

**Understanding Materials Science**

Rolf E. Hummel

(New York, Springer-Verlag, 1998)

xiv + 407 pages

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As I remarked in an earlier review some years ago, of books about materials science or the meaning of life, there is no end. Recently, a number of books have appeared presenting materials science in a mildly elementary manner linked to very recent scientific advances [I. Amato, *Stuff*; P. Ball, *Made to Measure*]. Amato connects present knowledge to historical origins (he distinguishes an empirical era from the present, sophisticated age), while another very recent book by S. Sass [*Substance of Civilization*], aimed at entirely nonscientific readers and avoiding equations like the plague, examines the bronze age, iron age, etc. in terms of how these materials affected daily life and the grand sweep of history. So...the history of materials is on the way to becoming a new orthodoxy.

The three recent books mentioned above are none of them textbooks—they are aimed at the interested general reader, though Ball's reader needs to be pretty sophisticated. Hummel has written what is forthrightly a textbook—as he says himself, for “engineering, physics and materials science students”—in which elementary but unashamedly quantitative explanations of phenomena are linked, again and again, to historical eras, the history of the growth of understanding and control, and fashionable issues of environment, substitution of materials, recycling and reserves of raw materials. For the listed groups, this book is clearly intended to be a scientific introduction to more advanced studies later on...but the author goes on to express the hope that a sizable readership will also come from the humanities, and that such readers will not shy away from the hard science. This is a first-class book, but—alas—I fear that this last hope is quixotic. Stephen Hawking was told, before he wrote his popular book on the theory of everything, that every equation would halve his readership; so he put in only one equation. Hummel has lots of equations, but nevertheless perhaps he will fare better; after all, unlike Hawking, he is not seeking to enter into the mind of God.

Hummel cunningly alternates scientific chapters with historical ones, although at intervals he mingles the two approaches: thus, in chapter 15, “history of glass-making” is immediately followed by “scientific aspects of glass-making.” He has succeeded admirably, to my mind, in rendering intrinsically complicated topics, such as polymerization, palatable and digestible. Thus, nine pages are devoted to agreeable “tales about plastics.” Yet, in those places where he introduces his read-

er to really complicated topics, such as optical or thermal properties, he does not shy away from going relatively deep; his treatment of the theory of lasers is exemplary, at his chosen level of depth.

This mix of proper science and respectable history is something new among the plethora of materials science books; it is based upon enormous reading (the lists for Further Reading are of exceptional quality and breadth) and careful reflection. As a first-level introduction to materials science I can recommend it unreservedly; it is a far cry indeed from the collection of pictures of reverberatory furnaces and the like with which I was introduced to metallurgy almost sixty years ago. Nevertheless, it is a very open question how far the history provided here will attract hard-headed scientists (and even more hard-headed engineers) whose exposure to the past in their schooldays may well have been minimal. It is also an open question whether many students of the humanities will have the courage to stay the course through the scientific bits; and they may be tempted to scoff at the history because it is not sociological and relativistic enough for their taste. Much will depend on the quality and dedication of the teachers who use this as a teaching-text: but really, they should try!

*Reviewer: Robert Cahn is a physical metallurgist turned materials scientist, currently attached in nominal retirement to Cambridge University. He has researched on intermetallics and many other metallurgical themes, has edited a number of journals and book series devoted to materials science, and has striven over the years to popularize materials science in the pages of Nature. He is a member of the Editorial Board and the Book Review Board of MRS Bulletin. This review is reprinted with permission from Euromaterials.*

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

**Books**

**Advances in Chemical Physics**, I. Prigogine and S.A. Rice, eds. John Wiley & Sons, New York, 1998. Cloth, 316 pp., \$125.00, ISBN 0-471-29338-5.

**Advances in Cryogenic Engineering**, Vol. 43, Parts A & B, P. Kittel, ed. Plenum, 1998. Cloth, 2,103 pp., \$275.00, ISBN 0-306-45807-1.

**Applied Superconductivity**, H. Rogalla and D.H.A. Blank, eds. Institute of Physics Publishing, United Kingdom, 1997. Cloth, 1,750 pp., \$495.00, ISBN 0-750-30487-1.

**Basic Vacuum Technology**, 2d ed., A. Chambers,

R.K. Fitch, B.S. Halliday, eds. Institute of Physics Publishing, United Kingdom, 1998. Cloth, 195 pp., \$45.00, ISBN 0-750-30495-2.

**CALPHAD (Calculation of Phase Diagrams): A Comprehensive Guide**, Vol. 1, N. Saunders and A.P. Miodownik, eds. Elsevier Science Ltd., New York, 1998. Cloth, 487 pp., \$180.00, ISBN 0-080-42129-6.

**Cemented Tungsten Carbides**, G.S. Upadhyaya, ed. Noyes Publications, New Jersey, 1998. Cloth, 411 pp., \$72.00, ISBN 0-815-51417-4.

**Cements Research Progress**, L.J. Struble, ed. The American Ceramic Society, Westerville, OH, 1998. Paper, 288 pp., \$75.00, ISBN 1-574-98081-5.

**Comprehensive Cellulose Chemistry**, Vol. 1, D. Klemm, B. Philipp, T. Heinze, U. Heinze, and W. Wagenknecht, eds. John Wiley & Sons, New York, 1998. Cloth, 272 pp., \$170.00, ISBN 3-527-29413-9.

**Current Problems in Condensed Matter**, J.L. Morán-López, ed. Plenum Press, New York, 1998. Cloth, 364 pp., \$125.00, ISBN 0-306-45915-9.

**Electrochemistry**, C.H. Hamann, A. Hamnett, and W. Vielstich, eds. John Wiley & Sons, New York, 1998. Paper, 432 pp., \$61.95, ISBN 3-527-29096-6.

**Electron Liquids**, 2d ed., A. Isihara, ed. Springer, New York, 1998. Cloth, 326 pp., \$65.00, ISBN 3-540-62789-8.

**Electronic Materials: The Oligomer Approach**, K. Müllen, and G. Wegner, eds. John Wiley & Sons, New York, 1998. Cloth, 613 pp., \$145.00, ISBN 3-527-29438-4.

**Elements of Rapid Solidification**, M.A. Otooni, ed. Springer, New York, 1998. Cloth, 254 pp., \$96.00, ISBN 3-540-61791-4.

**Encyclopedia of Polymer Science and Engineering (Concise)**, H.F. Mark, ed. John Wiley & Sons, New York, 1998. Paper, 1,356 pp., \$150.00, ISBN 0-471-31856-6.

**Engineering Flow and Heat Exchange**, rev. ed., O. Levenspiel, ed. Plenum Press, New York, 1998. Cloth, 387 pp., \$89.50, ISBN 0-306-45682-6.

**Fundamentals of Electrochemical Deposition**, M. Paunovic and M. Schlesinger, ed., John Wiley & Sons, New York, 1998. Cloth, 306 pp., \$64.95, ISBN 0-471-16820-3.

**Gate Dielectrics and MOS ULSIs Principles, Technologies and Applications**, T. Hori, ed. Springer, New York, 1997. Cloth, 360 pp., \$79.95, ISBN 3-540-63182-8.

**GC/MS: A Practical User's Guide**, M. McMaster, C. McMaster, eds. John Wiley & Sons, New York, 1998. Cloth, 170 pp., \$59.95, ISBN 0-471-24826-6.

**Handbook of Applied Superconductivity**,

*Vols. 1 & 2*, B. Seeber, ed. Institute of Physics Publishing, Philadelphia, 1998. Cloth, 2,329 pp., \$545.00, ISBN 0-750-30377-8.

**Handbook of Physical Vapor Deposition (PVD) Processing: Film Formation, Adhesion, Surface Preparation and Contamination Control**, D.M. Mattox, ed. Noyes Publication, New Jersey, 1998. Cloth, 943 pp., \$125.00, ISBN 0-815-51422-0.

**Hybrid Microcircuit Technology Handbook: Materials, Processes, Design, Testing, and Production 2d ed.**, J.J. Licari, L.R. Enlow, eds. Noyes Publications, New Jersey, 1998. Cloth, 598 pp., \$86.00, ISBN 0-815-51423-9.

**Imaging Phonons: Acoustic Wave Propagation in Solids**, J.P. Wolfe, ed. Cambridge University Press, New York, 1998. Cloth, 423 pp., \$110.00, ISBN 0-521-62061-9.

**Inorganic Syntheses, Vol. 32**, M.Y. Darensbourg, ed. John Wiley & Sons, New York, 1998. Cloth, 352 pp., \$80.00, ISBN 0-471-24921-1.

**Introduction to Ionomers**, A. Eisenberg and J.S. Kim, eds. John Wiley & Sons, New York, 1998. Cloth, 347 pp., \$99.95, ISBN 0-471-24678-6.

**Lattice Models of Polymers**, C. Vanderzande, ed. Cambridge University Press, New York, 1998. Paper, 232 pp., \$34.95, ISBN 0-521-55993-6.

**Lime and Limestone: Chemistry and Technology, Production and Uses**, J.A.H. Oates, ed. John Wiley & Sons, 1998. Cloth, 470 pp., \$199.00, ISBN 3-527-29527-5.

**Local Structure from Diffraction**, S.J.L. Billinge and M.F. Thorpe, eds. Plenum, New York, 1998. Cloth, 404 pp., \$120.00, ISBN 0-306-45827-6.

**Macroscopic Quantum Tunneling of the Magnetic Moment**, E.M. Chudnovsky and J. Tejada, eds. Cambridge University Press, New York, 1998. Cloth, 183 pp., \$54.95, ISBN 0-521-47404-3.

**Manufacturing of Electronic Materials and Components**, A.Ghosh, B. Hiremath, and S. Sumita, eds. The American Ceramic Society, Westerville, OH, 1998. Cloth, 186 pp., \$95.00, ISBN 1-574-98044-0.

**Modern Thermodynamics: From Heat Engines to Dissipative Structures**, D. Kondepudi, ed. John Wiley & Sons, New York, 1998. Cloth, 505 pp., \$79.95, ISBN 0-471-97393-9.

**Photovoltaic Materials**, R.H. Bube, ed. Imperial College Press, United Kingdom, 1998. Cloth, 289 pp., ISBN 1-860-94065-X.

**Phthalocyanine Materials: Synthesis, Structure, and Function**, N.B. McKeown, ed. Cambridge University Press, New York, 1998. Cloth, 210 pp., \$74.95, ISBN 0-521-49623-3.

**Quantitative Nondestructive Evaluation, Parts A & B**, D.O. Thompson and D.E. Chimenti, eds. Plenum, New York, 1998. Cloth, 2,128 pp., \$395.00, ISBN 0-306-45901-9.

**Quantum Field Theory: From Operators to Path Integrals**, K. Huang, ed. John Wiley & Sons, New York, 1998. Cloth, 439 pp., \$74.95, ISBN 0-471-14120-8.

**Semiconductor Safety Handbook: Safety and Health in the Semiconductor Industry**, R.A. Bolmen, Jr., ed. Noyes Publications, New Jersey, 1998. Cloth, 632 pp., \$86.00, ISBN 0-815-51418-2.

**Shape Memory Materials**, K. Otsuka and C.M. Wayman, eds. Cambridge University Press, New York, 1998. Cloth, 294 pp., \$85.00, ISBN 0-521-44487-X.

**Shock Compression of Condensed Materials**, R.F. Trunin, ed. Cambridge University Press, New York, 1998. Cloth, 173 pp., \$49.95, ISBN 0-521-58290-3.

**Sliding Friction: Physical Principles and Applications**, B.N.J. Persson, ed. Springer, New York, 1998. Cloth, 471 pp., \$79.95, ISBN 3-540-63296-4.

**SOL-GEL Silica Properties, Processing and Technology Transfer**, L.L. Hench, ed. Noyes Publications, New Jersey, 1998. Cloth, 176 pp., \$64.00, ISBN 0-815-51419-0.

**Structural Analysis: A Historical Approach**, J. Heyman, ed., Cambridge University Press,

New York, 1998. Cloth, 183 pp., \$59.95, ISBN 0-521-62249-2.

**Texture and Anisotropy**, U.F. Kocks, C.N. Tomé, and H-R. Wenk, eds. Cambridge University Press, New York, 1998. Cloth, 685 pp., \$100.00, ISBN 0-521-46516-8.

**Theory of Mode Conversion and Tunneling in Inhomogeneous Plasmas**, D.G. Swanson, ed. John Wiley & Sons, New York, 1998. Cloth, 266 pp., \$74.95, ISBN 0-471-24776-6.

**Theory of Wire Rope, 2d ed.**, G.A. Costello, ed. Springer, New York, 1997. Cloth, 136 pp., \$59.95, ISBN 0-387-98202-7.

**Ultrasonic and Dielectric Characterization Techniques for Suspended Particulates**, V.A. Hackley and J. Texter, eds. American Ceramic Society, Westerville, OH, 1998. Cloth, 364 pp., \$90.00, ISBN 1-574-98034-3.

**X-Ray Diffraction: A Practical Approach**, C. Suryanarayana and M.G. Norton, eds. Plenum, New York, 1998. Cloth, 280 pp., \$49.50, ISBN 0-306-45744-X.

**Zeke Spectroscopy**, E.W. Schlag, ed. Cambridge University Press, New York, 1998. Cloth, 283 pp., \$64.95, ISBN 0-521-58128-1.

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