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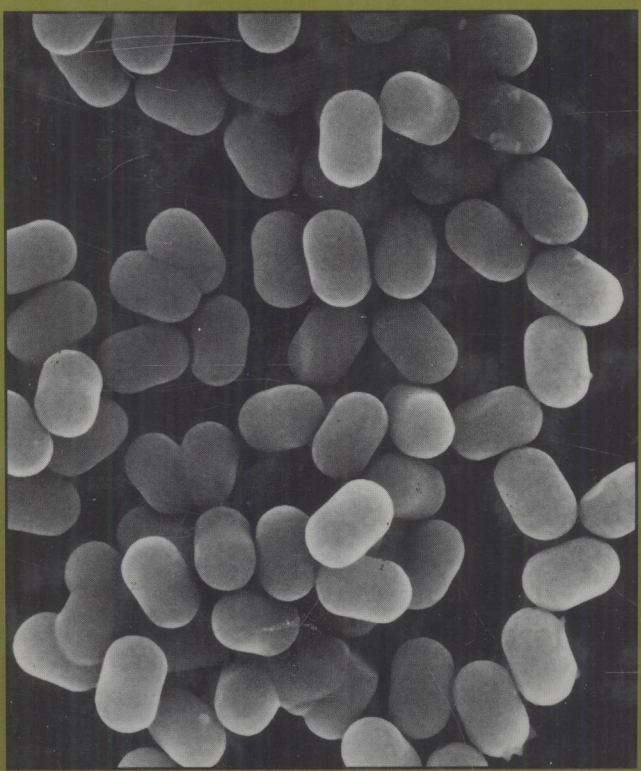
volume 92

FINE PARTICLES

Synthesis, Characterization, and Mechanisms of Growth



edited by
Tadao Sugimoto

FINE PARTICLES

Synthesis, Characterization, and Mechanisms of Growth

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Preface

Studies of the syntheses, mechanisms of formation, and properties of fine particles represent some of the essential aspects of colloid science and engineering. Although scientists have dealt with these kinds of materials for much longer than a century, a dramatic surge in general interest has occurred only recently. The reason for this appeal is the recognition of the importance of finely dispersed matter in nature and in countless applications, including ceramics, catalysts, electronics, magnetics, pigments, cosmetics, and medical diagnostics.

Since the properties of these particulate materials are basically determined by their mean size, size distribution, external shape, internal structure, and chemical composition, the science in the mechanistic study of particle formation and the fundamental technology in their synthesis and characteristic control may constitute the background for the essential development of colloid science and pertinent industries. Scientists have now learned how to form ''monodispersed'' fine particles of different shapes of simple or mixed chemical compositions, and, as a result, it is now possible to design many powders of exact and reproducible characteristics for a variety of uses. These achievements are especially important in the manufacture of high-quality products requiring stringent specification of properties.

Although many books have been published on various aspects of the science and technology of finely dispersed matter, no comprehensive text is available that covers both the fundamental mechanisms and practical procedures in the preparation and characterization of fine particles. The purpose of this book is to rectify this situation and offer a systematically organized review of the studies in this area of materials, including recent remarkable developments. This book covers the science and technology related to the preparation of fine particles in liquids and gases, with special emphasis on monodispersed particles varying in modal sizes from several nanometers to several micrometers. The chapters deal with inorganic and organic materials according to their chemical composition, including different metal compounds, such as (hydrous) oxides, chalcogenides (sulfides, selenides, tellurides), silver halides, sulfates, phosphates, apatites, carbonates, and nitrides. Other chapters describe silica, metals, carbon nanotubes, and polymer latexes. The last two chapters

are devoted to the surface modification of inorganic and organic particles and to particles of specific functions, including magnetic particles, luminous particles, and fine composite particles prepared mainly by mechanical processes. Each chapter for a chemical species consists of subsections for different synthetic methods of fine particles of the specific chemical species, in which concrete procedures of each method, analyses of the growth processes, characterization of the products, and their resulting physical or chemical properties are delineated on the basis of their causality. Wherever possible, information is offered on the mechanisms of formation and specific characteristics of each family of compounds, with indications of problems that still need to be resolved. Strong emphasis is given to extensive referencing of the relevant literature.

In view of the large variety of materials described in this volume and the numerous methods for the preparation of the fine particles of individual materials, no one author could adequately cover the entire subject matter. For this reason I asked a number of specialists in the field to contribute chapters on specific topics. It is gratifying that so many have been willing to undertake the tasks requested of them, which makes this publication truly representative of the present state of the science and engineering of finely dispersed matter. I deeply appreciate their invaluable contributions.

The objective of this volume is to cover the science and technology of particle synthesis in a comprehensive and up-to-date way by frontline contributors so that it will be useful to specialists who want to find information on the latest topics and their underlying backgrounds, with easy access to original works through the abundant references. Because the text is arranged plainly and systematically from the fundamentals to the highest levels related to particle synthesis, this book is also expected to be widely used as a textbook or reference for graduate or undergraduate students and general researchers in a wide variety of fields.

Tadao Sugimoto

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