

1. Record Nr.	UNINA9910686500803321
Titolo	1D semiconducting hybrid nanostructures : synthesis and applications in gas sensing and optoelectronics / / edited by Arvind Kumar, Dinesh K. Aswal, Nirav Joshi
Pubbl/distr/stampa	Weinheim, Germany : , : Wiley-VCH GmbH, , [2023] ©2023
ISBN	3-527-83764-7 3-527-83766-3
Descrizione fisica	1 online resource (365 pages)
Disciplina	730
Soggetti	Nanostructured materials
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Cover -- Title Page -- Copyright Page -- Contents -- Preface -- Chapter 1 One-Dimensional Semiconducting Hybrid Nanostructure: Gas Sensing and Optoelectronic Applications -- 1.1 Introduction -- 1.2 Synthesis of 1D Hybrid Nanostructures -- 1.2.1 Top-Down Approach -- 1.2.2 Bottom-Up Approach -- 1.2.2.1 Nanotubes -- 1.2.2.2 Nanowires -- 1.2.2.3 Nanorods -- 1.3 Applications of 1D Hybrid Nanostructures -- 1.3.1 Gas Sensing -- 1.3.1.1 Safety Monitoring of Exhaust Gases in Automobile -- 1.3.1.2 Health Monitoring -- 1.3.1.3 Environmental Monitoring -- 1.3.2 Optoelectronic Application -- 1.3.2.1 Photodetector -- 1.3.2.2 Solar Cell -- 1.3.2.3 Light-Emitting Diode -- 1.4 Conclusions -- Acknowledgment -- References -- Chapter 2 Synthesis and Gas-Sensing Application of 1D Semiconducting Hybrid Nanostructures -- 2.1 Introduction -- 2.2 Noble Metal-Functionalized 1D Metal Oxide Semiconductors for Gas Sensors -- 2.3 1D Metal Oxide/Metal Oxide Heterojunctions-Based Gas Sensors -- 2.4 Conducting Polymer/1D Metal Oxide Nanocomposites for Gas Sensors -- 2.5 Hybrid Conducting Polymer/Carbon Nanotube-Based Gas Sensors -- 2.6 Conclusion and Future Perspectives -- Acknowledgment -- References -- Chapter 3 Room-Temperature Gas-Sensing Properties of Metal Oxide Nanowire/Graphene Hybrid Structures -- 3.1 Introduction -- 3.2

Synthesis of Graphene and Graphene Oxide -- 3.2.1 Mechanical Exfoliation -- 3.2.2 Electrochemical Method -- 3.2.3 Sonication -- 3.2.4 Exfoliation of Graphite Oxide -- 3.2.5 Unzipping Carbon Nanotubes -- 3.2.6 Epitaxial Growth on Silicon Carbide (SiC) -- 3.2.7 Chemical Vapor Deposition -- 3.3 Graphene/Metal Oxide Nanowires Hybrid-Based Sensors -- 3.3.1 ZnO Nanowires Reduced Graphene Oxide-Based Hybrids for NH₃ Detection -- 3.3.1.1 Influence of Weight Percentage on Ammonia-Sensing Characteristics.

3.3.2 NO₂ Detection Using Metal Oxide Nanowires Hybrids with Reduced Graphene Oxide -- 3.3.2.1 Cu₂O Nanowires/RGO-Based Hybrid -- 3.3.2.2 SnO₂ Nanowires/RGO-Based Hybrid -- 3.3.3 H₂S Detection Using SnO₂ Quantum Wire/RGO-Based Hybrid -- 3.3.4 ZnO Nanowires-Graphene-Based H₂ Sensor -- 3.3.5 ZnO Nanowires on Laser-Scribed Graphene-Based Devices for NO Gas Detection -- 3.3.6 UV Light-Activated NO₂- and SO₂-Gas-Sensing Using RGO/Hollow SnO₂ Nanofibers -- 3.4 Conclusion -- References -- Chapter 4 Highly Sensitive Room-Temperature Gas Sensors Based on Organic-Inorganic Nanofibers -- 4.1 Introduction -- 4.2 Classification of Nanofibers for Gas-Sensing Application -- 4.2.1 Organic Nanofibers -- 4.2.2 Inorganic Nanofibers -- 4.2.3 Heterostructure-Based Organic-Inorganic Nanofibers -- 4.3 Different Configurations of Gas Sensors -- 4.4 Synthesis of NFs -- 4.4.1 Electrospinning and Coaxial Electrospinning Techniques -- 4.4.2 On-Chip Fabrication and Direct Writing of NFs-Based Gas Sensors -- 4.5 Role of Physicochemical Properties of Nanofibers in Gas Sensing -- 4.5.1 Surface-Dependent Properties -- 4.5.2 Interface-Dependent Properties -- 4.5.3 Morphology-Controlled Properties -- 4.5.4 Adsorption-Desorption Kinetics -- 4.6 Enhancement of Characteristics of Nanofibers-Based Sensor Performance -- 4.6.1 UV Light/High-Energy Beam Irradiation -- 4.6.2 Noble Metal Sensitizers -- 4.7 Recent Trends -- 4.7.1 Single-Nanofiber-based Gas Sensors Synthesized by Electrospinning -- 4.7.2 E-Noses and Nano-e-Noses Using NFs -- 4.7.3 On-Chip Fabrication of Aligned NFs Heterostructures -- 4.7.4 Wearable Devices -- 4.8 Conclusion and Future Perspectives -- Acknowledgment -- References -- Chapter 5 1D Hybrid Tin Oxide Nanostructures: Synthesis and Applications -- 5.1 Main Features of 1D Materials -- 5.2 Synthesis of 1D SnO, Sn₃O₄, and SnO₂ Materials -- 5.2.1 Hydrothermal Method. 5.2.2 Electrospinning Method -- 5.2.3 Chemical Vapor Deposition (CVD) -- 5.2.4 Reactive Sputtering Method -- 5.3 Tin-Based Hybrid Nanostructures -- 5.3.1 SnO₂-Based Hybrid Nanostructures -- 5.3.2 Sn₃O₄-Based Hybrid Nanostructures -- 5.3.3 SnO-Based Hybrid Nanostructures -- 5.4 Gas-Sensing Performance of 1D Tin Oxide-Based Hybrid Nanostructures -- 5.4.1 Pristine 1D Tin Oxide Nanostructures -- 5.4.2 Doping, Loading, and Surface Functionalization with Noble Metals -- 5.4.3 Heterostructures and the Effect of Heterojunctions in Gas-Sensing Performance -- 5.4.4 Composites with Carbon-Based Materials -- 5.4.5 Composites with Conducting Polymers -- 5.5 Photo(Electro)Catalytic Application of 1D Tin Oxide-Based Heterostructures and Doped Materials -- 5.5.1 Photocatalytic Degradation of Organic Pollutants and NO Gas and Photocatalytic Conversion of Benzyl Alcohol into Benzaldehyde Using 1D Tin Oxide-Based Materials -- 5.5.2 Photo(Electro)Catalytic Water Splitting with 1D Tin Oxide-Based Materials -- 5.6 Other Applications of 1D Tin Oxides -- 5.7 Final Considerations and Future Outlook -- Acknowledgments -- References -- Chapter 6 Recent Advances in Semiconducting Nanowires-Based Hybrid Structures for Solar Cell Application -- 6.1 Introduction -- 6.2 Semiconductor Materials -- 6.2.1 Classification Semiconductors -- 6.2.1.1 Intrinsic Semiconductor

-- 6.2.1.2 Extrinsic Semiconductor -- 6.2.2 Solar Photovoltaic Systems
-- 6.2.3 Nanomaterials as Semiconductors -- 6.2.4 Effect
of Nanomaterial Morphology in Semiconductors Applications -- 6.3
Semiconductor Nanowires Synthesis -- 6.3.1 Advantages of Nanowire
Morphology -- 6.3.2 Nanowire Synthesis -- 6.3.2.1 ZnO Nanowire --
6.3.2.2 SiNWs Preparation -- 6.3.2.3 NaNbO₃ Nanowire -- 6.3.2.4
TiO₂ Nanowires -- 6.3.2.5 ZnS Nanowire -- 6.3.2.6 CdS Nanowires --
6.3.3 Characterization.
6.4 Applications of Semiconductors in Solar Cells -- 6.4.1 Si-NWs for
Solar Cells -- 6.4.2 ZnO Nanowires for Solar Cell -- 6.4.3 Ag-NWs for
Solar Cells -- 6.4.4 III-V NWs -- 6.4.5 Cu-NWs for Solar Cell -- 6.5
Conclusion and Future Perspectives -- References -- Chapter 7
Introduction and Types of Semiconducting Hybrid Nanostructures for
Optoelectronic Devices -- 7.1 Introduction -- 7.2 Synthesis
of Nanostructured Materials -- 7.2.1 1D ZnO Nanostructures
(Nanowires/Nanorods) -- 7.2.1.1 Hydrothermal Method: Experimental
Steps for ZnO -- 7.2.2 Chemical Vapor Deposition: MoS₂ Few Layer
Structures -- 7.2.2.1 CVD: Experimental Steps for MoS₂ -- 7.2.2.2
CVD: Experimental Steps for ZnO -- 7.2.3 Reduced Graphene Oxide
(RGO) -- 7.2.3.1 Experimental Steps for RGO -- 7.2.3.2 Experimental
Steps for ZnO/RGO Hybrid Structure -- 7.2.4 Experimental Steps for
ZnO/MoS₂ Hybrid Structure -- 7.3 Applications of ZnO-Graphene
Heterostructure for Photon Detection -- 7.3.1 ZnO
Nanowire/Graphene-Based Photodetector -- 7.3.2 Figure of Merits of a
Photodetector -- 7.3.3 One-Dimensional Chalcogenide Material
for Optoelectronic Applications -- 7.3.4 Heterostructure-Based Solar
Cell -- 7.4 Conclusion and Summary -- References -- Chapter 8 One-
Dimensional Si Nanostructure-Based Hybrid Systems: Surface-
Enhanced Raman Spectroscopy and Photodetector Applications -- 8.1
Introduction -- 8.2 Si Nanostructures -- 8.3 Fabrication of 1D Si
Nanostructures -- 8.3.1 Vapor-Liquid-Solid Growth -- 8.3.2 Dry
Etching -- 8.3.3 Metal-Assisted Chemical Etching -- 8.4 Applications
of 1D Si Nanostructures Hybrids in SERS and Photodetectors -- 8.4.1
SERS Applications of Si Nanostructure Hybrids -- 8.4.2 Si Nanostructure
Hybrids for Photodetector Applications -- 8.4.2.1 Device Geometries of
Photodetectors -- 8.4.2.2 1D Si Nanostructure Hybrids for
Photodetectors -- 8.5 Conclusions -- References.
Chapter 9 Hybrid 1D Semiconducting ZnO and GaN Nanostructures for
Light-Emitting Devices -- 9.1 Introduction About 1D Nanostructures --
9.2 Synthesis Methods for the Growth of 1D Nanostructure -- 9.2.1
Hydrothermal Method for the Synthesis of 1D ZnO Nanorods -- 9.2.2
Pulsed Laser Deposition Method -- 9.2.3 Chemical Vapor Deposition
Method -- 9.2.4 Metal Organic Chemical Vapor Deposition -- 9.3
Application of ZnO- and GaN-Based Hybrid 1D Nanostructure for
Light-Emitting Devices -- 9.4 Conclusion -- References -- Chapter 10
Optoelectronic Properties of TiO₂ Nanorods/Au Nanoparticles
Heterostructure -- 10.1 Introduction -- 10.2 Theory of Electron
Transfer -- 10.2.1 Description of Band Diagram -- 10.2.2 Extinction
Estimation -- 10.3 Experimental -- 10.3.1 TiO₂ Nanorods -- 10.3.2
Structural, Morphological, Elemental, and Optical Measurement --
10.3.3 Amperometric Measurement -- 10.4 Results and Discussion --
10.4.1 Morphology -- 10.4.2 Structural -- 10.4.3 Optical -- 10.4.4
Electrical -- 10.4.4.1 Electron Transfer Mechanism from AuNP to
TiO₂NR -- 10.4.4.2 Amperometric (Current-Time) -- 10.5 Conclusions
-- Acknowledgments -- Compliance with Ethical Standards --
References -- Chapter 11 2D Materials with 1D Semiconducting
Nanostructures for High-Performance Gas Sensor -- 11.1 Introduction
-- 11.2 Enhanced Gas-Sensing Performances of 1D-Sensing Materials

Composited with Different 2D Materials -- 11.2.1 Graphene or Reduced Graphene Oxide-based Composites -- 11.2.2 MoS₂-based Composites -- 11.2.3 WS₂-based Composite -- 11.2.4 ZnO-based Composite -- 11.2.5 NiO-based Composites -- 11.2.6 Other 2D material-decorated 1D nanomaterial -- 11.3 Remain Challenges and Possible Effective Ways to Explore High-Performance Gas Sensor -- 11.4 Conclusions -- Acknowledgments -- References.

Chapter 12 Recent Advancement in the Development of Optical Modulators Based on 1D and 2D Materials.
