, CdSe is a semiconducting material having bandgap of around 1.7 eV. One of the photoelectronic applications viz. solid-solid junction photovoltaic cells, of CdSe material has been investigated. The results of these investigations have been covered in detail in chapter-5 of the thesis. This chapter starts with the overall discussion about the solid-solid junction solar cells and their comparison with the photoelectrochemical solar cells. Some of the parameters related with these solar cells like short circuit current, open circuit voltage, efficiency, fill factor etc. have been evaluated in present investigations. Their variation with the intensity of incident illumination has also been investigated and the results have been discussed at length in this chapter.

The chapter-6 highlights the results of the present investigations and general conclusions. It also focuses the direction towards future scope of work in this field.