Certificates			V-X	
Acknowledgement			xi	
Table of contents			XV	
List of tables			xix	
List of figures			xxi	
List of notations, nomenclatures, symbols				
Preface			xxvii	
Chapter 1	Introdu	iction	1–26	
1.1	Genera	l	4	
1.2	Hydrogen as an energy carrier			
1.3	Hydrogen production technique			
	1.3.1	By processing carbonaceous matter	11	
	1.3.2	Electrolysis of water	17	
1.4	Solar h	Solar hydrogen systems		
	1.4.1	Photovoltaic cell plus electrolyzer	20	
	1.4.2	Photo-electrochemical process	22	
	1.4.3	Photo-biochemical (bio-photolysis) process	23	
	1.4.4	Photocatalytic process	24	
Chapter 2	Literature review			
2.1	Catalys	Catalysis and photocatalysis		
	2.1.1	Semiconductor electrolyte interface	31	
	2.1.2	Basic principles of photocatalysis	33	
2.2	Hydrog	en production by photocatalytic water splitting	34	
2.3	2.3 Photocatalysts for water splitting			
	2.3.1	Metal oxide photocatalysts	37	
	2.3.2	Metal sulphide photocatalysts	41	
2.4	Charge	recombination phenomena and its prevention	42	
2.5	Graphene: Background and current status			
2.6	GO/rG0	GO/rGO-CdS based photocatalysts		
	2.6.1	In situ growth strategy	54	
	2.6.2	Two-phase method	55	

Table of contents

	2.6.3	Sol gel method	57		
	2.6.4	Precipitation method	58		
	2.6.5	Hydrothermal/solvothermal method	59		
2.7	Role of sacrificial agents				
2.8	Kinetics of photocatalytic dissociation of water				
2.9	Enhancement in hydrogen production rate by ultrasound				
	2.9.1	Theory and fundamentals	74		
	2.9.2	Application of ultrasound	77		
2.10	Future s	82			
2.11	Objectives of present work				
Chapter 3	Experimental				
3.1	Preparation of photocatalysts				
3.2	Experimental set-up for photocatalysis				
3.3	Characterizations of catalysts				
	3.3.1	Fourier transform infrared spectroscopy (FTIR)	96		
	3.3.2	X-Ray diffraction(XRD)	96		
	3.3.3	Diffuse reflectance spectroscopy (DRS)	97		
	3.3.4	Photoluminescence spectroscopy (PL)	98		
	3.3.5	Transmission electron microscope (TEM) and selected area diffraction pattern (SAED)	99		
	3.3.6	X-ray photoelectron spectroscopy (XPS)	99		
	3.3.7	Temperature programmed oxidation (TPO)	101		
	3.3.8	Electrochemical impedance spectroscopy (EIS)	102		
3.4	Reaction set-up for photocatalysis with ultrasound				
3.5	Kinetic studies				
Chapter 4	Results and discussion				
4.1	Photocatalytic activity				
4.2	FTIR studies				
4.3	XRD studies				
4.4	TEM studies and electron diffraction studies (SAED)				
4.5	Photoluminescence studies				

List of publications			205
References			177
Chapter 5	Conclusions		
4.11	Kinetics of hydrogen production by dissociation of water		
	4.10.4	Bubble detachment	160
	4.10.3	Effect of temperature	158
	4.10.2	Effect of ultrasonication power	157
	4.10.1	Effect of ultrasonication	155
4.10	Photocatalysis with ultrasound		155
4.9	EIS studies		153
4.8	Temperature programmed oxidation studies		151
4.7	XPS studies		
4.6	Diffuse reflectance studies		129

