

# Preface

“Oxide Synthesis as Cornerstone of Nanoscience” – This statement was the title of a short Editorial we recently wrote for a special issue of the European Journal of Inorganic Chemistry on Metal Oxide Nanoparticles (Eur. J. Inorg. Chem. 2008, 825). Without any doubts, metal oxide nanoparticles play an outstanding role in many applications that are regarded as particularly promising within the broad area of Nanotechnology, e.g., nanophotonics, spintronics, energy storage and conversion, catalysis, or biomedical applications.

The great variety of structures and properties of metal oxides made this class of materials not only the primary target in solid state chemistry, but also represents a major inspiration for designing new materials on the nanoscale. It is therefore not surprising that a large number of synthesis methodologies have been reported for the size and shape-controlled synthesis of metal oxide nanostructures. One of the most versatile and fast developing approaches are nonaqueous or nonhydrolytic synthesis protocols, i.e., syntheses performed in organic solvents under exclusion of water. The main challenge we faced during writing this book was that we wanted to present both general and basic principles of metal oxide nanoparticle research as well as a rather exhaustive overview of the various metal oxide nanoparticles synthesized in organic solvents so far. We solved the problem in such a way that the main text explains the concepts on selected examples, whereas several tables list the various metal oxides synthesized via nonaqueous processes. We put great efforts in the preparation of these tables, i.e., we included all the literature we were aware of (until the end of 2008), offering a unique information source for chemists, physicists, materials scientists, and engineers to find the appropriate synthesis method for a targeted metal oxide with the desired properties.

The contents of the various chapters in this book were chosen based on a personal prioritization of the most fascinating topics in this research area. After a short and general excursion into the world of nanoparticles in Chapter 1, we discuss the basic principles of nonaqueous sol-gel chemistry in comparison with aqueous systems. Although water-based processes are generally preferred, in the case of metal oxide nanoparticle synthesis the use of or-

ganic solvents represents an advantageous alternative, which is elaborated in more detail in Chapter 2. Chapter 3 and 4 are fully dedicated to the synthesis of metal oxide nanoparticles and metal oxide-based organic-inorganic hybrids, involving surfactant-assisted (Chapter 3) and surfactant-free routes (Chapter 4). Chapter 5 presents the main chemical pathways leading to metal oxides in organic solvents. There is no doubt that in addition to the extensive synthesis work, also the assembly and positioning of nanoparticles in desired locations and across extended length scales as well as the in-depth investigation of the physical and chemical properties are key steps on the way to implement these materials into technological devices. We took these topics into account in Chapter 6, dealing with the assembly, Chapter 7 on the characterization and Chapter 8 on the properties and applications of metal oxide nanoparticles. The last Chapter of the book summarizes the current knowledge and the future challenges in the field of metal oxide nanoparticles prepared in organic solvents.

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