Microwaves in Nanoparticle Synthesis

After more than quarter a century of nanoscience and nanotechnology evolution, a glaring fact remains that few nanomaterials-based devices have been utilized in practice, concerning factors such as cost-effectiveness, manufacturing capability, performance needs, robustness, etc. Although self-assembly of raw nanomaterials may not seem to be difficult, the challenge lies in achieving fast, scale-up suitable, and cost-effective fabrication of nanomaterials and devices with repeatable and robust characteristics. Overcoming this challenge has become an increasingly demanding direction in both academia and industry.

At such an important juncture, publication of the book *Microwaves in Nanoparticle Synthesis*, edited by Satoshi Horikoshi and Nick Serpone, is timely. The book presents a fresh look at microwave heating and the behind chemistry for synthesis of inorganic nanomaterials (as opposed to the already widely reviewed organic synthesis). A scalable and cost-effective technique for inorganic nanoparticles, microwave synthesis is discussed with a link realistically with industrial manufacturing and application.

Instead of just presenting a collection of articles, Horikoshi and Serpone have made an effort to deliver a coherent story. The book begins with introductions to nanoparticles, microwave chemistry, and microwave heating methods (Chapters 1–3), some helpful tips for readers with little background. Unfortunately, despite the early introduction to microwave chemistry, some redundant repetitions were spotted in later chapters.

Chapter 4 discusses the use of combined energy sources for nanomaterials synthesis. Chapters 5–7 present a survey of the synthesis of various nanoparticles using microwave heating. Chapter 7, despite the informative material presented, is found hard to follow; more illustrations and figures might be helpful in this case.

The book continues discussions with more specifics on the materials processing parameters. In Chapter 8, Niederberger discusses various nonaqueous solvents for synthesis using microwave heating and their effects on metal oxide nanostructure. In Chapter 9, focusing on the iron oxide system, Milosevic and co-authors comprehensively review the microwave synthesis of various nanocrystals and their surface functionalization using microwave irradiation. In Chapter 10, Opembe et al. describe progress towards the scale-up of nanoparticle synthesis with a comprehensive review of continuous microwave-assisted synthesis of inorganic nanomaterials. As a natural extension, a microwave-plasma-assisted synthesis technique is reviewed in Chapter 11, including pertinent instrumentation details and empirical parameters. Finally, in Chapter 12, Garella and Cravotto give a brief overview of an interesting microwave irradiation chemistry strategy for purification and surface functionalization of carbon nanotubes (CNT), which has implications for CNT-based electronic devices, biosensors, and biomedicine.

These chapters cover a wide range of inorganic nanomaterials, dealing with different aspects of the research described. The materials range from carbon, (noble) metals and alloys, binary metal oxides, complex oxides such as perovskites and spinels, to elemental and compound semiconductors. Aiming to provide a broad coverage of microwave techniques for synthesizing nanoparticles, the editors have done a good job in blending and organizing the different chapters in terms of processing, microwave chemistry, and relevant applications.

The book has some deficiencies that one expects in a multi-author work. In particular, the contents of individual chapters and relative lengths are not balanced, some seemly end in a hurry. Although application aspects are discussed in the book, they are clearly a secondary consideration, and in some chapters there are none. Thus, the book's title might be a bit misleading. It was pleasant to start the reading of this book, but rhythm was lost approaching the later chapters. Overall, the book lacks collective perspectives and future outlooks that would have been nice to have, to help readers get a good grasp of the field. Also, a clearly labeled and user-friendly division of the contents and guidance to the readers would be helpful for such a 12-chapter book. It is nit-picking to expect perfection in this first edition, but it would be nice to see improvements in these areas in a second edition.

In summary, this book offers a timely and comprehensive overview of the fundamentals of microwave-assisted synthesis of nanomaterials. Some fresh views are noted on the scale-up of nanoparticle synthesis through the use of combined energy sources, continuous synthesis, and microwave plasma synthesis. Although this book may fall short of collective perspectives on microwave synthesis of nanoparticles, it should be a good reference source, not only for engineers in industrial settings, but also for researchers in universities and institutes.

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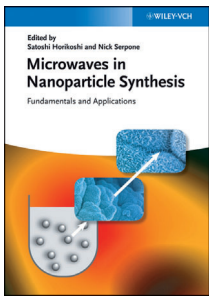

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