

The Science of Polymer Molecules

R.H. Boyd and P.J. Phillips
(Cambridge University Press, 1993, 410 pages).
ISBN: 0-521-32076-3

Polymer science is the interdisciplinary subject *par excellence*—chemists, chemical engineers, materials scientists, physicists, and mathematicians have all contributed to the subject and still research it. The wide range of disciplines that polymer science encompasses makes the task of the author of an introductory textbook very demanding. The problem is how to fairly represent all the different currents of thinking in polymer science but still remain accessible to the wide range of potential readers' backgrounds and yet produce a book of reasonable length.

Boyd and Williams have taken the view that the core of polymer science is to be found in the behavior of individual molecules rather than in the collective behavior of polymers in bulk phases—thus the title and emphasis of their book. My own view is that this restriction would be too limiting if rigidly followed, for in virtually no other class of materials are the bulk macroscopic properties so closely related to the behavior of individual molecules. I am thus relieved that the authors broke their own ordinance in a number of areas. A clear section on rubber elasticity is provided, albeit with a slight apology in the preface. No apology should be needed, as the theory of rubber elasticity is a beautiful and elementary example of the way statistical mechanical methods based on molecular ideas can explain the bulk properties of a condensed phase. A section about the origin of polymer solution viscosity is smuggled in under the guise of a characterization method, and there is a comprehensive discussion of the thermodynamics of polymer solutions and melts. Here the mutual interaction between many polymer chains is the essence of the problem; both mean-field and scaling methods receive fair coverage.

However, the authors' main aim is to provide a clear presentation of mainstream polymer physical chemistry. Despite the deviations from their stated aim that I have mentioned, the authors have still succeeded in providing a book which covers important topics in reasonable length. The characterization of molecular weight distributions and the kinetics of polymerization receive detailed attention, but the largest section of the

book is devoted to the question of the local conformation of macromolecules. This reflects a resurgence of interest in this area, perhaps a side-effect of the growing importance of computer molecular modeling.

Interdisciplinary subjects can also generate tensions; the different disciplines that contribute to a subject will have very different approaches to problems. In many cases there are even different views of what the problems are. Polymer science is no exception to this. The dialogue between chemists, materials scientists, and physicists has been creative but there has often been mutual misunderstanding. Some of this tension is detectable in this book; a nice example occurs in the discussion of gelation, where classical theory and modern percolation ideas are both well presented, but some skepticism is detectable from the authors about the relevance of the latter approach.

Perhaps these authors are right in their pessimistic view that no single book can usefully cover all of polymer science. Not everybody will agree with their view of what topics should be selected for an introductory text; nonetheless those readers looking for a clear introduction in depth to many of the core topics of polymer physical chemistry will find this book very useful.

Reviewer: Richard Jones is a lecturer at the Cavendish Laboratory, University of Cambridge.

Wear—35th Anniversary Issue: Novel Aspects of Wear

Edited by Duncan Dowson
(Elsevier Sequoia, 1992, 304 pages).
ISBN: 0-444-75090-8

The title of this volume is an open invitation to examine the contents for novelty. Using Webster's definition of novel, "new and not resembling something formerly known or used," as a rigid criterion, a review of the contents suggests that about half the papers represent truly novel aspects of wear. This evaluation, however, is not to disparage the remaining, somewhat less novel offerings, which succeed in providing vital knowledge of important facets of tribology.

Among the novel contributions to this volume are a discussion of large-scale molecular dynamics simulations of interactions of material contacts, investigation of bubble formation and collapse in thin lubrication films, direct measurements of the occurrence and persistence of thin

lubricant films in concentrated contacts, and the calculation of the formation of pressure variations within a concentrated contact. In fact, most of the novel topics seem to be related to the investigation of close contacts and the lubricant films associated with them. Other valuable, albeit less novel, papers contained in this work consider fretting, friction of diamond, unlubricated sliding wear of steels, an oxidation wear model for steels, wear of polytetrafluoroethylene (PTFE), aluminum hydroxide formation on alumina during wear, and micromechanisms of abrasive wear. In sum, the topics included in this collection range from atomistic considerations at asperities to the macroscopic effects of sliding wear in steel, alumina, and a polymer.

A professional level of writing is found in these papers, prepared by leaders in the field presenting their most recent results. In addition, several of the papers include reviews of previous work in the field as background to the current work discussed. In fact, the first paper in the volume contains introductory remarks that serve as a brief history of the field of tribology, and although the authors deny any desire to engage in a historical account, their comments, combined with the relevant references, lead the reader to as much of the tribological past as might be of interest. The papers included in this volume are clearly intended for serious students of tribology.

The overall quality of the book is excellent, both in intellectual content and in physical form. The greatest lapse in the former was the lack in identifying the principal material studied in one of the papers, other than by reference to previous work. With respect to the latter, the very high quality of the paper provides excellent reproduction of photographs, a feature so important to the presentation of tribological information. Drawings and graphs are also legible and uniform in appearance.

It is difficult for the individual to maintain a personal library of technical journals. A volume such as this, however, provides a valuable summary of many of the current and pertinent issues in the field, and merits a place on the serious tribologist's bookshelf.

Reviewer: Charles S. Yust is a senior research staff member at Oak Ridge National Laboratory. He has been engaged in friction and wear research, primarily on ceramics, since 1979.

The following recently published books and journals, relevant to materials science, have come to the *MRS Bulletin's* attention. Some of the books listed here may be reviewed in future issues of the *MRS Bulletin*.

Books

Composites: An Insider's Technical Guide to Corporate America's Activities, 2nd ed. Turner Moss, New York, 1994. Paperback, 434 pp, \$149.00, ISBN 0-9623228-5-7.

Continuous Casting of Steel, W.R. Irving, Institute of Materials, London, 1993. Hardcover, 207 pp, \$90.00, ISBN 0-901716-53-7.

Conversion of Polymer Wastes & Energetics, H.H. Krause and J.M.L. Penninger, eds. Chem-Tech Publishing, Toronto-Scarborough, 1994. Hardcover, 134 pp, \$78.00, ISBN 1-895198-06-2.

Corrosion and Related Aspects of Materials for Potable Water Supplies, P. McIntyre and A.D. Mercer, eds. Institute of Materials, London, 1993. Hardcover, 282 pp, \$160.00, ISBN 0-901716-47-2.

Effects of Explosions on Materials: Modification and Synthesis Under High-Pressure Shock Compression, S.S. Batsanov. Springer-Verlag, New York, Berlin, 1994. Hardcover, 194 pp, \$98.00, ISBN 0-387-94123-1.

Engineering Materials Technology: Structure, Processing, Properties & Selection, 2nd ed., J.A. Jacobs and T.F. Kilduff. Prentice Hall, Englewood Cliffs, New Jersey, 1994. Hardcover, 634 pp, ISBN 0-13-278284-7.

Ferromagnetic Materials: Structure and Properties, R.A. McCurrie. Academic Press, London, San Diego, 1994. Hardcover, 297 pp, \$45.00, ISBN 0-12-482495-1.

Fractal Surfaces, J.C. Russ. Plenum Press, New York, 1994. Hardcover, 309 pp, \$55.00, ISBN 0-306-44702-9. Includes diskette.

High Temperature Component Life Assessment, G.A. Webster and R.A. Ainsworth. Chapman & Hall, London, New York, 1994. Hardcover, 327 pp, £69.00, ISBN 0-412-58520-0.

Introduction to the Electronic Properties of Materials, D. Jiles. Chapman & Hall, London, New York, 1994. Paperback, 372 pp, £22.50, ISBN 0-412-49590-2.

Materials Science and Engineering Handbook, 2nd ed., J.F. Shackelford, W. Alexander, and J.S. Park, eds. CRC Press, Boca Raton, 1994. Hardcover, 1,532 pp, \$99.95, ISBN 0-8493-4250-3.

Microanalysis of Solids, B.G. Yacobi, D.B. Holt, and L.L. Kazmerski, eds. Plenum Press, New York, 1994. Hardcover, 460 pp, \$95.00, ISBN 0-306-44433-X.

Microscopy of Oxidation 2, *Proc. 2nd Intl. Conf. on Microscopy of Oxidation, Cambridge, March 1993*, S.B. Newcomb and M.J. Bennett, eds. Institute of Materials, London, 1993. Hardcover, 593 pp, \$170.00, ISBN 0-901716-50-2.

Modifications of Passive Films, *Proc. European Symposium on Modifications of Passive Films, Paris, February 1993*, P. Marcus, B. Baroux, and M. Keddam, eds. Institute of Materials, London, 1994. Paperback, 343 pp, ISBN 0-901716-52-9.

Nanoceramics, R. Freer, ed. Institute of Materials, London, 1993. Hardcover, 211 pp, \$115.00, ISBN 0-901716-41-3.

Optical Materials, R.M. Wood. Institute of Materials, London, 1993. Hardcover, 131 pp, \$50.00, ISBN 0-901716-44-8.

Physics of New Materials, F.E. Fujita, ed. Springer-Verlag, New York, Berlin, 1994. Hardcover, 304 pp, \$79.00, ISBN 0-387-56851-4.

Polymer Surfaces: From Physics to Technology, F. Garbassi, M. Morra, and E. Occhiello, eds. Wiley & Sons, Chichester, United Kingdom, New York, 1994. Hardcover, 462 pp, \$89.95, ISBN 0-471-93817-3.

Powder Metallurgy Science, 2nd ed., R.M. German. Metal Powder Industries Federation, Princeton, New Jersey, 1994. Hardcover, 472 pp, \$60.00, ISBN 1-878954-42-3.

Quenching and Carburising, *Proc. 3rd Intl. Seminar of the Intl. Federation for Heat Treatment, Melbourne, 1991*. Institute of Materials, London, 1993. Hardcover, 309 pp, \$130.00, ISBN 0-901716-51-0.

Real Structure of High-T_c Superconductors, V.S. Shekhtman, ed. Springer-Verlag, New York, Berlin, 1993. Hardcover, 189 pp, \$89.00, ISBN 0-387-56559-0.

Reversible Crystal Plasticity, V.S. Boyko, R.I. Garber, and A.M. Kossevich. American Institute of Physics, New York, 1994. Hardcover, 294 pp, \$85.00, ISBN 0-88318-869-4.

Semiconductor Growth, Surfaces and Interfaces, G.J. Davies and R.H. Williams, eds. Chapman & Hall, London, New York, 1994. Hardcover, 158 pp, £30.00, ISBN 0-412-57730-5.

Semiconductor-Laser Physics, W.W. Chow, S.W. Koch, and M. Sargent III. Springer-Verlag, New York, Berlin, 1994. Hardcover, 497 pp, \$49.95, ISBN 0-387-57614-2.

Structure and Properties of Polymeric Materials, D.W. Clegg and A.A. Collyer. Institute of Materials, London, 1993. Hardcover, 296 pp, \$70.00, ISBN 0-901716-39-1.

Surface Analysis by Electron Spectroscopy, G.C. Smith. Plenum Press, New York, 1994. Hardcover, 160 pp, \$49.50, ISBN 0-306-44806-8.

Surface and Colloid Chemistry in Advanced Ceramics Processing, R.J. Pugh and L. Bergström, eds. Marcel Dekker, New York, 1994. Hardcover, 363 pp, \$145.00, ISBN 0-8247-9098-7.

Theory of CMOS Digital Circuits and Circuit Failures, M. Shoji. Princeton Univ. Press, Princeton, New Jersey, 1994. Hardcover, 596 pp, \$79.50, ISBN 0-6910-8763-6.

Vacuum Methods in Electron Microscopy, W.C. Bigelow. Portland Press, London, 1994. Hardcover, 492 pp, \$175.00, ISBN 1-85578-053-4.

VLSI for Neural Networks and Artificial Intelligence, J.G. Delgado-Frias and W.R. Moore, eds. Plenum Press, New York, 1994. Hardcover, 320 pp, \$85.00, ISBN 0-306-44722-3. □

Positions Wanted

The following advertisements are from MRS members seeking employment in materials research and development.

PROSPECTIVE EMPLOYERS—
To correspond confidentially with the applicant,
REPLY TO THE APPROPRIATE
BOX NUMBER, AS FOLLOWS:

Box _____, No. _____,
c/o MRS Bulletin
Materials Research Society
9800 McKnight Road
Pittsburgh, PA 15237-6006

MS in electrical engineering (with background in materials science) seeks position in the semiconductor industry. Expertise in CVD, rapid thermal processing of electronic materials; process development and simulation (SUPREM III/IV); RTP/CVD equipment design and development. Industrial experience in VLSI design; very good computer hardware/software skills. **Employers—Please reply to Box XIX, 802.**

Polymer Chemist/Engineer, PhD, Postdoctoral. Seeking a position in plastics manufacturing. Experienced in synthesis of high-performance thermoplastics and thermosets; fabrication of composites, foams, fibers, adhesives; prototype design; pilot plant scale-up; analytical, thermal, mechanical testing. **Employers—Please reply to Box XIX, 801.**

PhD in materials science and engineering (1994) seeks industrial/academic position. Extensive experience in processing (sputtering, evaporation, diffusion bonding), microstructural analysis (TEM, SEM, XPS, AES, XRD, AFM) and mechanical testing (fiber pushout, four-point bending, nanoindentation, tribology) of metal/ceramic composites, thin films, biomaterials, and alloys. Seven first-author journal publications. Ten plus first-author proceedings papers and presentations. **Employers—Please reply to Box XIX, 804.**

PhD seeks industrial/academic research position. Three years postdoctoral research experience. Substantial experience with pulsed laser ablation of HTSC, plasma CVD of dielectric films, post processing using focused ion beam and ion implantation, UHV techniques, computer automation in manufacturing and control, and computer simulation of growth using parallel computers. **Employers—Please reply to Box XIX, 805.**

Process Chemist. Experience in technical support and R&D of manufacturing processes for 15 years: MLC package fabrication, slip formulation for tape casting and spray drying, powder evaluation, thick and thin film metallization, instrumental analysis, electrochemistry, furnacing, computer skills. BS *cum laude* in chemistry. Consulting and interim projects considered. **Employers—Please reply to Box XIX, 803.**