List of Figures

Chapter	Figure	Caption	Page No.
Chapter I			
	1.1	Change in band gap when the particle size is reduced from bulk to nano.	4
	1.2	Different types of nanomaterials.	4
	1.3	Variation of density of states vs energy.	6
	1.4	Core-shells of various shapes.	8
	1.5	Band alignments in TYPE 1 and TYPE 2 core-shell structures.	9
	1.6	Band alignments in different types of core-shell structure.	11
	1.7	Schematic of mechanism of photocatalysis.	15
	1.8	*J-V* curve of a photovoltaic cell.	18
Chapter II			
	2.1	XRD patterns of (a) core Ag_2S nanoparticles (b) core-shell Ag_2S-HgS (0.1 M Hg^{2+}) nanostructure and (c) core-shell Ag_2S-HgS (0.2 M Hg^{2+}) nanostructures.	39
	2.2	TEM images (a) Ag_2S nanoparticles (b) Core-shell Ag_2S-HgS nanostructure (with 0.1 M Hg^{2+}) (c) HRTEM image of core-shell Ag_2S-HgS nanostructure (d) Core-shell Ag_2S-HgS nanostructure (with 0.2 M Hg^{2+})	42
	2.3	EDX spectra (a) Ag_2S nanoparticles (b) Core-shell Ag_2S-HgS nanostructure	43
	2.4	FTIR spectra of core Ag_2S and core-shell Ag_2S-HgS nanostructure	44
	2.5	UV-Vis absorption spectra of core Ag_2S and corresponding core-shell heterostructures	45
	2.6	Room temperature PL spectra of core Ag_2S	47

	nanostructures and core-shell Ag_2S-HgS nanostructures (with 0.1 M Hg^{2+} and 0.2 M Hg^{2+}) (λ_{ex}=350 nm)	
2.7	Tauc's Plot (a) Ag_2S nanoparticles (b) Core-shell Ag_2S-HgS nanostructure (with 0.1 M Hg^{2+}) (c) Core-shell Ag_2S-HgS nanostructure (with 0.2 M Hg^{2+})	47
2.8	Different localization regimes of core-shell Ag_2S-HgS with varying shell thickness (a) Ag_2S nanoparticles (shell thickness=0) (b) Core-shell Ag_2S-HgS (0.1 M Hg^{2+}) (shell thickness very small) (c) Core-shell Ag_2S-HgS (0.2 M Hg^{2+}) (shell thickness large)	48
2.9	(a) Absorbance of MB in presence of catalyst (b) % Degradation vs time and rate constant determination of (c) Ag_2S (d) Ag_2S-HgS	50
Chapter III		
3.1	XRD pattern of TiO_2 nanostructures	57
3.2	TEM image of TiO_2 nanoparticles	57
3.3	3.3.1 UV-Vis absorbance spectra (inset) Urbach tail Plot	58
	3.3.2 Tauc's Plot for TiO_2 nanoparticles	59
3.4	PL spectra of TiO_2 nanoparticles	59
3.5	. XRD pattern of MgO nanoparticles	61
3.6	(a) Low resolution TEM and (b) HRTEM image of MgO nanoparticles	62
3.7	(a) Kubelka-Munk absorption plot and (b) Reflectance spectra of MgO	63
3.8	Photoluminescence spectra of MgO excited at (a) 206 nm. (b) PLE spectra monitored at the intense emission, λ_{ex} = 365 nm. Inset shows the extended spectra in the range from 220-280 nm to show the excitation peaks	65

3.9	Photoluminescence spectra at (a) λ_{ex} = 270 nm. (b) PLE spectra monitored at the intense emission 427 nm.	65
3.10	Photoluminescence spectra at (a) λ_{ex} = 330 nm. (b) PLE spectra monitored at λ_{em} = 330 nm. Inset shows the extended spectrum to display the excitation peaks	66
3.11	Photoluminescence spectra of MgO annealed at 600°C and 800°C and excited at (a) 206 nm (b) 270 nm and (c) 330 nm	67
3.12	Plot of the intensity ratio of defect emissions as a function of annealing temperature for (a) F^+/F (b) F^+/F_2^{2+} and (c) F/F_2^{2+} at 270 nm and 330 nm excitation	69
3.13	XRD pattern of core-shell TiO_2-MgO nanostructures with core annealed at (left) 450°C, (centre) 650°C and (right) 850°C.	69
3.14	TEM images of TEM images of TiO_2-MgO nanostructures annealed at (a) 450°C (b) 650°C and (c) 850°C	71
3.15	EDX pattern of (left) TiO_2 and (right) TiO_2-MgO	72
3.16	FTIR spectra of both core TiO_2 and core-shell TiO_2-MgO nanostructures. Extended version of the Ti-O bond (inset).	72
3.17	Raman spectra of both TiO_2 and TM 450	74
3.18	XPS of TiO_2 nanoparticles (a) O1s (b) Ti 2p spectra	77
3.19	XPS of core-shell TiO_2-MgO nanoparticles	77
3.20	UV-vis absorbance spectra	79
3.21	Tauc's Plot for band gap calculation of (left) TM 450, (centre) TM 650 and (right) TM 850	80
3.22	Urbach energy plot (a) TM 450, (b) TM 650 and (c) TM 850	80
3.23	PL spectra of the core-shell nanostructures excited at 350	81

nm

3.24 TRPL fit of (left) TiO_2 and (right) Core-shell TiO_2-MgO 83

3.25 (left) Absorbance of MB in presence of catalyst, (right) %Degradation w.r.t. irradiation time 85

Chapter IV

4.1 XRD pattern of core TiO_2 along with core-shell TiO_2-SnO_2 nanostructures with different shell concentrations 95

4.2 Low resolution (left) and High resolution (right) TEM image of TiO_2-SnO_2 nanostructures 97

4.3 EDX spectra of core-shell TiO_2-SnO_2 nanostructures 98

4.4 Raman spectra of the core TiO_2 and the synthesized core-shell (TS2, TS4 and TS6). 98

4.5 Eg bond vibration of core TiO_2 and the synthesized core-shell (TS2, TS4 and TS6) 100

4.6 XPS spectra of core-shell TiO_2-SnO_2 nanocrystal 101

4.7 Absorbance spectra of core TiO_2 and core-shell (TS2, TS4 and TS6) nanostructures 102

4.8 Urbach energy plot of core TiO_2 and core-shell (TS2, TS4 and TS6) nanostructures 104

4.9 Tauc's Plot for of core TiO_2 and core-shell (TS2, TS4 and TS6) nanostructures 104

4.10 Comparative room temperature PL spectra of core TiO_2 and core-shell (TS2, TS4 and TS6) nanostructures, excited at a wavelength of 350 nm 105

4.11 Gaussian fit of PL spectra of core TiO_2 and core-shell (TS2, TS4 and TS6) nanostructures 106

4.12 Charge separation in core-shell TiO_2-SnO_2 106

4.13 TRPL spectra of (left) core TiO_2 and (right) core-shell 108

TiO_2-SnO_2

4.14 Absorbance of MB in presence of catalyst (a) TiO_2, (b) TS2 and (c) TS4 110

4.15 ln C_o/C_t vs irradiation time graph for determination of rate constant 110

4.16 Charge transfer schematic diagram 111

Chapter V

5.1 (left) XRD pattern of TiO_2 nanoparticles and core-shell TiO_2-ZrO_2 nanostructures and (right) extended version of XRD of TiO_2-ZrO_2 nanostructures 116

5.2 (left) HRTEM image (right) Low resolution TEM image of core-shell TiO_2-ZrO_2 nanocomposites 118

5.3 EDX spectra of TiO_2-ZrO_2 nanoparticles 118

5.4 Raman spectra of TiO_2 and core-shell TiO_2-ZrO_2 nanostructure 118

5.5 Lorentzian fit on Raman active mode of (left) TiO_2 and (right) TiO_2-ZrO_2 120

5.6 UV-vis absorbance spectra 121

5.7 Urbach energy plot for (left) TiO_2 and (right) TiO_2-ZrO_2 nanostructures 121

5.8 Kubelka Munk Plot for (left) TiO_2 and (right) TiO_2-ZrO_2 122

5.9 Schematic charge separation in TiO_2-ZrO_2 123

5.10 PL spectra of (a) core TiO_2, (b) TiO_2-ZrO_2 core-shell nanostructure and (c) comparative plot of both core and core-shell nanocomposites 124

5.11 (a) Absorbance of methylene blue in presence of catalyst (b) % degradation, rate constant determination of (c) TiO_2 and (d) TiO_2-ZrO_2 125

5.12 (left) XRD pattern (right) W-H Plot of CdSe-TiO_2 127

5.13 (left) Low resolution (right) High resolution TEM image of CdSe-TiO_2 nanostructrures 128

5.14 EDX spectrum of CdSe-TiO_2 core-shell nanocomposites 128

5.15 UV-vis absorbance spectra of core CdSe and core-shell CdSe-TiO_2 nanocomposites 129

5.16 Tauc's Plot for (left) CdSe and (right) CdSe-TiO_2 129

5.17 Urbach energy plot for (left) CdSe and (right) CdSe-TiO_2 130

5.18 Transition from TYPE 1 to TYPE 2 in core-shell CdSe-TiO_2 nanocomposites 131

5.19 Comparative PL diagram for CdSe/TiO_2 core-shell nanocomposite 132

5.20 (a) Absorbance of methylene blue in presence of catalyst (b) % degradation 132

Chapter VI

6.1 XRD pattern of (a) TiO_2 (b) TiO_2-MgO (c) TiO_2-SnO_2 and (d) TiO_2-ZrO_2 films 136

6.2 UV-vis absorbance spectra of the films 137

6.3 Band gap determination from Tauc's Plot 138

6.4 Urbach tail plot of the core-shell structures 139

6.5 PL spectra of the prepared films 140

6.6 I-V Characteristic of (a) TiO_2 (b) TiO_2-MgO (c) TiO_2-SnO_2 and (d) TiO_2-ZrO_2 core-shell films 141

6.7 Different characteristic regimes of the films 143

6.8 Photovoltaic characterization under visible light 145