Preface

This book is written for those scientists and engineers who wish to understand the synthesis, physical and chemical properties, and applications of inorganic and metallic nanotubular materials. The original version of this book, written in Japanese, covered those of organic, inorganic, and metallic nanotubular materials or almost all the other nanotubular materials than carbon nanotubes. This English version is concerned with only the chapters of inorganic and metallic nanotubular materials.

In most industries worldwide, recent attention is unexceptionally focused on the research and development of highly functional new materials or technologies leading to energetically highly efficient activities. Nanotubular materials are one of the materials with such technological potentials because of their nano-sized unique structures available, for example, functionalization at their internal and external surfaces. In 1991, Dr. S. Iijima discovered a tubular material of carbon and named it carbon nanotubes. Since then, worldwide attention has been focused on the basic and functional properties of the novel materials and in more recent times the research phase has developed into an advanced stage based on strategic researches toward various applications. Carbon nanotubes have thus become synonymous with nanotubular materials and still more a symbol of nanotechnology because of their unique, valuable, and versatile properties.

In the field of inorganic materials, the discovery of mesoporous silica around 1990–1992 and the subsequent researches on mesoporous materials stimulated the synthesis of a wide range of inorganic nanotubular materials including oxides, sulfides, nitrides, and metals. Currently, nanotube ripples have spread from carbon to all categories of materials, inorganic, metallic, and organic materials. It might be not going too far to say nanotubular structures are obtainable from almost all of the main elements and main substances. However, a very few exhaustive books have appeared on inorganic, metallic, and organic materials excluding carbon nanotubes, although a great number of books have been published on the properties and applications of carbon
nanotubes. In particular, there is no English version exhaustively concerned with inorganic and metallic nanotubular materials.

This book covers a wide variety of inorganic and metallic nanotubular materials, ranging from metal oxides to fullerene and water nanotubes. This book is written by experts internationally known in the fields of nanomaterials and nanotechnology.

Chapter 1 summarizes an outline of inorganic and metallic nanotubular materials, including their classification in structure, formation pathway and tube sizes, as well as their representative applications.

Chapter 2 focuses on the synthesis and applications of titanium oxide nanotubes because they are the most extensively studied compared with all the other inorganic nanotubes. The first section, by Sekino, reviews the synthesis and functionalization of titanium oxide nanotubes and the second section, by Koyanagi, refers to its structural and photochemical characterization. In the succeeding section the synthesis and applications of titanium oxide nanotube thin-films are considered by Miyauch and Tokudome. The final section, by Yamana and Uno, is concerned with the synthesis and applications of titanium oxide nanohole arrays.

Chapter 3 deals with the synthesis and applications of the single metal oxide nanotubes based on manganese, molybdenum, rare-earth metals, zirconium and ruthenium, by Feng, Suemitsu, and Yada and/or Inoue, respectively. The conversion of metal oxide nanosheets into their nanotubes is also considered by Ma and Sasaki, together with the synthesis and applications of mixed oxide nanotubes, by Ogihara, Sadakane, and Ueda.

In Chapter 4, the synthesis, structure, and properties of imogolite nanotubes are discussed as well as their applications to heat-exchange materials and polymer nanocomposites, by Suzuki and Inukai and Ohtsuka and Takahara.

Chapter 5, by Ohtani, reviews the synthesis and applications of chalcogenide nanotubes, and Chap. 6, by Miyazawa, considers the synthesis and functions of fullerene nanotubes.

In Chapter 7, the synthesis, structure, and applications of noble-metal nanotubes are reviewed by Kijima and those of magnetic-metal nanotubes are considered by Nakagawa, Oda, and Kobayashi. Chapter 8, by Maniwa and Kataura, exhibits the formation and properties of water nanotubes. In the final chapter, several topics on the design, calculation, and/or manipulation of nanotubular materials are demonstrated using the titanium oxide and boron nitride systems by Hasegawa and by Golberg, Costa, Mitome, and Yoshio Bando, respectively.

Finally I would like to deeply thank Dr. T. Shimizu, the first editor of the Japanese version for agreeing with the translation of the inorganic and metallic parts of the Japanese version into the current English version. I would also like to thank all the authors who participated in preparing this version.
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