

1. Record Nr.	UNINA9910555129503321
Titolo	Nanogap electrodes / / edited by Tao Li
Pubbl/distr/stampa	Weinheim, Germany : , : Wiley, , [2021] ©2021
ISBN	3-527-65958-7 3-527-65959-5 3-527-65956-0
Descrizione fisica	1 online resource (435 pages)
Disciplina	621.3815
Soggetti	Nanoelectronics Electrodes Electronic books.
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 -- Contents -- Preface -- Chapter 1 Nanogap Electrodes and Molecular Electronic Devices -- 1.1 Introduction -- 1.2 Overview of Molecular Electronics -- 1.2.1 Why Molecular Electronics -- 1.2.1.1 History of Computing -- 1.2.1.2 Moore's Law -- 1.2.1.3 Molecular Electronics: A BeyondCMOS Option -- 1.2.2 Molecular Materials for Organic Electronics -- 1.2.2.1 OLEDs -- 1.2.2.2 OFETs -- 1.2.2.3 OPVs -- 1.2.3 Molecules for Molecular Scale Electronics -- 1.3 Introduction to Nanogap Electrodes -- 1.4 Summary and Outlook -- References -- Chapter 2 Electron Transport in Single Molecular Devices -- 2.1 Introduction -- 2.2 General Methods -- 2.2.1 Transport Mechanisms -- 2.2.2 Nonequilibrium Green's Function Method -- 2.2.3 Master Equation Method -- 2.3 Single Electron Transport Through Single Molecular Junction -- 2.3.1 Coherent Transport -- 2.3.2 Hopping Transport -- 2.4 Effect of ManyBody Interactions -- 2.4.1 ElectronVibration Interaction -- 2.4.1.1 Weak Coupling Regime -- 2.4.1.2 StrongCoupling Regime -- 2.4.2 Electron-Electron Interaction -- 2.4.2.1 Coulomb Blockade -- 2.4.2.2 Kondo Effect -- 2.5 Thermoelectric Transport -- 2.6 FirstPrinciples Simulations of Transport in Molecular Devices -- 2.7 Conclusions --

References -- Chapter 3 Fabricating Methods and Materials for Nanogap Electrodes -- 3.1 Introduction -- 3.2 Mechanical Controllable Break Junctions -- 3.3 Electrochemical and Chemical Deposition Method -- 3.3.1 Electroplating and Feedback System -- 3.3.2 Chemical Deposition -- 3.4 Oblique Angle Shadow Evaporation -- 3.5 Electromigration and Electrical Breakdown Method -- 3.5.1 Device Fabrication -- 3.5.2 Gap Size Control -- 3.5.3 Electromigration Applications -- 3.6 Molecular Scale Template -- 3.6.1 Molecular Rulers -- 3.6.2 Inorganic Films as Templates -- 3.6.3 OnWire Lithography -- 3.6.4 Nanowire Mask. 3.7 Focused Ion Beam -- 3.8 Scanning Probe Lithography and Conducting ProbeAtomic Force Microscopy -- 3.8.1 Destructive Way -- 3.8.2 Constructive Way -- 3.8.3 Conducting ProbeAtomic Force Microscopy -- 3.9 Nanogap Electrodes Prepared with Nonmetallic Materials -- 3.9.1 Introduction -- 3.9.2 Nanogap Electrodes Made from Carbon Materials -- 3.9.2.1 Advantages of Carbon Materials -- 3.9.2.2 Carbon Nanotubes for Nanogap Electrodes -- 3.9.2.3 Graphene -- 3.9.2.4 Silicon Nanogap Electrodes -- 3.9.2.5 Other Materials -- 3.10 Summary and Outlook -- References -- Chapter 4 Characterization Methods and Analytical Techniques for Nanogap Junction -- 4.1 Current-Voltage Analysis -- 4.1.1 Coherent Tunneling Transport -- 4.1.2 Transition Voltage Spectroscopy -- 4.1.3 Incoherent Transport -- 4.2 Inelastic Tunneling Spectroscopy (IETS) -- 4.2.1 Principle and Measurement of IETS -- 4.2.2 Selection Rule and Charge Transport Pathway -- 4.2.3 Line Shape of the IETS -- 4.2.4 Application of the IETS -- 4.2.5 Mapping the Charge Transport Pathway in Protein Junction by IETS -- 4.2.6 STM Imaging by IETS -- 4.3 Optical and Optoelectronic Spectroscopy -- 4.4 Concluding Remarks -- References -- Chapter 5 SingleMolecule Electronic Devices -- 5.1 Introduction -- 5.2 Wiring Molecules into "Gaps": Anchoring Groups and Assembly Methods -- 5.2.1 Anchor Groups -- 5.2.2 Effect of Anchor-Bridge Orbital Overlaps on Conductance -- 5.2.3 In Situ Chemical Reactions to Produce Covalent Contacts -- 5.3 Electrical Rectifier -- 5.3.1 Rectification Toward Diodes -- 5.3.2 General Mechanisms for Molecular Rectification -- 5.3.2.1 Aviram-Ratner Model -- 5.3.2.2 Kornilovitch-Bratkovsky-Williams Model -- 5.3.2.3 Datta-Paulsson Model -- 5.3.3 Rectification Originated from Molecules -- 5.3.3.1 D--A and D--A Systems -- 5.3.3.2 D-A Diblock Molecular System. 5.3.4 Rectification Stemming from Different Interfacial Coupling -- 5.3.4.1 Different Electrodes -- 5.3.4.2 Anchoring Groups -- 5.3.4.3 Contact Geometry -- 5.3.4.4 Interfacial Distance -- 5.3.5 Additional Molecular Rectifiers -- 5.4 Conductance Switches -- 5.4.1 Voltage Pulse Induced Switches -- 5.4.2 LightInduced Switching -- 5.4.3 Switching Triggered by Chemical Process (Redox and pH) -- 5.4.4 SpintronicsBased Switch -- 5.5 Gating the Transport: TransistorLike SingleMolecule Devices -- 5.5.1 Electrostatic Gate Control -- 5.5.2 Side Gating -- 5.5.3 Electrochemical Gate Control -- 5.5.4 Molecular Quantum Dots -- 5.6 Challenges and Outlooks -- References -- Chapter 6 Molecular Electronic Junctions Based on SelfAssembled Monolayers -- 6.1 Introduction -- 6.2 Molecular Monolayers for Molecular Electronics Devices -- 6.2.1 Monolayers Covalently Bonded to Noble Metals -- 6.2.2 Monolayers Attached to Nonmetal Substrates -- 6.2.3 Langmuir-Blodgett Method -- 6.3 Top Electrodes -- 6.3.1 Deposited Metal -- 6.3.1.1 Direct Evaporation -- 6.3.1.2 Indirect Evaporation -- 6.3.2 Make Top Contact by Soft Methods -- 6.3.2.1 Lift andFloat Approach -- 6.3.2.2 Crosswire Junction -- 6.3.2.3 Transfer Printing -- 6.3.2.4 Graphene as Top Electrode -- 6.3.2.5 Liquid Metal Contact -- 6.4 Experimental Progress with Ensemble Molecular

Junctions -- 6.5 Outlook -- References -- Chapter 7 Toward Devices and Applications -- 7.1 Introduction -- 7.2 Major Issues: Reliability and Robustness -- 7.2.1 Single Molecular Device -- 7.2.1.1 TopContact Junctions -- 7.2.1.2 Planar Metallic Nanogap Electrodes -- 7.2.1.3 Planar Nanogap Electrodes Based on Single Walled Carbon Nanotubes (SWCNTs) or Graphene -- 7.2.1.4 The Absorption of Molecule on the Surface of SWCNTs or Graphene -- 7.2.2 Molecular Device Based on Molecule Monolayer -- 7.2.2.1 Bottom Electrodes. 7.2.2.2 Insulating Layer with Holes to Define the Size of the Bottom Electrodes -- 7.2.2.3 Molecule Monolayer Formation -- 7.2.2.4 Top Electrodes -- 7.3 Potential Integration Solutions -- 7.3.1 Carbon Nanotube or Graphene Interconnects -- 7.3.2 SelfAssembled Monolayers for Integrated Molecular Junctions -- 7.3.3 Cross Bar Architecture -- 7.4 Beyond Simple Charge Transport -- 7.4.1 Mechanics -- 7.4.2 Thermoelectronics -- 7.4.3 Quantum Interference -- 7.4.4 Spintronics -- 7.4.4.1 SAMBased Magnetic Tunnel Junctions -- 7.4.4.2 Molecule Based SpinValves or Magnetic Tunnel Junctions -- 7.4.4.3 Single Molecular Spin Transistor -- 7.4.4.4 Single Molecular Nuclear Spin Transistor -- 7.4.4.5 Molecule Based Hybrid Spintronic Devices -- 7.5 Electrochemistry with Nanogap Electrodes -- References -- Index -- EULA.
