

1. Record Nr.	UNINA9911018944203321
Autore	Meng Hong
Titolo	Colloidal Quantum Dot Light Emitting Diodes : Materials and Devices
Pubbl/distr/stampa	Newark : , : John Wiley & Sons, Incorporated, , 2023 ©2024
ISBN	9783527845125
Edizione	[1st ed.]
Descrizione fisica	1 online resource (400 pages)
Disciplina	621.381522
Soggetti	Quantum dots Light emitting diodes
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Cover -- Title Page -- Copyright -- Contents -- Preface -- Chapter 1 History and Introduction of QDs and QDLEDs -- 1.1 Preparation Route of Quantum Dots -- 1.2 LightEmitting Characteristics of Quantum Dots -- 1.2.1 Particle Size and Emission Color -- 1.2.2 Quantum Dot Optical Property -- 1.2.2.1 Quantum Surface Effect -- 1.2.2.2 Quantum Size Effect -- 1.2.2.3 Quantum Confinement Effect -- 1.2.2.4 Quantum Tunnelling Effect -- 1.2.2.5 Quantum Optical Properties -- 1.2.3 Core-Shell Structure of QDs -- 1.2.4 Continuously Graded Core-Shell Structure of QDs (cgQDs) -- 1.2.5 Typical QDs Materials -- 1.2.5.1 II-VI Semiconductor QDs -- 1.2.5.2 IV-VI Semiconductor QDs -- 1.2.5.3 III-V2 Semiconductor QDs -- 1.2.5.4 Ternary I-III-VI2 Chalcopyrite Semiconductor QDs -- 1.2.5.5 Single ElementBased Semiconductor QDs -- 1.3 Application of Quantum Dots on Display Devices -- 1.3.1 The Basic Structure of QDLED -- 1.3.2 Main Factors Affecting QDLED Light Emission -- 1.3.2.1 Auger Recombination (AR) -- 1.3.2.2 Fluorescence Resonance Energy Transfer -- 1.3.2.3 Surface Traps and Field Emission Burst -- 1.3.3 History of QDLED Development -- 1.4 Conclusion and Remarks -- References -- Chapter 2 Colloidal Semiconductor Quantum Dot LED Structure and Principles -- 2.1 Basic Concepts -- 2.1.1 Color Purity -- 2.1.2 Solution Processability -- 2.1.3 Stability -- 2.1.4 Surface States of Quantum Dots -- 2.1.5 Energy Levels and Energy Bands -- 2.1.6 Metals, Semiconductors, and

Insulators -- 2.1.7 Electrons and Holes -- 2.1.8 Fermi Distribution Function and Fermi Energy Level -- 2.1.9 Schottky Barrier -- 2.1.10 Energy Level Alignment -- 2.2 Colloidal Quantum Dot Light Emitting Devices -- 2.2.1 The Basic Structure of QDLED -- 2.2.2 The Working Principle of QDLED -- 2.2.3 Operating Parameters of QDLED -- 2.2.3.1 Turnon Voltage -- 2.2.3.2 Luminous Brightness. 2.2.3.3 Luminous Efficiency -- 2.2.3.4 Luminescence Color -- 2.2.3.5 Luminous Lifetime -- 2.2.3.6 QDLED Device Fabrication Process -- References -- Chapter 3 Synthesis and Characterization of Colloidal Semiconductor Quantum Dot Materials -- 3.1 Background -- 3.2 Synthesis and Postprocessing of Colloidal Quantum Dots -- 3.2.1 Direct Heating Method and Hot Injection Synthesis Method -- 3.2.1.1 HotInjection Method -- 3.2.1.2 Direct Heating Method -- 3.2.2 Precursor Chemistry -- 3.2.3 Ligating and Nonligating Solvents -- 3.2.4 Mechanism of Nucleation and Growth of Colloidal Quantum Dots -- 3.2.5 Size Distribution Focus and Size Distribution Scatter -- 3.2.6 Crystalline Species Mediated Growth and Orientation of Nanocrystals Attachment Growth -- 3.2.7 Synthesis Methods and Band Gap Regulation Engineering of Nuclear Shell Quantum Dots -- 3.2.7.1 Non alloyed Core-Shell Quantum Dots -- 3.2.7.2 Alloy Core-Shell Quantum Dots -- 3.2.8 Surface Chemistry of Colloidal Quantum Dots -- 3.2.8.1 Covalent Bond Classification Method -- 3.2.8.2 Entropic Ligands -- 3.3 Material Characterization -- 3.3.1 Ultraviolet-Visible (UV-Vis) Absorption and Fluorescence Spectra -- 3.3.2 Nuclear Magnetic Resonance Spectroscopy -- 3.3.3 Fourier Transform Infrared Spectroscopy (FTIR) -- 3.3.4 XRay Photoelectron Spectroscopy (XPS) -- 3.3.5 Transmission Electron Microscopy -- 3.3.6 Small Angle XRay Scattering and Wide Angle XRay Scattering -- 3.3.7 XRay Diffractometer -- 3.3.8 XRay Absorption Fine Structure Spectra -- 3.3.9 Measurement of Fluorescence Quantum Yield -- 3.4 Conclusion and Outlook -- References -- Chapter 4 Red Quantum Dot Light Emitting Diodes -- 4.1 Background -- 4.2 Red Light Quantum Dot Materials -- 4.2.1 Materials -- 4.2.2 Quantum Dot Structure Design and Optimization -- 4.2.3 Surface Ligands -- 4.2.4 Core-Shell Structure -- 4.2.5 Alloy Core-Shell Structure. 4.3 Red QDLED Devices -- 4.3.1 Red QDLED Device Architecture Development -- 4.3.2 Common Device Structures -- 4.4 Conclusion and Outlook -- References -- Chapter 5 Green Quantum Dot LED Materials and Devices -- 5.1 Background -- 5.2 Commonly Used Luminescent Layer Materials in Green QDLEDs -- 5.2.1 Discrete Core/Shell Quantum Dots -- 5.2.2 Alloyed Core/Shell Quantum Dots -- 5.2.3 Core/Multilayer Shell Quantum Dots -- 5.3 Development of Device Structures for Green QDLEDs -- 5.4 Factors Affecting the Performance of Green QDLEDs -- 5.4.1 QD Ligand Effect -- 5.4.2 QD Core/Shell Structure -- 5.4.3 Optimization of the Device Structure -- 5.4.4 Other Strategies to Improve Device Performance -- 5.5 Summary and Outlook -- References -- Chapter 6 Blue Quantum Dot Light Emitting Diodes -- 6.1 Introduction -- 6.2 Blue Quantum Dot Luminescent Materials -- 6.2.1 Blue Quantum Dots Containing Cadmium -- 6.2.2 Cadmium Free Quantum Dots -- 6.2.2.1 Quantum Dots Based on InP -- 6.2.2.2 Quantum Dots Based on ZnSe -- 6.2.2.3 Quantum Dots Based on Cu -- 6.2.2.4 Quantum Dots Based on AlSb -- 6.3 Optimization of Charge Transport Layer (CTL) -- 6.3.1 Hole Transport Layer -- 6.3.2 Electron Transport Layer -- 6.4 Device Structure -- 6.5 Summary -- References -- Chapter 7 Near Infrared Quantum Dots (NIR QDs) -- 7.1 Introduction of Near Infrared Quantum Dots -- 7.2 Near Infrared Quantum Dot Materials -- 7.2.1 Chalcogenide Lead Quantum Dots -- 7.2.2 Chalcogenide Cadmium

Quantum Dots -- 7.2.3 Silicon Quantum Dots -- 7.3 Optimization of NearInfrared Quantum Dot Materials -- 7.3.1 Regulation of Near Infrared Quantum Dots by Ligand Engineering -- 7.3.2 Control of Near Infrared Quantum Dots by Core/Shell Structure -- 7.3.3 Quantum Dots in the Matrix -- 7.4 Summary and Prospect -- References -- Chapter 8 White QDLED -- 8.1 Generation of White Light -- 8.2 Quantum Dots for White LEDs.

8.2.1 Yellow-Blue Composite White Light Quantum Dots -- 8.2.1.1 CadmiumContaining Yellow Light Quantum Dots -- 8.2.1.2 Cadmium Free Yellow Light Quantum Dots -- 8.2.2 ThreeBase Color Quantum Dot Composite -- 8.2.3 Quantum Dots with Direct White Light Emission -- 8.3 Summary Outlook -- References -- Chapter 9 NonCadmium Quantum Dot LightEmitting Materials and Devices -- 9.1 Introduction -- 9.2 Quantum Dots and QDLED -- 9.2.1 InP -- 9.2.2 ZnSe -- 9.2.3 I IIIVI -- 9.3 Methods for Optimizing QDLED Performance -- 9.3.1 Ligand Engineering -- 9.3.2 Shell Engineering -- 9.3.3 QDLED Device Structure Optimization -- 9.4 Summary and Outlook -- References -- Chapter 10 ACDriven Quantum Dot LightEmitting Diodes -- 10.1 Principle of Luminescence of DC and ACDriven QDLEDs -- 10.2 Mechanism of DoubleEmission Tandem Structure of AC QDLEDs -- 10.2.1 FieldGenerated AC QDLEDs -- 10.2.2 HalfField to HalfInjection AC QDLEDs -- 10.2.3 AC/DC Dual Drive Mode QDLEDs -- 10.3 Optimization Strategies for AC QDLEDs -- 10.3.1 Optimization of the FieldInduced AC QDLED -- 10.3.1.1 Dielectric Layer Optimization -- 10.3.1.2 Quantum Dot Layer Optimization -- 10.3.2 Optimization of HalfFieldDriven HalfInjected AC QDLEDs -- 10.3.2.1 Charge Generation Layer Optimization -- 10.3.2.2 Tandem Structure -- 10.3.2.3 AC/DC Dual Drive Mode QDLED Optimization -- 10.3.3 Conclusion and Future Direction of ACQDLED -- References -- Chapter 11 Stability Study and Decay Mechanism of Quantum Dot Light Emitting Diodes -- 11.1 Quantum Dot LightEmitting Diode Stability Research Status -- 11.2 Factors Affecting the Stability of Quantum Dot LightEmitting Diodes -- 11.2.1 Quantum Dot LightEmitting Layer -- 11.2.2 Hole Transport Layer -- 11.2.3 Electronic Transport Layer -- 11.2.4 Other Functional Layers -- 11.3 Quantum Dot LightEmitting Diode Efficiency Decay Mechanism.

11.4 Aging Mechanisms of QDLEDs -- 11.4.1 Positive Aging -- 11.4.2 Negative Aging -- 11.4.3 Electron Transport Layer -- 11.4.4 Hole Transport Layer -- 11.4.5 QDs Layer -- 11.5 Characterization Technologies for QDLEDs -- 11.5.1 Transient Electroluminescence -- 11.5.2 ElectroAbsorption (EA) Spectroscopy -- 11.5.3 InSitu EL-PL Measurement -- 11.5.4 Differential Absorption Spectroscopy -- 11.5.5 Displacement Current Measurement DCM Technology -- 11.6 Outlook -- References -- Chapter 12 Electron/Hole Injection and Transport Materials in Quantum Dot LightEmitting Diodes -- 12.1 Introduction -- 12.2 ChargeTransport Mechanisms -- 12.3 Electron Transport Materials (ETMs) for QDLED -- 12.3.1 MetalDoped ETMs -- 12.3.2 Metal SaltDoped ETMs -- 12.3.3 Design of Composite Materials ETMs -- 12.3.4 PolymerModified ETMs -- 12.3.5 Inorganic Organic Hybrid ETMs -- 12.3.6 DoubleStacked ETMs -- 12.4 Electron Injection Materials for QDLED -- 12.5 Hole Transport Materials for QDLED -- 12.5.1 Doping of HTMs -- 12.5.2 Compositions of HTMS -- 12.5.3 New HTM Materials for QDLED -- 12.6 Hole Injection Materials for QDLED -- 12.7 Summary and Outlook -- References -- Chapter 13 Quantum Dot Industrial Development and Patent Layout -- 13.1 Introduction -- 13.2 Patent Layout -- 13.2.1 Nanosys -- 13.2.2 SAMSUNG -- 13.2.3 Nanoco -- 13.2.4 Najing Tech -- 13.2.5 CSOT -- 13.2.6 BOE -- 13.2.7 TCL -- 13.3 Summary and Outlook -- References

-- Chapter 14 Patterning Techniques for Quantum Dot LightEmitting Diodes (QDLED) -- 14.1 Introduction -- 14.2 Photolithography -- 14.3 MicroContact Transfer -- 14.4 Inkjet Printing -- 14.5 Other Patterning Techniques -- 14.6 Conclusion -- References -- Index -- EULA.

Sommario/riassunto

This comprehensive book provides an in-depth exploration of colloidal quantum dot light-emitting diodes (QDLEDs), focusing on their materials and devices. It covers the history, principles, and structure of QDLEDs, offering insights into their synthesis, stability, and decay mechanisms. The book also discusses the various colors of quantum dot diodes, including red, green, and blue, as well as more specialized types such as near-infrared and non-cadmium quantum dots. With detailed chapters on electron injection and transport materials, industrial development, patent layouts, and patterning techniques, this book serves as a valuable reference for researchers, scientists, engineers, and students interested in the field of quantum dot technology. Authored by Professor Hong Meng, it aims to advance the understanding of QDLEDs and their potential applications in display and lighting technologies.
