

Contents

Acknowledgements	vii
Contents	ix
List of Figures	xiii
List of Tables	xix
Abbreviations	xxi
PREFACE	xxiii
Chapter 1 Introduction and Literature Review	1
1.1 Introduction	1
1.2 Classification of nanostructure materials	1
1.2.1 Zero dimensions (0D) nanostructure materials	2
1.2.2 One dimensions (1D) nanostructure materials	2
1.2.3 Two dimensions (2D) nanostructure materials	2
1.2.4 Three dimensions (3D) nanostructure materials	3
1.3 The Application of nanostructure materials	4
1.3.1 Energy harvesting	5
1.4 The properties of nanostructure materials	8
1.4.1 The optical properties of nanostructure materials	8
1.4.2 Plasmonic property of metallic nanostructure materials	11
1.4.2.1 The classification of different plasmonic nanostructure for energy harvesting application	12
1.4.2.2 Plasmonic energy conversation	13
1.4.3 Basic Principle of Water Splitting via Photoelectrochemical Process	14
1.5 Materials for photocatalytic and photoelectrocatalytic application	17
1.6 Photo detector	17
1.7 Scope and objective of present work	20
Chapter 2 In situ Growth and Charactrization Techniques	25
2.1 Materials synthesis	25
2.2 Substrate cleaning process	25
2.3 Fabrication of metal oxide, metal or metal sulfide/metal oxide thin film	26
2.3.1 Synthesis and fabrication of TiO ₂ thin film	26
2.3.2 Synthesis and fabrication of ZnO thin film	26
2.3.3 Fabrication of ion conducting metal oxide Li ₄ Ti ₅ O ₁₂ thin film	26
2.3.4 Fabrication of Ag-TiO ₂ thin film	28
2.3.5 Fabrication of Ag ₂ S-TiO ₂ heterojunction	29
2.3.6 Fabrication of Cu ₂ S-TiO ₂ heterojunction thin film	30
2.3.7 Fabrication of Cu ₂ S-TiO ₂ /ZnO heterojunction thin film	31
2.4 Characterizations Technique	32
2.4.1 X-ray diffraction	32

2.4.2	UV-visible spectrophotometer	33
2.4.3	High resolution electron microscopy and Transmission electron microscopy	33
2.4.4	Incident photon to current efficiency (IPCE) measurement	33
2.4.5	Electrochemical measurements	34
2.4.6	Impedance measurements	36
Chapter 3	Direct evidence of an efficient plasmon-induced hot electron transfer at in situ grown Ag/TiO ₂ interface for highly enhanced solar H ₂ generation	37
3.1	Indroduction	37
3.2	Resutls and discussion	39
3.2.1	Structural and Optical properties	39
3.2.2	Surface morphology characterization and microstructure characterization	40
3.2.3	X-ray photoemission spectroscopy (XPS)	45
3.2.4	Photoelectrochemical H ₂ generation study	46
3.2.5	IPCE Measurement	48
3.2.6	AC impedance study and Mott–Schottky (M-S) measurements	50
3.2.7	Volumetric hydrogen generation rate and time response measurement	53
3.3	Conslusions	54Error! Bookmark not defined.
Chapter 4	In situ grown electronically coupled Cu ₂ S-TiO ₂ heterojunction thin film for the efficient H ₂ evolution via water splitting	57
4.1	Indroduction	57
4.2	Resutls and discussion	58
4.2.1	Structural and Optical characterization	58
4.2.2	Surface morphology characterization and Microstructure characterization	61
4.2.3	X-ray photoemission spectroscopy (XPS)	64
4.2.4	Photoelectrochemical H ₂ generation study	65
4.2.5	IPCE Measurement	67
4.2.6	AC impedance study and Mott–Schottky (M-S) measurements	68
4.2.7	Volumetric hydrogen generation rate and time response measurement	72
4.3	Conslusions	73
Chapter 5	Role of electronically coupled in situ grown silver sulfides (Ag ₂ S) nanoparticles with TiO ₂ for the efficient photoelectrochemical H ₂ evolution	75
5.1	Indroduction	76
5.2	Resutls and discussion	Error! Bookmark not defined. 76
5.2.1	Structural and Optical properties	76

5.2.2	Surface morphology characterization and Microstructure characterization	80
5.2.3	X-ray photoemission spectroscopy (XPS)	82
5.2.4	Photoelectrochemical H ₂ generation study	82
5.2.5	IPCE Measurement	85
5.2.6	AC impedance study and Mott–Schottky (M-S) measurements	86
5.2.7	Volumetric hydrogen generation rate and time response measurement	90
5.3	Conslusions	91
Chapter 6	In situ growth of Cu ₂ S/TiO ₂ heterojunction for visible-NIR photodetector	93
6.1	Indroduction	94
6.2	Resutls and discussion	94
6.2.1	Structural and Optical properties	94
6.2.2	Surface morphology characterization and Microstructure characterization	95
6.2.3	Electrical properties	98
6.2.4	EQE, Responsivity and Detectivity Measurement	
6.3	Conslusions	102
Chapter 7: Conclusion and Scope for Future Work		105
7.1	Conclusions	105
7.2	Scope for future work.....	107
References		108
List of Publications		117