The Science of Crystallization: Microscopic Interfacial Phenomena

W.A. Tiller
(Cambridge University Press, 1991, 391 pages).
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The Science of Crystallization: Macroscopic Phenomena and Defect Generation

W.A. Tiller
(Cambridge University Press, 1991, 484 pages).
ISBN: 0-521-38828-7 (paperback); 0-521-38139-8 (hardback)

These books are the outcome of four decades of work by the author, working at the leading edge of crystallization research both in industry and academia. Their declared aim is to serve as teaching texts rather than as scientific treatises, and through the two volumes they build up a thorough understanding of the myriad interwoven processes involved in crystal formation and growth, whether natural/geological or manufactured. The volumes may be used together or singly; the second volume on macroscopic phenomena provides an introductory chapter summarizing the main principles carried forward from its predecessor on microscopic phenomena. Both volumes are provided with a comprehensive list of the symbols used and their definitions to support the analytical approach.

The volume on microscopic phenomena is composed of two parts. The first deals with the underlying science of interfacial phenomena involved in all crystallization processes, including interfacial energetics and molecular attachment, ledge and trapping effects, interfacial solute partitioning, and thin-film formation via vapor deposition. The second part treats the thermodynamics of bulk phases and interfaces, and the principles of reaction kinetics and of nucleation phenomena.

The volume on macroscopic phenomena has two parts, the first containing chapters on convection and heat transfer, steady-state and transient solute partitioning, morphological stability, and interface morphologies. These lead to the second part, containing chapters on defect formation during both bulk and thin-film growth.

The earlier chapters in both volumes deal with basic principles and conclude with problems designed to lead students to a quantitative understanding of the phenomena involved and help them learn to make useful quantitative appraisals. Although the principles and phenomena described in the two volumes are widely applicable, the author applies them, wherever possible, to the processing of silicon, with less frequent references to other materials (such as compounds and metals) for contrast and breadth. The books should particularly interest those involved in semiconductor processing and solid-state electronics, although they are evidently intended to be used primarily as texts for the relevant advanced courses in chemistry, chemical engineering, materials science, metallurgy and geology, as well as electrical and electronic engineering and solid-state physics.

The range of the material certainly exceeds that covered by any previous text in the field, and the approach is distinctive. These books should definitely be on the shelves of every library where teaching and research on crystallization are conducted, and the modest cost of the paperback editions should encourage students and practitioners to acquire copies for their own bookshelves. These volumes are very welcome additions to the limited number of authoritative texts in this subject area.

Reviewer: Howard Jones is a professor in the Department of Engineering Materials, University of Sheffield, England.

Hydrogenated Amorphous Silicon

R.A. Street
(Cambridge University Press, 1991, 480 pages).
ISBN: 0-521-37156-2

When I receive a book to review I always ask myself "Would I buy it for myself?", and "Would I recommend it to my library?" The answer to both questions in the case of this book is a very definite "yes." Although reasonably expensive at $110, even for a scientific text, the book is an excellent investment for all those interested in a clear account of the properties and a basic understanding of this increasingly important material. With the Japanese investing over $4 billion in fiscal year 1991/92 in only one of its applications (namely, the active matrix array for liquid crystal displays in portable computers, video screens, etc.), amorphous silicon is clearly a material of considerable and rapidly growing importance.

The author has written a remarkably comprehensive account of the plasma-enhanced chemical vapor deposition of amorphous silicon, its properties, and the models used to interpret these. As a consequence, there are places where some effort is required to follow the subtle arguments. Nevertheless, the author clearly has a remarkable understanding of the basic science of amorphous silicon, and he conveys this to those who persevere with his text. The book is not intended, nor is it suitable, for a general or undergraduate audience wishing to know why this material is of growing commercial importance. Rather, those doing research or about to commence research on this material will find the book superbly crafted and beautifully written, not only in those areas where the author has made major contributions to our understanding but throughout the text. The only flaw I could find with this book, aside from its cost, is a relatively minor one—the history of the field as given by Street differs from my recollection in many ways. However, this should not detract from a very firm recommendation of this book for individuals and institutions claiming any real involvement with this fascinating amorphous material.

Reviewer: The late Peter G. LeComber was Harris Professor of Physics in the Department of Applied Physics and Electronic and Manufacturing Engineering, University of Dundee, Scotland.

Chemical Synthesis of Advanced Ceramic Materials

David Segal
(Cambridge University Press, hardback edition 1989, 170 pages; paperback edition 1991, 200 pages).
ISBN: 0-521-35436-6

Major injections of chemical thinking into the technology of ceramic fabrication have been prompted by the need to prepare ceramic materials with microstructures closely fitted for application (i.e., coatings, multilayers, superconductors, electrolyte membranes, sensors, engine parts, prostheses, and wear parts) and the need to achieve greater reliability in such applications. This research movement has been extensively reported in conference proceedings and refereed journals, but David Segal brings this diverse and complex theme into textbook format for the first time. The success of the hardback volume has allowed its publishers to enhance the accessibility of the text by issuing this present paperback version.

After three opening chapters of discussion on ceramic systems, their applications, and their preparation by conventional routes, the book deals with the main patterns by which chemical methods have been used to prepare high-performance ceramics. These include the use of sol/gel methods involving the control of colloids, sol/gel processes involving the hydrolysis and condensation of alkoxides, the cross-linking and pyrolysis of organic precursors for fabrication of non-

oxide ceramics, and the use of gas phase reactions. There are additional chapters on hydrothermal synthesis and non-aqueous liquid phase reactions, with an appendix on the determination of powder particle size. The chapters deal predominantly with the methods for fabricating powders that can then be introduced into subsequent forming and sintering processes, the powders being especially suitable by virtue of their homogeneity, size, size distribution, and shape. Attention also is given to the so-called "powder-free" preparation routes in which chemistry provides methods for direct precursor to component conversion.

The book brings into perspective the different methods and mentions each of the major research directions. The comprehensive references are also a helpful guide to the wider literature.

Reviewer: Richard J. Brook is Cookson Professor of Materials Science in the Department of Materials, Oxford University, England. □

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