

# Nanostructured Metal-Oxide Electrode Materials for Water Purification: Fabrication, Electrochemistry and Applications

Onoyivwe Monday Ama

Department of Chemical Sciences, University of Johannesburg, Johannesburg, South Africa

Suprakas Sinha Ray

Department of Chemical Sciences, University of Johannesburg, Johannesburg, South Africa

Centre for Nanostructures and Advanced, Materials, DSI-CSIR Nanotechnology

Innovation Centre, Council for Scientific and Industrial Research, Pretoria, South Africa

<https://link.springer.com/book/10.1007%2F978-3-030-43346-8>

## Abstract

Over the last two decades, “nanostructured materials” or “nanostructures” have become popular terms, not only among researchers, but also the general public. Owing to their extraordinary and unexpected behavior; nanostructures have gained tremendous attention in various fields such as water purification, sensors, electronics, health care, and biomedical applications. In this direction, there is a recent focus on the modification of nanostructured properties of some solvent electrolyte combinations that are commonly used in electrochemical characterization. However, the electrolyte provides the pathway for ions to flow between and among electrodes in the cell to maintain charge balance for the degradation of organic dyes with the use of metal oxide. Since water treatment is becoming more challenging owing to the complexity of the pollutants present within. This necessitates the need to seek alternative and complementary approaches to the removal of these organic dyes. This book will contribute to this need in our community, which cuts across electrochemistry, water science, materials science, and nanotechnology. It successfully highlights the applicability of the fabricated electrode and nanocomposites in electrochemical technology. This book is structured in ten chapters. Chapter 1 focuses on the dynamic degradation efficiency of major organic pollutants such as pharmaceutical wastes and synthetic dyes from wastewater. Chapter 2 describes the synthesis and fabrication of photoactive nanocomposite electrodes for the degradation of wastewater pollutants. Chapter 3 is dedicated to the essence of electrochemical measurements on corrosion characterization and electrochemistry applications. The particular focus is on photoelectrochemical technique. Different kinds of electrochemical cells and their definitions of specific physical quantities are presented in Chap. 4. The synthesis and properties of various metal oxide nanoparticles in electrochemical applications are summarized in Chap. 5. Chapter 6 focuses on the construction of different biosensors using metal oxide nanoparticles for the detection of various harmful biological molecules in water. In Chap. 7, the authors report multiple kinds of metal oxide nanomaterials for electrochemical detection of heavy metals in water. Chapter 8 provides various applications of metal oxide electrodes and Chap. 9 focuses applications of modified metal oxide electrodes in photoelectrochemical removal of organic pollutants from wastewater. The final section, Chap. 10, provides metal oxide nanocomposites for adsorption and photochemical

degradation of pharmaceutical pollutants. In summary, this book addresses fundamental issues that persist concerning nanostructured metal oxide-based electrode design which cuts across electrochemistry, water science, materials science, and nanotechnology. This book is ideal for water scientists, material scientists, researchers, engineers (chemical and civil) including under- and post-graduate students who are interested in this exciting field of research. Moreover, this book will also help industrial researchers and R&D managers who want to bring advanced nanostructured metal oxide-based electrodes into the market. Finally, we express our sincerest appreciation to all authors for their valuable contribution, as well as reviewers for their critical evaluation of proposals and chapter manuscripts. Our special thanks go to Dr. Zachary Evenson, Associate Editor at Springer Nature for his suggestions, guidance, and advice during various stages of book preparation, organization, and production of this book. The financial support from the Council for Scientific and Industrial Research, the Department of Science and Innovation, and the University of Johannesburg is highly appreciated.