

Electrochemical methods for synthesizing different nanomaterials are elaborated. Structures, synthesis methods/ techniques of different electroceramics and ceramic oxides e.g. Perovskite, Columbite and Spinel are described. Conductive boron-doped diamond electrodes with recent work on the fabrication are summarized in detail. It takes up important role as novel electrode materials with fascinating applications in electroanalysis, electrosynthesis and environment. Recent progress in electrochemical synthesis strategies for the fabrication of electrocatalysts for fuel cell reactions like methanol oxidation reaction, ethanol oxidation reaction and oxygen reduction reaction, electrode materials for Li-ion batteries and supercapacitors and various synthesis conditions adapted during the developed electrodeposition are thoroughly discussed. Electrochemical synthesis and electrophoretic deposition of perovskites and 2D transition metal dichalcogenides are also been added. Finally, the challenges involved in the current electrochemical synthesis strategies and future perspectives of electrochemically deposited materials for energy conversion and storage systems are conveniently presented.

Nano, 2D, Electroceramic, Perovskites



Balaprasad Gangaram Ankamwar

Electrochemical Synthesis: Nano, 2D, Ceramic and Perovskite Materials



Balaprasad Gangaram Ankamwar works as Professor in the Dept. of Chemistry, S. P. Pune University. He did research mainly on 'Biosynthesis of Nanomaterials and their Applications' at National Chemical Laboratory, Pune and Post-Doctoral Research jointly at National Taiwan University and Genomics Research Centre, Academia Sinica, Taiwan.

FOR AUTHOR USE

Balaprasad Gangaram Ankamwar



Balaprasad Gangaram Ankamwar

**Electrochemical Synthesis: Nano, 2D, Ceramic and Perovskite
Materials**

FOR AUTHOR USE ONLY

FOR AUTHOR USE ONLY

Balaprasad Gangaram Ankamwar

**Electrochemical Synthesis:
Nano, 2D, Ceramic and
Perovskite Materials**

FOR AUTHOR USE ONLY

LAP LAMBERT Academic Publishing

Imprint

Any brand names and product names mentioned in this book are subject to trademark, brand or patent protection and are trademarks or registered trademarks of their respective holders. The use of brand names, product names, common names, trade names, product descriptions etc. even without a particular marking in this work is in no way to be construed to mean that such names may be regarded as unrestricted in respect of trademark and brand protection legislation and could thus be used by anyone.

Cover image: www.ingimage.com

Publisher:

LAP LAMBERT Academic Publishing

is a trademark of

Dodo Books Indian Ocean Ltd. and OmniScriptum S.R.L publishing group

120 High Road, East Finchley, London, N2 9ED, United Kingdom
Str. Armeneasca 28/1, office 1, Chisinau MD-2012, Republic of Moldova,
Europe

Printed at: see last page

ISBN: 978-620-6-16284-1

Copyright © Balaprasad Gangaram Ankamwar

Copyright © 2023 Dodo Books Indian Ocean Ltd. and OmniScriptum S.R.L
publishing group

FOR AUTHOR USE ONLY

CONTENTS

1. Electrochemical Synthesis of Nanomaterials

-----11-46

Saili Kirtiwar, Saeed Gharpure and Balaprasad Ankamwar*

This chapter comprises of electrochemical method for synthesis of silver, gold, zinc oxide, tin oxide, chromium oxide and carbon fluroxide nanomaterials. Synthesis method for the above-mentioned nanomaterials is explained with schematic images and flow charts for effective understanding of the synthesis method. Comparative table for quick review of nanomaterials explained this chapter is given at the end of the chapter.

2. Electrochemical Synthesis of 2D Materials

-----47-75

Janvi Shirsul, Rachana Yadwade and Balaprasad Ankamwar*

This chapter is comprised of general introduction about two dimensional (2D) materials and their synthesis by electrochemical approaches. Wide range of 2D materials including graphene family, MXenes, layered double hydroxides, black phosphorus, Phosphorene, metal-organic frameworks, chalcogenides along with 2D oxide's exceptional potential characteristics and their different electrochemical synthesis methods are discussed in this chapter. Some synthesis techniques are also explained with the help of depictions, for quick and easy understanding of method.

3. Boron-Doped Diamond Electrodes: A New Type of Electrode Material

-----76-99

Ujjal Kumar Sur

Conductive diamond electrodes, especially boron-doped diamond electrodes are of great importance. It takes up important role as a novel electrode material with fascinating applications in electro analysis as well as electrosynthesis and environmental applications. This chapter summarizes some of the recent work on the fabrication as well as use of

boron-doped diamond electrodes especially for electrochemical applications.

4. Electrochemical Synthesis of Nanostructured Materials for Energy Applications

-----100-132

B. Sravani, Y. Chandrashekar, P. Sri Chandana and Dr. L. Subramanyam Sarma*

This chapter covers the recent progress made in this exciting field and discussed various electrochemical synthesis strategies for the fabrication electrocatalysts for fuel cell reactions like methanol oxidation reaction (MOR), ethanol oxidation reaction (EOR) and oxygen reduction reaction (ORR), electrode materials for Li-ion batteries (LIBs) and supercapacitors. In addition, various synthesis conditions adapted during the developed electrodeposition methods in controlling the size, shape, composition and structure of nanostructured materials are thoroughly discussed. Finally, the challenges involved in the current electrochemical synthesis strategies and future perspectives of electrochemically deposited materials for electrochemical energy conversion and storage systems are conveniently presented.

5. Synthesis of Nanomaterials Based Electrochemical Sensors

-----133-178

Asadullah Asraf Ali, Rishikesh Deka, Sagarika Khound, Jayanta K Sarmah*

This chapter comprises of some classical methods of synthesis of nanomaterials for electrochemical sensors. The synthesis of carbon based and noble metal nanoparticles-based nanomaterials are described.

6. Electrochemical and Electrophoretically Derived Nanoscale Perovskites and 2D Materials

-----179-209

Hemanga J. Sarmah, Manjit Borah, and D. Mohanta*

In this book chapter, we review the electrochemical synthesis and electrophoretic deposition of perovskites and 2D transition metal dichalcogenides (TMDCs).

7. Different Synthetic Strategies of Nanocomposite Based Electrode Materials for Green Energy Technology

-----210-254

Rasu Ramachandran*, Pitchaimani Veerakumar, Tharini Jeyapragasam, Kannaiyan Dinakaran, and Muthusamy Boominathan, Abdullah G. Al-Sehemi

This chapter is summarized in various synthetic routes and fabrication of different kinds of environmentally friendly nature nanocomposite in energy conversion and storage technologies based on recent research progress and development. Most importantly, authors have mainly discussed the electrochemical parameters especially, C_{sp} , discharge specific capacity, current density, power density and electrode cyclic stability. In each part, brief introduction, insights the challenges and future advancement of different nanocomposite in green energy technologies has highlighted.

Chapter-7

Different Synthetic Strategies of Nanocomposite Based Electrode Materials for Green Energy Technology

Rasu Ramachandran^{1*}, Pitchaimani Veerakumar², Tharini Jeyapragasam³, Kannaiyan Dinakaran⁴, Muthusamy Boominathan¹, Abdullah G. Al-Sehemi⁵

¹*Department of Chemistry, The Madura College, Vidya Nagar, Madurai 625011, India.*

²*Centre of Molecular Medicine and Diagnostics (COMManD), Department of Biochemistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai 600 077, India.*

³*Department of Chemistry, VPMM College of Arts and College for Women, Krishnan kovil, Tamil Nadu, India.*

⁴*Department of Chemistry, Thiruvalluvar University, Vellore – 632 115, Tamil Nadu, India.*

⁵*Research Center for Advanced Materials Science (RCAMS), King Khalid University, Abha, 61413, Saudi Arabia and Department of Chemistry, College of Science, King Khalid University, Abha, 61413, Saudi Arabia.*

Table of contents

- 7.1 Introduction
- 7.2 Carbon Based Electrocatalysts
- 7.3 Metal-free Based Electrocatalysts
- 7.4 Metal Oxide Based Electrocatalysts
- 7.5 Conducting Polymer Based Electrocatalysts
- 7.6 Graphene Based Electrocatalysts
- 7.7 Fullerene Based Electrocatalysts
- 7.8 Conclusion