

List of Figures

Figure No.		Page No.
1.1	Wurtzite hexagonal crystal structure of ZnO	5
1.2	The valence band and conduction band of ZnO separated by fundamental band gap	6
1.3	Summary of the point defects that may occur in ZnO, where A and D stand for acceptor and donor respectively	9
1.4	FESEM images of different ZnO nanostructures reproduced from the published literature including (a) ZnO nanowires [Ngo-Duc <i>et al.</i> (2012)] (b) ZnO nanorods [Chae <i>et al.</i> (2010)] (c) ZnO nanotubes [Tang <i>et al.</i> (2007)], (d) ZnO nanoparticles [Singh and Nakate (2013)] (e) ZnO nanohelices [Wang (2004)], (f) ZnO nanorings [Wang (2004)] (g) ZnO nanocombs [www.phy.mtu.edu] (h) ZnO nanobelts [Xu <i>et al.</i> (2008)] (i) ZnO nanotetrapods [Jin <i>et al.</i> (2013)] (j) ZnO nanoflowers [Xu and Sun (2011)].	11
1.5	Schematic diagram of Scanning Electron Microscopy	14
1.6	Principal of energy dispersive spectroscopy	15
1.7	Schematic diagram on working principal of atomic force microscope.	16
1.8	Schematic diagram for working principal of X-ray diffraction pattern	17
1.9	Different photoluminescence emission in the band gap of ZnO	18
1.10	Energy band diagram of metal and n-type semiconductor (a) before contact (b) Schottky contact under thermal equilibrium	24
1.11	Energy band diagram of metal and n-type semiconductor (a) with applied forward bias (b) with applied reverse bias.	24
1.12	Different types of energy band alignments in heterojunction diodes	25
1.13	(a) Energy band diagram of two isolated semiconductors with different energy bandgap E_g , different work function $q\phi_s$ and different affinities $q\chi$ (b) the equilibrium band of an ideal abrupt (n-ZnO/p-Si) heterojunction	26
1.14	Different current transport mechanism across M-S junction	29
1.15	The Gaussian distribution of barrier heights across M/S interface reproduced from the literature [Werner and Güttler (1991)]	34
1.16	The schematic of different Metal -Semiconductor based photodetectors	38
3.1	Schematic diagram of thermal evaporation process	80

3.2	Schematic diagram for fabrication details of Pd/ZnO thin film/n-Si/Ti/Al Schottky diodes	82
3.3	FESEM image of ZnO thin film grown on n-Si substrates by thermal evaporation method	84
3.4	XRD pattern of ZnO thin film grown on n-Si substrates	84
3.5	Typical EDS spectrum of ZnO thin film grown on n-Si substrates	85
3.6	PL spectrum of ZnO thin film grown on n-Si substrates by thermal evaporation method	86
3.7	Energy band diagram of Pd/ZnO/n-Si Schottky diodes	87
3.8	I-V characteristics of n-ZnO/n-Si contacts	88
3.9	A^2/C^2 versus V characteristics of Pd/ZnO thin film based Schottky diodes	89
3.10	Room temperature I-V characteristics of Pd/ZnO thin film Schottky diodes grown on n-Si substrates by thermal evaporation method	91
3.11	Equivalent circuit of Schottky diodes with series resistance	93
3.12	Plot of the bias-dependent resistance $R_i = dV / dI$ versus applied voltage	94
3.13	(a) Plot of $dV/d(\ln I)$ vs. I (b) plot of H (I) vs. I for Pd/ZnO thin film Schottky diodes grown on n-Si substrate	96
3.14	F(V) vs. V plot for Pd/ZnO thin film Schottky contact	98
3.15	Temperature-dependent I-V characteristics of Pd/ZnO thin film Schottky contacts grown on n-Si substrate for a operating temperature range of 300-423 K	99
3.16	Variation of barrier height and ideality factor with temperature	100
3.17	Variation of barrier height with ideality factor	102
3.18	Typical $\ln(I_0 / T^2)$ versus q / kT plot for determination of experimental Richardson constant without taking the barrier inhomogeneity effects into consideration	102
3.19	Typical $\phi_{B,eff}(T)$ versus $q / 2kT$ and $(\eta^{-1}(T) - 1)$ versus $q / 2kT$ curves and their linear approximations by taking the effect of Gaussian distribution of barrier heights.	105
3.20	Plot of $\ln(I_0 / T^2) - q^2 \sigma_0^2 / 2(kT)^2$ versus q / kT for determining the effective Richardson constant after taking the barrier inhomogeneity into consideration.	105
4.1	Schematic diagram for fabrication of Pd/ZnO Schottky diodes grown on n-Si substrates with assistance of ZnO, Sn and Zn seed layer	110
4.2	FESEM image (top view) of (a) ZnO thin film grown on bare n-Si substrate; (b) ZnO seed layer (c) ZnO seed layer assisted ZnO thin film grown on n-Si substrates by thermal evaporation method (Scale - 2 μm)	113

4.3	(a) Two dimension (2D) (b) three dimension (3D) AFM image of ZnO nanorods obtained in tapping mode grown on n-Si substrates with assistance of ZnO seed layer	114
4.4	Typical EDS spectra of (a) ZnO thin films grown on bare n-Si substrates (b) ZnO thin film grown on ZnO seed layer coated n-Si substrates by thermal evaporation method	115
4.5	Typical XRD pattern of (a) ZnO thin films grown on bare n-Si substrates (b) ZnO seed layer (c) ZnO seed layer coated ZnO thin film	117
4.6	Schematic diagram for the possible growth mechanism of ZnO nanorods grown on n-Si substrates by ZnO seed layer assisted thermal evaporation method	118
4.7	Room temperature $\ln I$ vs. V characteristics of Pd/ZnO thin film Schottky diodes with and without ZnO seed layer	120
4.8	Calculation of series resistance by (a) $dV/d(\ln I)$ vs. I plot (b) $H(I)$ vs. I plot	121
4.9	FESEM images of ZnO thin film grown on (a) bare n-Si substrates (b) Sn seed layer (c) Zn seed layer grown on n-Si substrates by thermal evaporation method	123
4.10	EDS spectrum of ZnO thin film grown on (a) bare n-Si substrates (b) Sn seed layer (c) Zn seed layer grown on n-Si substrates by thermal evaporation method	124
4.11	XRD pattern of ZnO thin film grown on (a) bare n-Si substrates (b) Sn seed layer (c) Zn seed layer grown on n-Si substrates by thermal evaporation method	125
4.12	$\ln I$ vs. V characteristics of Pd/ZnO thin film Schottky diodes grown on (a) bare n-Si substrates (b) Sn seed layer coated n-Si substrates (c) Zn seed layer coated n-Si substrates	126
4.13	Determination of series resistance by Cheung's Methods (a) $dV/d(\ln I)$ versus I plot (b) $H(I)$ vs. I Plot	127
4.14	Variation of rectification ratio with different types seed layers	128
4.15	Current transport mechanism across all the Pd/ZnO thin film Schottky diodes under consideration	129
5.1	Schematic diagram of Pd/ZnO NPs Schottky diode grown on n-Si substrates under UV illuminated condition	133
5.2	Typical FESEM image (top view) of ZnO thin film grown on (a) n-Si substrates (b) Sn seed layer coated n-Si substrate (c) high resolution image of ZnO NPs	135
5.3	Typical XRD pattern of ZnO thin film grown on (a) n-Si substrates (b) Sn seed layer coated n-Si substrate	136
5.4	Photoluminescence Spectrum of ZnO NPs grown on Sn coated n-Si substrates	137

5.5	UV detection characteristics of Pd/ZnO NPs based Schottky diodes with (a) Sn seed layer (b) without Sn seed layer	140
5.6	UV detection characteristics of Pd/ZnO NPs based Schottky diodes with and without UV illumination	143
6.1	Schematic diagram of Al/Ti/n-ZnO NWs/p-Si /Al heterojunction diodes	147
6.2	Energy band diagram of n-ZnO NWs/p-Si heterojunction diodes using Anderson's model	149
6.3	FESEM images (top view) of as-grown ZnO NWs on AZO seed layer coated p-Si substrates at different magnification view (a) 1 μ m (b) 100 nm	150
6.4	Typical EDS spectrum of ZnO NWs grown on p-Si substrates	151
6.5	Typical XRD pattern ZnO NWs on AZO coated p-Si substrates	152
6.6	Room temperature PL spectrum of ZnO NWs grown on AZO coated p-Si substrates by thermal evaporation method	153
6.7	Room temperature reverse bias (a) C-V characteristics (b) A^2/C^2 vs. V characteristics of n-ZnO NWs/p-Si based heterojunction diodes	155
6.8	Temperature dependent I-V characteristics of n-ZnO NWs/p-Si heterojunction diodes measured in the temperature range 300 to 423K.	156
6.9	Variation of barrier height and ideality factor with temperature	158
6.10	Variation of barrier height with ideality factor	159
6.11	The $\phi_{B,eff}(T)$ and $(\eta^{-1}(T) - 1)$ versus $q/2kT$ plot for determination of different electrical parameters.	161
6.12	Richardson plot without barrier inhomogeneity taken into account	163
6.13	The Modified activation energy plot for calculation of Richardson constant by taking Gaussian distribution of barrier heights into consideration.	163
6.14	The distribution of interface states at n-ZnO NWs/p-Si Heterojunction diodes	165