Preface

In recent times, the zinc oxide (ZnO) based nanostructures have drawn considerable interests of the researchers due to their many attractive properties for transport electronics, blue/Ultraviolet (UV) optoelectronics, spintronics, gas sensing, piezoelectronic, biomedical and bio-sensing applications. The ZnO nanostructures based devices grown on the Si substrates are of special interests for the development of future generation ZnO based smart nanoscaled devices for electronic and optoelectronic applications because of their inherent flexibility of possible integration with the well-matured CMOS technology. In view the above, the present thesis has been developed to mainly focus on the fabrication and characterization of some ZnO nanostructure based devices grown on Si substrates by the simple and low-cost thermal evaporation method for electronic and UV detection applications. The thesis has been divided into seven chapters outlined as follows:

Chapter-1 *presents some general properties and applications of ZnO nanostructures. The general electrical characteristics of ZnO based Schottky contacts and heterojunction diodes using thermionic emission theory have been discussed. The barrier inhomogeneity phenomenon at the metal/semiconductor and at any heterojunction interface has been introduced. The metal/ZnO based Schottky diodes for UV detection applications have also been discussed in details. Finally, the scopes of present thesis have been outlined at the end of this chapter.*

In ***Chapter-2****, the review of some important state-of-the-art works reported on the electrical characteristics of ZnO thin film based Schottky and heterojunction diodes have been presented to justify the scopes of the thesis outlined in Chapter-1. The current-voltage, capacitance-voltage and temperature-dependent current-voltage (I-V-T) characteristics of ZnO thin film based Schottky diodes as well as heterojunction diodes have been reviewed. Some important literatures related the UV detection characteristics of ZnO thin film based Schottky diodes have also been studied.*

Chapter-3 *includes the detailed analysis of the temperature-dependent current-voltage (I-V-T) characteristics of Pd/ZnO thin film Schottky diodes grown on n-Si substrates by thermal evaporation method over a temperature range of 300-423 K by considering the effect of the barrier height inhomogeneity (BHI) phenomenon discussed in Chapter-1 and Chapter-2. The characterization of vacuum deposited ZnO films have been carried out by the scanning electron microscopy (SEM), X-ray diffraction (XRD), and Photoluminescence (PL) spectroscopy measurements. The values of various electrical parameters, such as the barrier height, ideality factor, and Richardson constant of the diode have been estimated from the I-V-T measurements with and without taking the effect of BHI into consideration.*

In ***Chapter-4****, the effects of ZnO, Sn and Zn seed layers on the structural and morphological characteristics of thermally deposited ZnO films grown on the n-Si substrates have been first investigated by analyzing the SEM, XRD and EDS data. The effects of different seed layers on the electrical characteristics of the Pd Schottky contacts grown on the ZnO thin films grown on the seed layers considered above have then been analyzed. The respective values of the rectification ratio, barrier height ideality factor and series*

resistance of the Pd/ZnO thin film Schottky diodes grown on different seed layer coated n-Si substrates by thermal evaporation method have been finally estimated and compared in this chapter.

Chapter-5 *discusses the UV detection properties of the Pd Schottky contacts on the ZnO nanoparticles (NPs) achieved by growing the films on the Sn seed layer coated n-Si substrates by the thermal evaporation method already considered in Chapter-4. The contrast ratio, quantum efficiency, responsivity and zero-bias resistance-area product of the Pd/ZnO NPs Schottky diodes have been determined by applying a UV radiation of 650 μW power at 365 nm wavelength on the device. The results have been compared with the reposted results to justify the suitability of the device for UV detection applications.*

The ***Chapter-6*** *presents a detailed analysis of the temperature-dependent current-voltage (I-V-T) characteristics of the n-ZnO NWs/p-Si heterojunction diodes by taking the BHI phenomenon into consideration. The ZnO NWs have been synthesized on AZO seed layer coated p-Si substrates by thermal oxidation of vacuum deposited Zn in O_2 gas atmosphere at 600 ºC for the duration of 60 minutes. The effects of the BHI on various electrical parameters, such as the barrier height, ideality factor, and Richardson constant of the heterojunction diode under consideration have been estimated from the I-V-T measurements.*

Finally, ***Chapter-7*** *includes the overall summary and conclusion of the thesis. Some future scopes of work related to the present area of research are also outlined at the end of chapter.*

I strongly believe that the work presented in this thesis will be very much useful to the scientific community working in the area of ZnO thin film based Schottky and heterojunction devices for electronic, optoelectronic and gas sensing applications. I also believe that the present thesis will help the researchers to develop ZnO nanostructure based smart photonic devices on Si substrates for future generation optoelectronic applications.