Preface

Nanoscience is an interdisciplinary field of science which has its early beginnings in the 1980s. At small dimensions of a few nanometers (billionths of a meter) new physical properties emerge, often due to quantum mechanical effects. During the last decades, additionally novel microscopical techniques have been developed in order to observe, measure, and manipulate objects at the nanoscale. It rapidly turned out that nanosized features not only play a role in physics and materials sciences but also are most relevant in chemistry, biology, and medicine, giving rise to new fenestrations between these disciplines and wide application prospects.

The early precursors to this book on *Nanoscience* date back to the 1990s when the author initiated a course on Nanoscience and Nanotechnology at Stuttgart University, Germany, based on his early studies of nanostructured solids which were performed due to most stimulating discussions in the early 1980s with Herbert Gleiter and the late Arno Holz, at that time at Saarbrücken University.

Together with the growing interdisciplinarity of the field, the author's research and teaching activities in nanoscience were extended at Stuttgart University and at research laboratories in South America, Japan, China, and Russia. During these research and teaching activities it became clear that a comprehensive yet concise text which comprises the current literature on nanoscience from physics to materials science, chemistry, biology, and medicine would be highly desirable. Such a textbook or monograph should be a valuable source of information for students and teachers in academia and for scientists and engineers in industry who are involved in the many different fields of nanoscience.

In the present book, the state of the art of nanoscience is presented, emphasizing in addition to the width and interdisciplinarity of the field the rapid progress in experimental techniques and theoretical studies. The text which focuses to the fundamental aspects of the field in 12 chapters is supported by more than 600 figures and a bibliography of nearly 2000 references which may be useful for more detailed studies and for looking at historical developments and which cover with their own references the wealth of the literature. A number of textbooks and review articles are quoted as introductory literature to the various fields.

The book starts in Chap. 1 with some general comments, physical principles, and a number of nanoscale measuring methods with the subsequent Chap. 2 on microscopy techniques for investigating nanostructures. Chapter 3 is devoted to

the synthesis of nanosystems whereas Chap. 4 surveys dimensionality effects with Chap. 5 focusing to carbon nanostructures and Chap. 6 to bulk nanocrystalline materials. In the Chaps. 7 and 8 the topics of nanomechanics, nanophotonics, nanofluidics, and nanomagnetism are raised before in Chap. 9 nanotechnology for computers and data storage devices are overviewed. The text is concluded with Chap. 10 on nanochemistry and Chap. 11 on nanobiology with finally an extended section on nanomedicine in Chap. 12.

These 12 chapters are closely linked and intertwined as demonstrated by many cross-references between the chapters. Although a particular chapter is dedicated, e.g., to synthesis (Chap. 3), some synthesis aspects reappear in other chapters. The same is true for nanomagnetism. In addition to the particular chapter on this topic (Chap. 8), nanomagnetic features appear in the introductory chapter, in the chapters on nanocrystalline materials (Chap. 6), on nanotechnology for computers and data storage (Chap. 9), on nanobiology (Chap. 11), or nanomedicine (Chap. 12). The Subject Index may additionally help the reader to find the appropriate information in his field of interest quickly.

The wide application prospects of nanoscience are discussed in the various chapters. The importance of risk assessment strategies and toxicity studies in nanotechnology is emphasized in Sect. 12.11.

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