Semiconductor thin films have not only figured prominently for many years in a wide variety of commercial electronic applications, but have also played an important role in the development of semiconductor devices physics. Thin films have many advantages in the fabrication of several types of devices such as, it can decrease the size of electronic devices, provide higher packing density, higher speed performance and lower the costs etc.. Some basic phenomena like superconductivity, photoconductivity and electroluminescence were observed and successfully exploited in thin films. This explains why thin films are used in the various types of new electronic devices. Semiconductor films are widely used in thin film passive devices such as resistors, anti-reflection coatings, protecting coatings, etc. and active devices such as photoconductors, Schottky diodes, thin film transistors(TFTs), electroluminescence display panels, strain gauges, gas sensors, quantum wells, solar cells, Hall effect devices, memory switching devices, integrated optical devices, etc.. The field of semiconductor is so dynamic and fast changing that todays concepts may be obsolete by tomorrow. It is therefore important to understand the fundamental physical processes in order to meet the challenges in this field.

The increasing acceptance of II-VI(II = Cd, Zn and VI = S, Se, Te) compound semiconductors in the field of electronics shows the growing importance in basic research and technical applications. The future of the II-VI compound semiconductors are crucially dependent on the creation and development of major new device applications. CdSe thin films have been investigated in the past with regard to their structural, electrical and optical properties. They are used in opto-
electronics devices, photoconductions, rectifiers, etc.. The aim of the present research work is to study the growth of CdSe thin films by Physical Vapour Deposition (PVD), its characterization, electronic properties and exploit its potential applications in the fabrication of semiconductor electronics devices such as Schottky diodes, solar cells, thin film transistors (TFTs) and gas sensors.

The thesis begins with the introduction (Chapter-1), review of the previous work done on the II-VI compound semiconductor thin films particularly on cadmium selenide (CdSe) and its applications. The importance of the present investigation is also incorporated.

Chapter-2 deals with the experimental techniques used in the present investigation. The brief working operation of the vacuum evaporation technique is described. The characterization techniques used for the study of CdSe thin films such as Transmission Electron Microscopy (TEM), Energy Dispersive Analysis of X-ray (EDAX), X-ray diffraction and spectrophotometer are briefly described.

A detail investigation of the optimized growth conditions for the deposition of CdSe films is presented in chapter-3. The structure, crystallinity and composition of the CdSe thin films have been examined using Transmission Electron Microscope (TEM), X-ray diffraction methods and Energy Dispersive Analysis of X-rays (EDAX). It is observed that the substrate temperature plays an important role for crystallinity and stoichiometry of CdSe thin films.

Chapter-4 contains the electrical and optical characterizations of the CdSe thin films. The electrical properties like nature of contacts and electrical parameters such as electrical resistivity, carrier mobility, carrier concentration and activation energy are measured at the different thicknesses as well as different substrate temperatures of the CdSe thin films. The optical energy bandgap of CdSe thin films deposited at different substrate temperatures are determined from the absorption spectra.
Schottky diodes have several advantages compared to p-n junction diodes. The advantages are (1) the fast switching speed, (2) the low forward voltage drop (i.e. high forward conductance per unit area), (3) the large reverse impedance per unit area, (4) compact size, (5) structure which is easily integrated and (6) low temperature fabrication. The Schottky barrier diode is fabricated with gold (Au) metal film on to cadmium selenide thin film and is presented in chapter-5. The electrical properties of these Schottky diodes have been investigated by the current (I)-voltage (V) and capacitance (C)-voltage (V) characteristics. The saturation current density, diode ideality factor, barrier height and donor impurity density are determined from the I-V as well as C-V characteristics at the different temperatures.

The advantage of the thin film solar cells is the low cost processing and the use of relatively low cost materials. There is flexibility in size and shape of the solar cells. The heterojunction of p-ZnTe/n-CdSe is of interest for the solar cell applications because of the use of CdSe as a absorber layer and the wide bandgap of ZnTe as window layer which allows a wide range of wavelength of photons. Chapter-6 describes the fabrication and characteristics of p-ZnTe/n-CdSe thin film solar cells. The solar cell is characterized by I-V, C-V and spectral response measurements. The diffusion potential, depletion width, fill factor and efficiency are calculated.

All the thin film integrated circuit includes active devices in the form of thin film transistors (TFTs). Intense interest has been generated in the applications of thin film transistors in large area flat panel displays, image sensor array, etc. Efforts have been made in similar direction and CdSe thin film transistors are successfully fabricated in our laboratory. The fabrication of CdSe thin film transistor (TFT) and its characterization are discussed in Chapter-7. The CdSe thin film is used as a channel, Yttrium oxide (Y$_2$O$_3$) as a gate insulator. Aluminum (Al) and chromium (Cr) have been used as gate and source-drain electrode respectively. The output and
transfer characteristics are studied. The effects of annealing, thickness of gate insulator and source-drain gap on the performance of TFT are studied. The various electrical parameters of TFT such as drain resistance, transconductance, amplification factor, gate capacitance and gain band width (GBW) product are calculated. The TFT is successfully used as a switching element for liquid crystal pixel.

Thin film gas sensors form a modern family of sensors which are currently used for pollution monitoring and control of other environmental and industrial processes. The use of binary compound semiconductors rather than the oxides as gas sensors is not very common. The gas sensing behaviour of cadmium selenide (CdSe) thin films with respect to carbon dioxide (CO\textsubscript{2}) gas is investigated for the first time. The fabrication of a cadmium selenide thin film gas sensor is described in chapter-8. The sensitivity of CO\textsubscript{2} gas on CdSe thin films is studied. A tentative mechanism is proposed, in which the role of CO\textsubscript{2} gas in increasing the conductivity of CdSe thin films are explained by Molecular Orbital (MO) theory. The CdSe gas sensor is coupled to an electronic CO\textsubscript{2} gas sensing alarm system.

A brief review of the present investigation and the scope for future work are described at the end of the thesis.