

1. Record Nr.	UNINA9910508478303321
Autore	Gurylev Vitaly
Titolo	Nanostructured photocatalyst via defect engineering : basic knowledge and recent advances // Vitaly Gurylev
Pubbl/distr/stampa	Cham, Switzerland : , : Springer, , [2021] ©2021
ISBN	3-030-81911-6
Descrizione fisica	1 online resource (388 pages)
Disciplina	541.395
Soggetti	Photocatalysis Nanostructured materials Catalysts - Materials
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Intro -- Preface -- Acknowledgments -- About the Book -- Contents -- About the Author -- Chapter 1: Photocatalysis: Fundamentals -- 1.1 Introduction -- 1.2 Case Example I: Photocatalytic Degradation of Pollutants in Water -- 1.3 Case Example II: Photocatalytic and Photoelectrochemical Water Splitting -- 1.4 Case Example III: Photoconversion of CO ₂ -- 1.5 Case Example IV: Photocatalytic Nitrogen Fixation -- 1.6 Other Photocatalytic Reactions -- 1.6.1 Photocatalytic Reduction of Cr (VI) -- 1.6.2 Photocatalytic Reduction of Other Toxic and Nontoxic Metals -- 1.6.3 Photocatalytic Hydrogen Peroxide Production -- 1.6.4 Biomass Treatment: Photocatalytic Oxidation of Glucose -- 1.6.5 Several More Examples of Photocatalytic Reactions -- 1.7 Final Remarks on Photocatalysis -- References -- Chapter 2: General Principles of Defect Engineering -- 2.1 Introduction -- 2.2 Defect Engineering: Fundamentals -- 2.3 Point Defects -- 2.3.1 Brief Overview -- 2.3.2 Intrinsic and Extrinsic Defects: Difference and Particularities -- 2.3.3 Intrinsic Defects -- 2.3.3.1 Anion Vacancies -- 2.3.3.2 Cation Vacancies -- 2.3.4 Extrinsic Defects -- 2.3.4.1 Metal Doping -- 2.3.4.2 Non-metal Doping -- 2.4 Line Defects -- 2.5 Planar Defects -- 2.6 Volume Defects -- 2.7 Defects in Semiconductor Nanomaterials: Current Progress -- 2.7.1 General Methods to Produce Defects -- 2.7.2 Manipulation and Control of Defects -- 2.7.3 Materials

Properties vs Defect Presence: Positive and Negative Sides -- 2.7.3.1 Positive Contribution of Defect Engineering -- 2.7.3.2 Negative Contribution of Defect Engineering -- 2.7.4 Current Challenges and Future Perspectives -- 2.8 Final Remarks on Defect Engineering -- References -- Chapter 3: Bulk vs Surface Defects -- 3.1 Introduction -- 3.2 Bulk Defects -- 3.3 Surface Defects -- 3.4 Distribution, Concentration, and Diffusion of Defects: Why Is It Important. 3.4.1 Distribution of Defects -- 3.4.2 Concentration of Defects -- 3.4.3 Diffusion of Defects -- 3.5 Defect Engineering of 0-D, 1-D, 2-D, and 3-D Materials -- 3.5.1 Brief Overview -- 3.5.2 Defects in 0-D Materials -- 3.5.3 Defects in 1-D Materials -- 3.5.4 Defects in 2-D Materials -- 3.5.5 Defects in 3-D Materials -- 3.6 Final Remarks on Defect Localization -- References -- Chapter 4: Analysis of Defects -- 4.1 Introduction -- 4.2 Electron Microscopy, Surface Scan, and Visualization Techniques -- 4.2.1 Transmission Electron Microscopy -- 4.2.2 Scanning Probe Microscopy (SPM) -- 4.2.2.1 Brief Overview of SPM Techniques -- 4.2.2.2 Scanning Tunneling Microscopy (STM) -- 4.2.2.3 Atomic Force Microscopy (AFM) -- 4.2.2.4 Kelvin Probe Force Microscopy (KPFM) -- 4.2.2.5 Conductive Force Microscopy (C-AFM) -- 4.2.3 Another Microscopy Analysis -- 4.3 Spectroscopy Techniques -- 4.3.1 Electron Paramagnetic Resonance (EPR) -- 4.3.2 Positron Annihilation Spectroscopy (PAS) -- 4.3.3 X-ray Photoelectron Spectroscopy (XPS) -- 4.3.4 Valence Band X-ray photoelectron spectroscopy (VBXPS) -- 4.3.5 Fourier Transform Infrared Spectroscopy (FTIR) -- 4.3.6 Raman Spectroscopy -- 4.3.6.1 Brief Overview -- 4.3.6.2 Non-resonance Raman Spectroscopy -- 4.3.6.3 Resonance Raman Spectroscopy -- 4.3.7 Photoluminescence (PL) and Cathodoluminescence (CL) Spectroscopies -- 4.3.8 Transient Absorption Spectroscopy (TAS) -- 4.3.9 X-ray Absorption Spectroscopy (XAS) -- 4.4 X-ray Diffraction Analysis (XRD) -- 4.5 Other Analyzing Techniques -- 4.6 Final Remarks on Various Analysis Tools and Methods -- References -- Chapter 5: Case Study I Defect Engineering of TiO₂ -- 5.1 TiO₂: Fundamentals -- 5.2 Intrinsic Defects in TiO₂ -- 5.2.1 Introduction -- 5.2.2 Defect Chemistry of TiO₂ -- 5.2.2.1 Brief Overview -- 5.2.2.2 Oxygen Vacancies -- 5.2.2.3 Titanium Vacancies -- 5.2.2.4 Titanium Interstitials. 5.2.2.5 Oxygen Interstitials -- 5.2.3 How to Create Defects? -- 5.2.3.1 Hydrogenation -- 5.2.3.2 High-Energy Particles Bombardment -- 5.2.3.3 Thermal Treatment in Reducing Atmosphere -- 5.2.3.4 Vapor-Phase Synthesis -- 5.2.3.5 Chemical-Based Approaches -- 5.2.3.6 Electrochemical Methods -- 5.2.3.7 Mechanical Methods -- 5.2.3.8 Alternative Methods -- 5.2.3.9 Influence of TiO₂ Crystallinity and Phase on the Formation of Defects -- 5.2.4 Properties of Defective TiO₂ -- 5.2.4.1 Structural Properties -- 5.2.4.2 Optical Properties -- 5.2.4.3 Chemical Modifications -- 5.2.4.4 Electronic Properties -- 5.2.4.5 Electrical Properties -- 5.2.4.6 Other Properties -- 5.2.5 Defective TiO₂ via Theoretical Simulations -- 5.2.5.1 Various Simulation Models and Their Outcome -- 5.2.5.2 Comparison with Real Experimental Studies -- 5.2.5.3 Current Challenges -- 5.2.6 Application of Defective TiO₂ as Photocatalyst -- 5.2.6.1 Brief Overview -- 5.2.6.2 Photocatalytic and Photoelectrochemical Water Splitting -- 5.2.6.3 Light-Induced Water Purification -- 5.2.6.4 Photoconversion of CO₂ -- 5.2.6.5 Other Applications -- 5.2.6.6 Current Challenges and Future Perspectives -- 5.2.7 Amorphous TiO₂: Alternative to Defective TiO₂ -- 5.2.7.1 Introduction: Amorphous TiO₂ vs Crystalline TiO₂ -- 5.2.7.2 How to Fabricate Amorphous TiO₂: Morphology-Controlled Synthesis -- 5.2.7.3 Properties of Amorphous TiO₂ -- 5.2.7.4 Application of Amorphous TiO₂ as Photocatalyst -- 5.3 Final Remarks About

Defective TiO₂ -- References -- Chapter 6: Case Study II: Defect Engineering of ZnO -- 6.1 ZnO: Fundamentals -- 6.2 Intrinsic Defects in ZnO -- 6.2.1 Introduction -- 6.2.2 Defect Chemistry of ZnO -- 6.2.2.1 Brief Overview -- 6.2.2.2 Oxygen vs Zinc Vacancies: Particularities in Electronic and Geometrical Configurations -- 6.2.3 How to Create Defects -- 6.2.3.1 Hydrogenation. 6.2.3.2 High-Energy Particles Bombardment -- 6.2.3.3 Treatment in Reduced Atmosphere -- 6.2.3.4 Vapor Phase Synthesis -- 6.2.3.5 Chemical-Based Approaches -- 6.2.3.6 Electrochemical Methods -- 6.2.3.7 Mechanical Methods -- 6.2.3.8 Crystallinity, Size, and Dimension of ZnO vs Formation of Defects -- 6.2.4 Properties of Defective ZnO -- 6.2.4.1 Structural Properties -- 6.2.4.2 Optical Properties -- 6.2.4.3 Electronic Properties -- 6.2.4.4 Electrical Properties -- 6.2.4.5 Other Properties -- 6.2.5 Application of Defective ZnO as Photocatalyst -- 6.2.5.1 Brief Overview -- 6.2.5.2 Photocatalytic and Photoelectrochemical Water Splitting -- 6.2.5.3 Light-Induced Water Purification -- 6.2.5.4 Photoconversion of CO₂ -- 6.2.5.5 Antibacterial and Antimicrobial Applications -- 6.2.5.6 Other Applications -- 6.2.5.7 Current Challenges and Future Perspectives -- 6.3 Final Remarks About Defective ZnO -- References -- Chapter 7: Case Study III: Defect Engineering of Ta₂O₅, Ta₃N₅, and TaON -- 7.1 Ta₂O₅, Ta₃N₅, and TaON: Fundamentals -- 7.2 Intrinsic Defects in Ta₂O₅, Ta₃N₅, and TaON -- 7.2.1 Introduction -- 7.2.2 Defects in Oxide, Nitrides, and Oxynitrides: What Is Difference -- 7.2.2.1 Brief Overview -- 7.2.2.2 Defects in Ta₂O₅ -- 7.2.2.3 Defects in Ta₃N₅ -- 7.2.2.4 Defects in TaON -- 7.2.3 How to Create Defects -- 7.2.3.1 Ta₂O₅ -- 7.2.3.2 TaN₅ -- 7.2.3.3 TaON -- 7.2.4 Properties of Defective Ta₂O₅, Ta₃N₅, and TaON -- 7.2.4.1 Structural Properties -- 7.2.4.2 Optical Properties -- 7.2.4.3 Electronic Properties -- 7.2.4.4 Electrical Properties -- 7.2.5 Application of Defective Ta₂O₅, Ta₃N₅, and TaON as Photocatalyst -- 7.2.5.1 Brief Overview -- 7.2.5.2 Photocatalytic and Photoelectrochemical Water Splitting -- 7.2.5.3 Light-Induced Water Purification -- 7.2.5.4 Photoconversion of CO₂ -- 7.2.5.5 Current Challenges and Future Perspectives. 7.3 Final Remarks About Defective Ta₂O₅, Ta₃N₅, and TaON -- References -- Chapter 8: Case Study IV: Defect Engineering of MoS₂ and WS₂ -- 8.1 MoS₂ and WS₂: Fundamentals -- 8.2 Intrinsic Defects in MoS₂ and WS₂ -- 8.2.1 Introduction -- 8.2.2 Defects in MoS₂ -- 8.2.3 Defects in WS₂ -- 8.2.4 How to Create Defects -- 8.2.4.1 Exfoliation -- 8.2.4.2 Vapor Phase Synthesis -- 8.2.4.3 Hydrothermal Method -- 8.2.4.4 Other Methods -- 8.2.5 Properties of Defective MoS₂ and WS₂ -- 8.2.5.1 Structural Properties -- 8.2.5.2 Optical Properties -- 8.2.5.3 Electronic Properties -- 8.2.5.4 Electrical Properties -- 8.2.6 Application of Defective MoS₂ and WS₂ as Photocatalyst -- 8.2.6.1 Brief Overview -- 8.2.6.2 Photocatalytic and Photoelectrochemical Water Splitting -- 8.2.6.3 Light-Induce Water Purification -- 8.2.6.4 Photoconversion of CO₂ -- 8.2.6.5 Other Applications -- 8.2.6.6 Current Challenges and Future Perspectives -- 8.3 Final Remarks About Defective MoS₂ and WS₂ -- References -- Chapter 9: Defect Engineering of Other Nanostructured Semiconductors -- 9.1 Introduction -- 9.2 Methods to Introduce Intrinsic Defects: Recent Trends and Future Perspectives -- 9.3 Defect-Controlled Properties: Tuning and Adjustment -- 9.4 Defective Nanostructures: Examples -- 9.4.1 Brief Overview -- 9.4.2 Case Example I: g-C₃N₄ -- 9.4.2.1 g-C₃N₄: Fundamentals -- 9.4.2.2 How to Create Defects -- 9.4.2.3 Properties of Defective g-C₃N₄ -- 9.4.2.4 Photocatalytic Application of Defective g-C₃N₄ -- 9.4.3 Case Example II: WO₃ -- 9.4.3.1 WO₃: Fundamentals -- 9.4.3.2 How to Create Defects --

9.4.3.3 Properties of Defective WO₃ -- 9.4.3.4 Photocatalytic Application of Defective WO₃ -- 9.4.4 Case Example III: CuO and Cu₂O -- 9.4.4.1 CuO and Cu₂O: Fundamentals -- 9.4.4.2 How to Create Defects -- 9.4.4.3 Properties of Defective CuO and Cu₂O. 9.4.4.4 Photocatalytic Application of Defective CuO and Cu₂O.
