

Contents

List of contributing authors — IX

Dong Wang and Peter Schaaf

- 1 Synthesis and characterization of size controlled bimetallic nanosponges — 1**
 - 1.1 Introduction — 1
 - 1.2 Preparation methods — 3
 - 1.2.1 Preparation methods of nanoporous metals — 3
 - 1.2.2 Preparation methods of size controlled metallic nanosponges — 5
 - 1.3 Characterization methods and instrumentation — 14
 - 1.3.1 Structural characterization via topographical reconstruction — 14
 - 1.3.2 Optical characterizations and applications — 19
 - 1.4 Critical safety considerations — 24
 - 1.5 Conclusions and future perspective — 25
 - References — 26

Yunyun Zhou

- 2 Controllable design, synthesis and characterization of nanostructured rare earth metal oxides — 35**
 - 2.1 Introduction — 36
 - 2.2 Preparation methods — 39
 - 2.2.1 Hydrothermal synthesis — 39
 - 2.2.2 Solvothermal synthesis — 45
 - 2.2.3 Co-precipitation synthesis — 46
 - 2.2.4 Sol-gel process — 48
 - 2.2.5 Thermal decomposition synthesis — 51
 - 2.2.6 Microemulsion method — 54
 - 2.2.7 Combustion method — 56
 - 2.2.8 Microwave assisted synthesis — 59
 - 2.2.9 Sonochemical method — 61
 - 2.2.10 Electrochemical method — 63
 - 2.2.11 Other methods — 65
 - 2.3 Characterization methodologies and instrumentation techniques — 66
 - 2.3.1 Electron microscopy — 66
 - 2.3.2 Scanning tunneling microscopy — 78
 - 2.3.3 Atomic force microscopy — 81
 - 2.3.4 X-ray diffraction — 82
 - 2.3.5 X-ray photoelectron spectroscopy — 87

- 2.3.6 X-ray absorption spectroscopy — **91**
- 2.3.7 Raman spectroscopy — **94**
- 2.3.8 Other characterization methods — **98**
- 2.4 Critical safety considerations — **100**
- 2.5 Conclusions and future perspectives — **101**
- References — **103**

Jingfang Zhang, Yifu Yu and Bin Zhang

3 Synthesis and characterization of size controlled alloy nanoparticles — 115

- 3.1 Introduction — **115**
- 3.2 Preparation methods — **117**
 - 3.2.1 Chemical reduction — **117**
 - 3.2.2 Thermal decomposition of metal complex precursors — **129**
 - 3.2.3 Electrochemical deposition — **130**
- 3.3 Characterization methodologies and instrumentation techniques — **132**
 - 3.3.1 Microscopy — **132**
 - 3.3.2 X-ray spectroscopy — **133**
 - 3.3.3 Other characterization techniques — **134**
- 3.4 Critical safety considerations — **135**
- 3.5 Conclusions and future perspective — **136**
- References — **138**

Concha Tojo, David Buceta and M. Arturo López-Quintela

4 On the minimum reactant concentration required to prepare Au/M core-shell nanoparticles by the one-pot microemulsion route — 145

- 4.1 Introduction — **146**
- 4.2 Preparation methods and computational model — **148**
 - 4.2.1 One-pot method to prepare bimetallic nanoparticles in microemulsions — **148**
 - 4.2.2 Computational model to simulate the synthesis of bimetallic nanoparticles in microemulsions by a one-pot method — **149**
- 4.3 Characterization methodologies and instrumentation techniques — **152**
- 4.4 General remarks about factors affecting metals distribution — **152**
- 4.5 How to prepare Au/M (M = Ag, Pt, Pd) in a core-shell structure — **154**
- 4.6 Conclusions and future perspective — **163**
- References — **163**

Sumana Kundu and Vijayamohan K. Pillai

5 Synthesis and characterization of graphene quantum dots — 169

- 5.1 Introduction — **170**
- 5.1.1 The background of graphene — **170**
- 5.1.2 Emergence of graphene quantum dots (GQDs) — **171**
- 5.2 Structure, defects and properties of GQDs — **174**
- 5.2.1 Structure of graphene and GQDs — **174**
- 5.2.2 Defects in graphene-based nanomaterials — **180**
- 5.2.3 Properties of GQDs — **182**
- 5.3 Preparation strategies — **186**
- 5.3.1 Top-down methods — **186**
- 5.3.2 Bottom-up methods — **193**
- 5.3.3 Mechanism of oxidation of carbon skeleton — **202**
- 5.3.4 Effect of functionalization and doping of GQDs — **203**
- 5.4 Characterization methodologies — **204**
- 5.4.1 X-ray diffraction (XRD) — **204**
- 5.4.2 Raman spectroscopy — **205**
- 5.4.3 Ultraviolet-visible spectroscopy (UV-VIS) — **206**
- 5.4.4 Fluorescence spectroscopy — **208**
- 5.4.5 Fourier transform infrared spectroscopy (FT-IR) — **208**
- 5.4.6 TEM and high-resolution transmission electron microscopy (HRTEM) — **209**
- 5.4.7 Atomic force microscopy (AFM) — **210**
- 5.4.8 X-ray photoelectron spectroscopy (XPS) — **211**
- 5.5 Applications of GQDs — **212**
- 5.5.1 Energy-related applications of GQDs — **213**
- 5.5.2 Bio-medical applications of GQDs — **214**
- 5.5.3 GQDs for sensor applications — **214**
- 5.5.4 Miscellaneous applications of GQDs — **215**
- 5.6 Critical safety and environmental considerations — **215**
- 5.7 Conclusion and future perspectives — **216**
- References — **217**

Index — 227

