Undoubtedly, the recent development in the field of faster semiconductor devices not only revolutionized the electronic industry but also drastically impacted our daily life style. We all witness the influence of electronics on our life. Thin film and devices play an important role in the development of modern science. The electronic industry has become the greatest beneficiary of thin film technology due to use of thin films in electronic, opto-electronic and other devices. Electronics really have changed the way we live, whether it’s been through communication, cars, household appliances or even the computer. Semiconductor devices are at the central stage in all these. The advances leading to today’s status of semiconductor device physics is the result of continuous research on fundamental problems regarding physical and chemical phenomena occurring in and across the semiconductor interface. History of semiconductor devices shows that it is a race of achieving better performing devices by developing proper technologies providing high purity semiconductors. Thus, with the advances in technology, it became possible to have a better and clearer understanding of device behavior under different conditions. The advances in the devices and development of more fruitful devices are based on understanding the basic physical aspects involved in their working. Metal-Semiconductor contacts form an area of wide interest in this context. Even after great efforts have been made since more than over a century the Schottky barrier devices still need clear understanding of mechanisms and their exact contribution in the observed barrier heights. All these have created different challenges in these areas which have continuously attracted researchers. Such a motive is behind the work presented in this thesis.

Study of semiconductors has attracted a great deal of attention both for its fundamental importance and technological applications. As we know elemental semiconductors such as Si and Ge were widely used in early days of the semiconductor device physics development. Then to cope up with the requirement of a material to be used in various applications, many new semiconducting materials have been investigated. During this period many compound semiconducting materials belongs to different groups like group III-V, group II-VI, group I-III-VI, group IV-VI etc. have shown high potential towards their applications in the field of electronics
and communication. Among these, group IV-VI semiconductors have attracted growing interest for over a decade due to their important unique properties in optoelectronics such as light emitting diodes or laser diodes, memory switching devices as well as infrared production and detection. Now a day layered structure semiconductors are of current interest in material science. Tin selenide (SnSe) is a layered semiconductor of group IV-VI having orthorhombic structure. It has attracted attention of many researchers because of higher absorption co-efficient which is useful for optoelectronic applications. This material has been investigated in a crystalline as well as thin film form. Fabrication and study of Schottky diode based on crystalline SnSe has been investigated by some researchers, but study of such diode based on thin film SnSe has not been investigated much. Hence this study centers on efforts to understand basic physical processes going on around interface of the Schottky diodes which includes the fabrication of Schottky barrier diodes by depositing Silver (Ag) and Indium (In) on p-SnSe thin film using thermal evaporation technique and examining its physical and electrical behavior in a temperature range of 303-398 K.

In this study, the deposition of SnSe thin films by thermal evaporation method has been studied to optimize various optical, physical and electrical properties. For this, thin films of SnSe were deposited at different substrate temperatures and having different thicknesses also. These well characterized thin films were used to prepare SBDs and they were studied to extract the diode parameters at different temperature using I-V and C-V characteristics. It was also planned to study the possible conduction mechanisms in these Schottky diodes. Objective is also to study the effect of variation in stoichiometry on different properties of SnSe thin films. The work done during this study is reported and presented in this thesis, which comprises of seven chapters.

Chapter 1 contains the general introduction regarding thin film technology, Schottky contacts, material importance and overview of prior work. It begins with a brief introduction of thin film technology giving its importance in various fields. The overview of metal-semiconductor contacts has been discussed. Historical development of semiconductor devices with overview of group IV-VI Semiconductor compounds and choice of material with its importance in device fabrication have been described in this chapter. A brief review of research work on SnSe thin films and Schottky barrier diodes based on these films has been given. The existing information
regarding properties of SnSe has been briefly discussed and aims and objectives of present work have also been stated with describing its importance.

**Chapter-2** describes in detail about the thin film preparation methods, growth processes of thin films, choice of deposition technique, experimental techniques used for preparation of thin films, factors affecting growth, structure and film properties. The fabrication of Schottky barrier diodes and details of vacuum coating unit used in present study have been described in this chapter.

**Chapter 3** covers the detailed studies of preliminary characterization of deposited thin films of SnSe. As it is always essential to confirm chemical composition and structure of the thin films, Energy Dispersive Analysis of X-rays (EDAX) and X-ray diffraction (XRD) techniques used for this purpose have been discussed here and also the results of these investigations and calculations of necessary parameters like crystallite size (\(t\)), micro strain (\(\varepsilon\)), dislocation density (\(\rho\)), lattice parameters etc. have been discussed in this chapter. The effects of thickness of thin films, substrate temperature and variation of stoichiometry on the structural parameters have also been discussed here. Results of Transmission Electron Microscopy (TEM) are also described.

**Chapter 4** gives the detailed description of optical absorption study. In this chapter various optical parameters like extinction coefficient (\(k\)), refractive index (\(n\)), and band gap energy gap (\(E_g\)) were evaluated by the analysis of UV-VIS-IR spectra for the deposited thin films and described in detail. The analysis for the determination of type of transition has also been carried out and discussed here. The effects of thickness of thin films, substrate temperature and variation of stoichiometry on these properties have also been discussed here.

**Chapter 5** incorporates the study of electrical transport properties of SnSe thin films. It includes temperature dependent Hall-Effect measurements and thermoelectric power measurements. The conductivity type of deposited thin films, electrical resistivity, carrier concentration and Seebeck coefficient, scattering parameters etc. have been evaluated from these study. The effect of thickness, substrate temperature and variation of stoichiometry on electrical transport properties is also described in detail in this chapter.
Chapter 6 begins with brief introduction of Metal-semiconductor contacts. The theoretical explanation of M-S contacts and various charge transport mechanisms have been discussed in this chapter. It includes discussion of SCS-4200 system. Experimental detail of fabrication of Ag/p-SnSe Schottky barrier diodes is described here. Results of $I-V-T$ and $C-V-T$ measurements and evaluation of various device parameters have been discussed in detail in this chapter. Finally, the role of barrier inhomogeneity in the conduction mechanism is described at the end of this chapter.

Chapter-7 General conclusions of the present investigations are summarized in this chapter and it ends with the scope for the future work.