

Table of Contents

Description	Page numbers
Certificates	i-iii
Acknowledgments	iv-v
Table of Contents	vi-xi
List of Figures	xii-xviii
List of Tables	xix-xx
List of Schemes	xxi
Abbreviations	xxii-xxiii
Preface	xxiv-xxviii
Chapter 1: Introduction, Literature Survey and Objective	1-26
1.1. Organic pollutants: A serious threat environment	1
<i>1.1.1. Dyes</i>	2
<i>1.1.2. Pharmaceutical pollutants</i>	3
1.2. Removal or destruction of organic pollutants from wastewater	4
1.3. Photocatalysis	7
1.4. Types of Photocatalysis	7
<i>1.4.1. Homogeneous photocatalysis</i>	7
<i>1.4.2. Heterogeneous photocatalysis</i>	8
1.5. General mechanism of photocatalysis	9
1.6. Parameters for designing good photocatalyst	10
1.7. Challenges in designing good photocatalysts	11
1.8. Fundamental strategies to overcome challenges associated with photocatalysts	14
<i>1.8.1. Defects and doping</i>	14
<i>1.8.2. Heterostructures formation</i>	15

1.8.2.1. <i>p-n heterojunction/Type II heterojunction</i>	16
1.8.2.2. <i>Z-scheme Photocatalyst</i>	17
1.9. Literature review and research gap	17
1.9.1. <i>CuWO₄</i>	19
1.9.2. <i>Ag-based semiconductors</i>	20
1.9.3. <i>Literature review on Z-Scheme Photocatalysts</i>	21
1.10. Fabrication strategies for Z-scheme Photocatalyst	22
1.10.1. <i>Deposition–precipitation method</i>	23
1.10.2. <i>Hydrothermal and solvothermal method</i>	23
1.10.3. <i>Solid-state synthesis</i>	24
1.10.4. <i>Ion exchange method</i>	24
1.10.5. <i>Electrospinning method</i>	24
1.10.6. <i>Self-assembly method</i>	25
1.11. Objective of this thesis	25
Chapter 2: Experimental: Materials and methods	27-35
2.1. Introduction	27
2.2. Chemicals	27
2.3. Sample preparation	29
2.2.1. <i>Synthesis of CuWO₄</i>	29
2.4. Techniques used for Materials characterization	30
2.4.1. <i>Powder X-Ray Diffraction (XRD)</i>	31
2.4.2. <i>Sample preparation and imaging for Transmission Electron Microscopy (TEM)</i>	31
2.4.3. <i>UV-Visible spectroscopy</i>	32

2.4.4. <i>UV-visible diffuse reflectance spectroscopy (UV- DRS)</i>	32
2.4.5. <i>X-ray photoelectron spectroscopy (XPS)</i>	33
2.4.6. <i>Photoluminescence Studies</i>	33
2.5. Photocatalytic performance measurements	34
2.6. Scavenging experiments	35
Chapter 3: AgI/CuWO₄ Z-scheme photocatalysts for the degradation of organic pollutants	36-57
3.1. Introduction	36
3.2. Experimental	38
3.2.1. <i>Synthesis of AgI/CuWO₄</i>	38
3.2.2. <i>Photocatalysis experiments</i>	39
3.3. Result and Discussion	39
3.3.1. <i>XRD pattern and Phase analysis</i>	39
3.3.2. <i>Morphology analysis through HR-TEM</i>	40
3.3.3. <i>XPS characterization</i>	43
3.3.4. <i>Optical bandgap studies</i>	45
3.3.5. <i>Photoluminescence properties</i>	47
3.3.6. <i>Evaluation of photocatalytic activity</i>	48
3.3.7. <i>Reusability of photocatalysts</i>	52
3.3.8. <i>Scavenger test</i>	54
3.3.9. <i>Photocatalytic reaction mechanism</i>	56
3.4. Conclusion	57

antibiotic degradation

4.1. Introduction	58
4.2. Experimental	60
4.2.1. <i>Hydrothermal synthesis of $\text{Ag}_3\text{PO}_4/\text{CuWO}_4$</i>	60
4.2.2. <i>Photocatalytic activity of $\text{Ag}_3\text{PO}_4/\text{CuWO}_4$</i>	61
4.3. Result and Discussion	61
4.3.1. <i>XRD Analysis</i>	62
4.3.2. <i>FTIR Analysis</i>	62
4.3.3. <i>Morphology and heterostructures interface analysis</i>	64
4.3.4. <i>XPS analysis</i>	65
4.3.5. <i>Bandgap studies through UV-visible Spectroscopy</i>	67
4.3.6. <i>Photoluminescence analysis</i>	69
4.3.7. <i>Evaluation of the photocatalytic activity</i>	69
4.3.8. <i>Recyclability</i>	72
4.3.9. <i>Active species trapping experiment</i>	74
4.3.10. <i>Photocatalytic reaction mechanism</i>	75
4.4. Conclusion	76

Methyl Orange Degradation

5.1. Introduction	77
5.2. Experimental	79
5.2.1. <i>Synthesis of $\text{Ag}_3\text{VO}_4/\text{CuWO}_4$</i>	79
5.2.2. <i>Photocatalysis experiments</i>	80

5.3. Result and Discussion	81
5.3.1. XRD diffraction pattern	81
5.3.2. TEM analysis	82
5.3.3. XPS analysis	83
5.3.4. UV-DRS analysis	86
5.3.5. Photoluminescence	87
5.3.6. Photocatalytic Activity	87
5.3.7. Recyclability	90
5.3.8. Photocatalysis with scavenger molecules	90
5.3.9. Photocatalytic mechanism	91
5.4. Conclusion	92
Chapter 6: Z-scheme Ag₂MoO₄/CuWO₄ photocatalysts for dye degradation	93-108
6.1. Introduction	93
6.2. Experimental	95
6.2.1. Synthesis of Ag ₂ MoO ₄ /CuWO ₄	95
6.2.2. Photocatalysis experiments	96
6.3. Result and Discussion	96
6.3.1. XRD analysis	96
6.3.2. Morphology and heterostructures interface analysis	97
6.3.3. XPS analysis	98
6.3.4. Solid-state UV-visible spectroscopy	100
6.3.5. Photoluminescence spectroscopy	101
6.3.6. Evaluation of photocatalytic activity	102

<i>6.3.7. Recyclability</i>	105
<i>6.3.8. Scavenger test</i>	106
<i>6.3.9. Photocatalytic reaction mechanism</i>	107
6.4. Conclusion	108
Chapter 7: Summary and Future Scope	109-113
References	114-153
List of Conferences/Presentations	154
List of Publications	155
