

1. Record Nr.	UNINA9911019393103321
Autore	Fernandes Diana M
Titolo	Applied Polyoxometalate-Based Electrocatalysis
Pubbl/distr/stampa	Newark : , : John Wiley & Sons, Incorporated, , 2024 ©2025
ISBN	9783527842711 3527842713 9783527842704 3527842705 9783527842698 3527842691
Edizione	[1st ed.]
Descrizione fisica	1 online resource (381 pages)
Soggetti	Polyoxometalates Nanostructured materials
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Cover -- Title Page -- Copyright -- Contents -- Part I Fundamentals -- Chapter 1 Introduction to Polyoxometalates -- 1.1 Introduction -- 1.2 Polyoxometalate Structures -- 1.2.1 Synthetic Methodologies -- 1.2.2 Lindqvist Structure -- 1.2.3 Keggin Structure -- 1.2.4 Wells-Dawson Structure -- 1.2.5 Anderson-Evans Structure -- 1.2.6 Preyssler Structure -- 1.2.7 Other POM Structures -- 1.3 POMbased Composites and Materials -- 1.4 Conclusions -- References -- Chapter 2 Design and Strategies to Enhance the Electrochemical Properties of POM Nanomaterials for Electrocatalysis -- 2.1 Introduction -- 2.1.1 Structure Bonding and Formation -- 2.1.2 POM Archetypes: Keggin and Wells-Dawson -- 2.1.3 Factors Influencing the Catalytic Role of POMs -- 2.1.4 The Structure-Redox Relationship in POMs -- 2.2 Design Approaches via Organofunctionalization -- 2.2.1 Transitionmetal substituted POMs (TMSPOMs) -- 2.2.2 Class I Hybrid POMs -- 2.2.3 Class II Hybrid POMs -- 2.2.4 Asymmetric Systems -- 2.2.5 Supramolecular Assembly -- 2.2.6 Immobilization Techniques -- 2.2.6.1 Surface Immobilization -- 2.2.6.2 Nanoencapsulation -- 2.3

Conclusion -- References -- Part II Polyoxometalates for Oxidative Electrocatalysis -- Chapter 3 POMbased Electrocatalysts for ICysteine and NADH Oxidation -- 3.1 Introduction -- 3.2 The Electrocatalytic Oxidation of ICysteine (Cys) -- 3.2.1 Vcontaining POMs as Electrocatalysts in Homogeneous Phase -- 3.2.2 Cecontaining POMs as Electrocatalysts in Homogeneous Phase -- 3.2.3 POMcontaining Hybrids as Electrocatalysts in Heterogeneous Phase: Carbon Paste Electrodes -- 3.2.4 POMcontaining Hybrids as Electrocatalysts in Heterogeneous Phase: Layerbylayer modified Electrodes -- 3.2.5 POM containing Hybrids as Electrocatalysts in Heterogeneous Phase: Layer bylayer and Nanoparticlemodified Electrodes.

3.3 The Electrocatalytic Oxidation of Nicotinamide Adenine Dinucleotide (NADH) -- 3.3.1 Vcontaining POMs as Electrocatalysts in Homogeneous Phase -- 3.3.2 POMcontaining Hybrids as Electrocatalysts in Heterogeneous Phase: Layerbylayer and Precipitate depositionmodified Electrodes -- 3.3.3 POMcontaining Hybrids as Electrocatalysts in Heterogeneous Phase: Layerbylayer and Nanoparticlemodified Electrodes -- 3.3.4 POMcontaining Hybrids as Electrocatalysts in Heterogeneous Phase: Precipitatedeposition modified Electrodes and Electrogenerated Chemiluminescence -- 3.3.5 POMs in Artificial Reductase Systems for Oxidation Catalysis -- 3.4 Conclusion -- List of Abbreviations -- References -- Chapter 4 POM based Electrocatalysts for Pharmaceutical Molecules Oxidation -- 4.1 Introduction -- 4.2 Preparation Methods of POMbased Films and (Nano)composites -- 4.3 POMbased Electrocatalysis -- 4.3.1 Electrocatalysis -- 4.3.2 Dopamine Oxidation -- 4.3.3 Ascorbic Acid Oxidation -- 4.3.4 Other Molecules -- 4.4 Conclusions -- Acknowledgments -- List of Abbreviations -- References -- Part III Polyoxometalates for Reductive Electrocatalysis -- Chapter 5 POM based Electrocatalysts for Inorganic Water Contaminants and Hydrogen Peroxide Reduction -- 5.1 Introduction -- 5.2 Nitrite Reduction -- 5.3 Bromate Reduction -- 5.4 Iodate Reduction -- 5.5 Hydrogen Peroxide Reduction Reaction -- 5.6 Conclusions -- Acknowledgment -- List of Abbreviations -- References -- Chapter 6 POMbased Electrocatalysts for Carbon Dioxide Reduction -- 6.1 Introduction -- 6.2 Thermodynamics of CO₂ Reduction -- 6.3 Appealing Properties of POMs for CO₂ Reduction -- 6.3.1 A Reservoir of 'Hopping' Electrons -- 6.3.2 Protoncoupled Electron Transfer in POMs -- 6.3.3 Tuning of the Reducibility of the POMs -- 6.3.4 Massive Electron Storage in POMs -- 6.3.5 A Versatile Platform.

6.4 Coordination of CO₂ by POM Compounds -- 6.5 Electrocatalytic Reduction of CO₂ with Dissolved POMs -- 6.5.1 3D Transitionmetal substituted POMs as Electrocatalysts in Organic Solvents -- 6.5.2 Platinoidcontaining Hybrid POMs as Electrocatalysts in Organic Solvents -- 6.5.3 POMs as Electron Relays in Aqueous Solution -- 6.6 Electrocatalytic Reduction of CO₂ at POMsmodified (Semi)conducting Electrode Surfaces -- 6.6.1 Immobilization of POMs on Electrodes -- 6.6.2 POMsmodified Electrodes Electrocatalytically Active for CO₂ Reduction -- 6.7 Conclusions -- References -- Part IV Polyoxometales for Fuel Cells and Electrolysers -- Chapter 7 POMbased Electrocatalysts for Oxygen Evolution Reaction -- 7.1 Introduction: The OER Process -- 7.2 Pure POMs as OER Electrocatalysts -- 7.2.1 Structural and Mechanistic Considerations -- 7.2.1.1 POMs as Platforms for Water Oxidation Electrocatalysis -- 7.2.1.2 Water Oxidation Mechanism of POMs -- 7.2.2 Homogeneous Electrocatalysis -- 7.2.3 Heterogeneous Electrocatalysis -- 7.3 POMcontaining (Nano)composites as OER Electrocatalysts -- 7.3.1 POM/Carbon (Nano)composites -- 7.3.2 POMs Combined with Metals/Metal Oxides/Metal Hydroxides/Metal

Complexes -- 7.3.3 POM/MOF Nanocomposites -- 7.3.4 Other Nanomaterials -- 7.4 Heterogeneous Materials Derived from POM and POM-containing Nanocomposites -- 7.4.1 Encapsulation of POMs into MOFs Structures as Precursors for WO Electrocatalysts -- 7.4.2 Other POM-based Materials -- 7.5 Concluding Remarks -- Acknowledgements -- List of Abbreviations -- References -- Chapter 8 POM-based Electrocatalysts for Hydrogen Evolution Reaction -- 8.1 Introduction: HER Process -- 8.2 Pure POMs as HER Electrocatalysts -- 8.3 Composite/Hybrid Materials -- 8.3.1 Carbon/POM -- 8.3.2 MOF/POM (POMOFs) -- 8.3.3 Transitionmetal/POM Composites -- 8.3.4 Polymer/POM -- 8.4 POM-derived Electrocatalysts. 8.4.1 SACs -- 8.4.2 Transitionmetal Carbides -- 8.4.3 Transition metal Chalcogens -- 8.4.4 Transitionmetal Nitrates -- 8.4.5 Transitionmetal Phosphides -- 8.4.6 Transitionmetal Oxides -- 8.5 Concluding Remarks -- Acknowledgements -- List of Abbreviations -- List of Symbols -- References -- Chapter 9 POM-based Electrocatalysts for Oxygen Reduction Reactions -- 9.1 Introduction -- 9.2 Fundamentals of Oxygen Reduction Reaction -- 9.3 StateoftheArt Electrocatalysts for the ORR -- 9.4 POM-based Electrocatalysts for the ORR -- 9.5 Conclusions -- Acknowledgements -- References -- Part V Polyoxometalates for Batteries and Supercapacitors -- Chapter 10 POM based Nanomaterials for Battery Applications -- 10.1 Introduction -- 10.2 Criteria for Efficient Redox Flow Batteries -- 10.3 Electrolyte Requirements for Redox Flow Batteries (RFBs) -- 10.3.1 Wide Potential Window -- 10.3.2 Energy Density and High Solubility -- 10.3.3 Fast Electrontransfer Kinetics -- 10.3.4 High Ionic Conductivity -- 10.3.5 Mass Transfer and Viscosity of Electrolyte -- 10.3.6 Longterm Stability of Active Materials -- 10.3.7 Costs and Safety -- 10.4 Classification of POMs -- 10.5 Suitability of POMs for Energy Conversion and Storage Devices -- 10.5.1 POMs in Supercapacitors -- 10.5.2 POMs in Liion Batteries -- 10.5.3 POMs in Naion Batteries -- 10.5.4 POMs in RFBs -- 10.6 Further Possibilities -- 10.7 POM-based RFBs in Comparison with Other RFBs -- 10.7.1 Iron/Chromium RFBs -- 10.7.2 Allvanadium RFBs -- 10.7.3 Zn/Br₂ RFBs -- 10.8 Conclusions -- Abbreviations and Symbols -- References -- Chapter 11 POM-based Nanomaterials for Supercapacitors -- 11.1 Introduction to Energystorage Devices -- 11.2 Properties of POMs for Supercapacitors -- 11.2.1 POMs as Electrode Materials -- 11.2.1.1 POM/Carbon Composites -- 11.2.1.2 POMs into Conductive Polymers. 11.2.1.3 POM-based Ternary Nanohybrids (TNH) -- 11.2.1.4 POMs Within Supramolecular Structures -- 11.2.2 POMs as Electrolyte Additives -- 11.3 Conclusions and Future Perspectives -- Acknowledgements -- References -- Index -- EULA.

Sommario/riassunto

This book provides a comprehensive exploration of polyoxometalates (POMs), a class of nanoscale metal-oxide clusters known for their structural and chemical versatility. The text delves into the synthesis, structure, and applications of POMs in various fields such as catalysis, biomedicine, and materials science. It covers fundamental aspects, design strategies to enhance POM properties, and their use in oxidative and reductive processes. The book also discusses POM-based nanomaterials for energy applications, including fuel cells, batteries, and electrolysis. It serves as a resource for researchers, scientists, and students interested in nanomaterials and their technological applications.
