

Science of Ceramic Chemical Processing

L. L. Hench and D. R. Ulrich (Eds.)

J. Wiley and Sons, New York, 1986, xxi + 594 pages, US\$90.30, £61.80, ISBN 0-471-82645-6

Chemical-based processing of ceramics, glasses and composites has become one of the most actively pursued and rapidly evolving areas of research in materials science and engineering. The objective of this intense activity is to develop a new generation of high-performance materials.

The present volume is based on the Proceedings of the Second International Conference on Ultrastructure Processing of Ceramics, Glasses and Composites held from 25 February to 1 March, 1985, in Palm Coast, Florida. It comprises sixty papers and is divided into six parts devoted to sol-gel science, applications of sol-gel processing, materials from organometallic precursors, ultrastructure in macromolecular materials, micro-morphology science and quantum chemistry. Three of the papers are based on Keynote lectures delivered at the Conference by the distinguished scientists Ralph K. Iler, Paul J. Flory and Per. Olov Löwden, the titles of their contributions being, respectively, 'Inorganic Colloids for Forming Ultrastructures', 'Network Theory and Gelation', and 'New Directions in Quantum Chemical Calculations - Particularly as to New Materials'.

Part 1 consists of 19 papers on sol-gel science and includes such topics as the sol-to-gel and gel-to-glass conversions, hydrolysis and polymerization mechanisms and kinetics, rheological studies, structure and physical and chemical properties of gels, drying of gels and sintering studies of silica aerogels. Part 2 contains 16 papers on various applications of the sol-gel process including the production of glass and ceramic thin films, fibres, monoliths, powders, substrate materials, disphasic gels and glass and ceramic matrix composites. In Part 3 there are 8 papers on various aspects of the chemistry of organometallic precursors to such important ceramics as silicon carbide and silicon nitride. Among the topics discussed are crosslinking and pyrolysis of silane precursors for silicon carbide, a novel polymeric organosilazane precursor to $\text{Si}_3\text{N}_4/\text{SiC}$ ceramics, electrochemical and sonochemical routes to organosilane precursors and new routes to cyclic spiro-siloxanes. Part 4 is devoted to macromolecular materials and contains six articles, which include such topics as conducting polymers, polymer thin films, ordered polymers and

molecular composites and particle/polymer suspensions. Part 5 is mainly concerned with colloidal ceramic systems. There are ten papers discussing, for example, synthesis and processing of fine ceramic powders (oxides and non-oxides), structures of colloidal solids, rheological science in ceramic processing and the influence of particle arrangement on sintering. The book concludes with a short section on quantum chemistry (Part 6).

The publication of this most useful volume is timely in view of the considerable efforts currently being made to apply the various traditional branches of chemistry, both separately and in combination, to the development of new processing methods for ceramic materials. This book, which is a companion to 'Ultrastructure Processing of Ceramics, Glasses and Composites' (Wiley, 1984), will be of particular interest to research workers in the field of chemical processing of materials. It will remain a valuable compilation of information for years to come.

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Synthetic Polymeric Membranes: A Structural Perspective

R. E. Kesting

2nd Edn, Wiley-Interscience, New York, 1985, xi + 348 pages, US\$80.50, £55.15, ISBN 0-471-80717-6

The first edition of this book, published in 1971, remained unique for fifteen years as the only textbook devoted wholly to the preparation and description of polymeric membranes. Much progress has been made since 1971 and this new edition is essentially a new book. It has no competitor and is essential reading for anyone concerned with developing membranes for separation processes. Despite, perhaps because, of this monopoly position it should not escape critical assessment.

The immense complexity of the molecular processes, governed by thermodynamics and kinetics, that occur during the formation of a polymer membrane has limited the level of scientific understanding achieved so far, while a bewildering mass of experimental observations has accumulated on the properties of membranes formed from multicomponent systems. As a result, any

attempt to reduce this information to a coherent text is bound to depend as much on art and informed speculation as on established scientific principles. Dr Kesting is better able than other authors to suggest explanations for groups of empirical facts which seem to work, even in a limited predictive sense, although they would be hard to defend in terms of established polymer physical chemistry.

The book opens with a historical review, fuller than in most books on membrane science, and a short market and literature survey on membrane processes. Two chapters follow, which deal briefly with the main uses of membranes in separations, sensors, batteries and medicine. While a few theories are mentioned the approach is mainly descriptive.

The next two chapters deal with polymer physical chemistry, shaped for dealing with membranes. The first of these deals with the structures of polymer molecules. It is relatively conventional and covers a lot of ground in a single section, 4.1, which would benefit from subdivision. The same applies to 4.2, which deals with particular membrane polymers, common and uncommon. This chapter also contains, rather incongruously, a section on the structure of liquid water and its interaction with polymers.

The chapter on polymer solutions is remarkable for its concentration on polymer-solvent interactions and complete omission of configurational entropy. Any reader should approach this chapter only after studying the basic texts of Flory and others. However, it contains a wealth of information on specific solvent systems, and how and why they have been developed, which could not be found from any other source, except perhaps by months of study of patent literature.

The second half of the book deals in five chapters with particular classes of membranes, categorized primarily by methods of preparation. It is probably reasonable to assume that the reader of such a specialized text will be already well versed in the basic principles of membrane structure and what types are preferred for each process. A reader lacking that knowledge would find these chapters hard to follow. The chapter on dense membranes is almost wholly concerned with polymer crystallization and what influences it. The treatment of phase inversion membranes shows, as in the first edition, Dr Kesting's remarkable ability to see the wood for the trees in this complicated topic, which is so burdened with factual information. His account gives one a very good feeling for what is going on. It makes no concessions to theory, for example spinodal decomposition is mentioned, but no attempt is made to deal with it, perhaps because the author feels that molecular kinetics

dominates thermodynamics at all the important moments in membrane formation. This chapter also contains a brief account of thin-film composite membranes.

Finally, three short chapters deal with membranes made from pure polymers by mechanical processing and track etching, liquid and dynamic membranes, and biological membranes leading up to polymerized vesicles.

The book is well produced and has a subject index only. It would have benefited by having a section describing the technology of membrane production on the industrial scale. Space could have been made for this by omitting the sections relating to ion-exchange membranes and their uses. They are better treated in other books.

Despite these comments the hard work of Dr Kesting has put in to update his first book should be welcomed by all membrane scientists who will deprive only themselves if they do not take full advantage of its many virtues.

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Encyclopedia of Polymer Science and Engineering

J. I. Kroschwitz, H. F. Mark,
N. Bikales, C. G. Overberger
and G. Menges (Eds.)
John Wiley and Sons, New
York, 1985, 906 pages,
US\$240, £170,
ISBN 0-471-89540-7

Some 23 years have elapsed since the initial publication of this multi-volumed work, and the appearance of a new edition is a major event in polymer science.

This encyclopedia has been the major reference work on polymers for the past two decades, and the new edition, which has been completely rewritten and extended, reflects the great changes that have occurred. The encyclopedia will remain the prime reference work on polymers and their technology and engineering applications. The new edition will comprise 19 volumes of about 850 pages each, and the series is scheduled to be completed by mid-1989.

The topics in the first volume – A to amorphous polymers – include many articles of major interest to both polymer scientists and technologists. A few of the many outstanding articles that may be selected for their special interests are: abrasion and wear; acetal resins; acoustic properties; acrylic polymers, elastomers and fibres (270 pages); acrylonitrile polymers (182 pages); adhesion and adhesives (100 pages) and amorphous polymers (182 pages).

The standard of the individual articles – some of which rank as the equivalent of a text book in size and content – is uniformly excellent, and all are authoritative and well produced. The volume as a whole is very satisfactory, and will undoubtedly grow in usefulness with the publication of subsequent volumes.

This series will undoubtedly be a welcome, valuable, and essential addition to all scientific and industrial libraries.

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Polymer Products: Design, Materials and Processing

D. H. Morton-Jones and
J. W. Ellis

Chapman & Hall Ltd., London,
1986, xvi + 345 pages, £19.95,
ISBN 0-412-27130-3

The aim of this book is to introduce students to many aspects of polymer engineering by the novel use of actual illustrative examples. Case studies of successful products are presented, which include details of design, the selection of materials and the manufacturing process. It is hoped that difficult concepts introduced by means of relevant practical applications will be easier for students to grasp.

The book derives from a project undertaken at the University of Lancaster and is one of a number of initiatives taken by the SERC to integrate more fully academe and industry, a weakness in Britain highlighted by the Finniston Report. It is all too easy for lecturers, particularly those who have themselves become remote from industry, to resort to theoretical rather than applied topics. Furthermore, most students find it easier to become skilled in reproducing and manipulating mathematical proofs than tackling real technological problems. Such circumstances can lead to a rather undemanding educational process, but which is apparently cloaked in academic respectability. By providing this collection of case histories both the authors and the sponsoring body clearly hope to break the mould and encourage the development of problem-solving skills.

Altogether there are some two dozen case histories of very varying nature. They include the design of injection-moulded clips and gear wheels, a washing

machine tank made from glass-coupled polypropylene structural foam, printed gaskets for hydraulic control equipment, a high-speed train cab, DMC vehicle headlamps, a mine belt 28.8 km in circumference, a blow-moulded acid container and heat shrinkable terminations for cables. A wide variety of polymer processes are encountered, whilst many facets of polymer science as well as conventional chemistry, physics and engineering are invoked.

Very sensibly, the authors have grouped the case histories, for example, the first group all involve injection moulding, the second are all foam core mouldings, and the fourth glass-reinforced plastics. Each collection is preceded by a short chapter outlining relevant aspects of polymer science and technology. One of my few criticisms is that of necessity such outlines are very brief and I believe that the more inquisitive reader would appreciate more references to detailed background reading.

Sometimes I found it rather difficult to follow the written description of a process or product and a few more illustrations should have made things clearer. My uncertainty here is that I found some of the diagrams confusing. For example, the homofocal lamp drawings on pp. 202–3 left me quite baffled.

Notwithstanding these criticisms I believe that the authors are to be congratulated on their contribution to the literature, and one can only hope that this turns out to be only the first of a series of similar publications.

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Polymer Science and Technology, Vol. 32: Polymeric Materials in Medication

C. G. Gebelein and
C. E. Carraher, Jr (Eds.)
Plenum Press, New York,
1985, viii + 302 pages,
US\$63, £39.38,
ISBN 0-306-42115-1

This book is based on the proceedings of an ACS Polymer Materials Division Symposium and comprises 22 chapters. An index and full details of contributions are included.

Beginning with methodologies (Gebelein) and body tissue reactions (Marchant & Anderson) the reader is prepared for the remainder of applications chapters. The introductory chapter is a useful outline of systems in vogue. The chapter from Marchant and