

### Introduction to High-Temperature Superconductivity

Thomas P. Sheahen  
(Plenum Press, 1994)  
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High-temperature superconductors (HTS) have the potential to have an enormous impact upon world commerce, particularly in the electronics and electric power industries. This book covers the science and technology of HTS at an introductory level. It will appeal to materials scientists, physicists, mechanical and electrical engineers, ceramists, chemists, and metallurgists. The book makes extensive use of information developed by the U.S. Department of Energy's national laboratories, by the entrepreneurial companies that are developing thin-film and "bulk" applications of HTS, and by researchers at many universities and companies in the United States and around the world. The book also uses a series of reports prepared for the Electric Power Research Institute as a starting point in the applications' chapters.

The book is divided into five sections, with 28 chapters and two appendices, and each chapter is heavily referenced. Several of the chapters have co-authors from Argonne National Laboratory and private companies developing power applications. The first major section deals with an introduction to the history of superconductivity, cryogenics, and some of the modern-day applications of "conventional," NbTi or Nb<sub>3</sub>Sn superconducting wires and films. A fine chapter on refrigeration sets the stage for introduction of HTS and the excitement generated by HTS wires that are used at temperatures as low as 20 K. Discussions of wire-making processes for metallic superconductors and two chapters on theory are also included in the first section.

The second section covers the full range of properties of HTS. The chapters in this section present a comprehensive, detailed account of the synthesis of HTS, the issues associated with flux pinning, and mechanical properties of oxides and metallic sheath materials. An overview of HTS microscopic theory and a chapter on weak links completes the section. The section was written prior to development of compelling new evidence for percolative networks of small-angle grain boundaries that helps explain the high critical current densities obtained in polycrystalline thallium and bismuth-based HTS tapes.

The third section, "Carrying Electricity," begins with a chapter on flux pinning, the second major challenge (with weak links) facing HTS wire manufacturers. Two

chapters cover processing, one dealing with powders and the other with fabricating useful wire forms with the powders. The issues of quench propagation and losses in HTS are covered in depth, and the summary of the likely behavior of HTS in the event of resistive zone propagation, which itself is (thankfully) difficult to initiate, has proven to be accurate.

A chapter on each of the promising electric power applications is included in section four. The book covers transmission lines, levitation, energy storage, motors, and fault current limiters in enough detail to satisfy most scientists and engineers. The omission of transformers, electric generators, and inductors is unfortunate since it is perhaps the promise of alternating current applications of HTS that is most tantalizing.

The book ends with a section that briefly covers the new refrigerators for mid-range (10–35 K) HTS use, and the research applications of HTS. An introduction to the organic superconductors is included. The use of HTS for high-field insert magnets is one niche application reviewed in this section. The book achieves its primary aim and belongs on the desk of every scientist and engineer working with HTS.

*Reviewer: Robert A. Hawsey is director of the Superconductivity Technology Center at Oak Ridge National Laboratory.*

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

#### Books

**Adhesion Measurement of Films and Coatings**, K.L. Mittal, ed. VSP, The Netherlands, 1994. Cloth, 111 pp, \$96.00, ISBN 90-6764-182-0.

**The Advanced T<sub>c</sub>Xbook**, David Salomon. Springer-Verlag, New York, 1995. Paper, 510 pp., \$39.95, ISBN 0-387-94556-3.

**Biomimetics: Design and Processing of Materials**, Mehmet Sarikaya and Ilhan A. Aksay, eds. AIP Press, Woodbury, New York, 1995. Cloth, 297 pp., \$69.00, ISBN 1-56396-196-2.

**Designing the Molecular World: Chemistry at the Frontier**, Philip Ball, Princeton University Press, Princeton, 1994. Cloth, 383 pp, \$29.95, ISBN 0-691-00058-1.

**Dynamics of the Liquid State**, Umberto Balucani and Marco Zoppi, Clarendon Press, Oxford, 1994. Cloth, 352 pp, \$95.00, ISBN 0-19-851739-4.

**Electronic Structure Calculations on Fullerenes and Their Derivatives**, Jerzy Cioslowski, Oxford University Press, New York, 1995. Cloth, 290 pp, \$65.00, ISBN 0-19-508806-9.

**Geometric Scattering Theory**, Richard B. Melrose. Cambridge University Press, New York, 1995. Cloth, 127 pp., \$39.95, ISBN 0-521-49673-X; paper \$14.95, ISBN 0-521-49810-4.

**Handbook of Thin Film Process Technology**, D.A. Glocker and S.I. Shah, eds. IOP Publishing Inc., Philadelphia, 1995. Cloth, 894 pp., \$450.00, ISBN 0-7503-0311-5.

**Laser Communications in Space**, Stephen G. Lambert and William L. Casey, Artech House, Boston, 1995. Cloth, 411 pp, \$99.00, ISBN 0-89006-722-8.

**Modern Aspects of Electrochemistry no. 27**, Ralph E. White, J. O'M. Bockris, and B.E. Conway, eds. Plenum Press, New York, 1995. Cloth, 566 pp, \$115.00, ISBN 0-306-44930-7.

**Oxygen in Silicon: Semiconductors and Semimetals, Vol. 42**, Fumio Shimura, ed. Academic Press, Boston, 1994. Cloth, 710 pp, \$169.00, ISBN 0-12-752-142-9.

**Physical and Non-Physical Methods of Solving Crystal Structures**, Michael Woolfson and Fan Hai-fu. Cambridge University Press, New York, 1995. Cloth, 388 pp., \$69.95, ISBN 0-521-41299-4.

**The Physics and Applications of Resonant Tunnelling Diodes**, Hiroshi Mizuta and Tomonori Tanoue. Cambridge University Press, New York, 1995. Cloth, 253 pp., \$54.95, ISBN 0-521-43218-9.

**The Physics of Creep: Creep and Creep-Resistant Alloys**, F.R.N. Nabarro and H.L. de Villiers. Taylor & Francis, London, 1995. Cloth, 428 pp., \$99.00, ISBN 085066-852-2.

**Physics of Critical Fluctuations**, Yuli M. Ivanchenko and Alexander A. Lisyansky. Springer-Verlag, New York, 1995. Cloth, 406 pp., \$59.00, ISBN 0-387-94414-1.

**Plasma Deposition of Amorphous Silicon-Based Materials**, I. Bruno, Pio Capezzuto, and Arun Madan, eds. Academic Press, Boston, 1995. Cloth, 336 pp., \$85.00, ISBN 0-12-137940-X.

**Plasma Surface Modification of Polymers: Relevance to Adhesion**, M. Strobel, C.S. Lyons, and K.L. Mittal, eds. VSP, The Netherlands, 1994. Cloth, 300 pp, \$79.00, ISBN 90-6764-164-2.

**The Practical Approach™ Utilities for Maple™**, Darren Redfern. Springer-Verlag, New York, 1995. Cloth, 320 pp., \$69.00, ISBN 0-387-14221-5.

**Principles of Condensed Matter Physics**, P.M. Chaikin and T.C. Lubensky. Cambridge University Press, New York, 1995. Cloth, 719 pp., \$49.95, ISBN 0-521-43224-3.

**Principles of Nonlinear Optical Spectroscopy**, Shaul Mukamel. Oxford University Press, New York, 1995. Cloth, 561 pp., \$65.00, ISBN 0-19-509278-3.

**Properties of Narrow Gap Cadmium-Based Compounds**, Peter Capper, ed. IEE, United Kingdom, 1994. Cloth, 639 pp, \$295.00, ISBN 0-85296-880-9.

**Quadrupole Mass Spectrometry and Its Applications**, Peter H. Dawson, ed. AIP Press, Woodbury, New York, 1995. Cloth, 371 pp, \$65.00, ISBN 1-56396-455-4.

**Quantum Mechanics: Concepts and Applications**, John D. McGervey, Academic Press, San Diego, 1995. Cloth, 421 pp, \$54.95, ISBN 0-12-483545-7.

**Review of Progress in Quantitative Nondestructive Evaluation**, vols. 14A-14B, Donald O. Thompson and Dale E. Chimenti, eds. Plenum Press, New York, 1995. Cloth, 2515 pp, \$365.00, ISBN 0-306-45062-3.

**Science in the Making. Vol. 1: 1798-1850**, E.A. Davis, ed. Taylor & Francis, London, 1995. Cloth, 453 pp., \$115.00, ISBN 0-7484-02195.

**Semiconductor Optics**, C.F. Klingshirn. Springer-Verlag, New York, 1995. Cloth, 408 pp., \$54.50, ISBN 3-540-58312-2.

**Sol-Gel Processing and Applications**, Yosry A. Attia, ed. Plenum Press, New York, 1994. Cloth, 406 pp., \$115.00, ISBN 0-306-44837-8.

**Structure and Bonding in Condensed Matter**, Carol S. Nichols. Cambridge University Press, New York, 1995. Cloth, 323 pp., \$64.95, ISBN 0 521 46283 5; paper, \$24.95, ISBN 0-521-46822-1.

**Surface Infrared and Raman Spectroscopy: Methods and Applications**, W. Suétaka. Plenum, New York, 1995. Cloth, 284 pp, \$59.50, ISBN 0-306-44963-3.

**Transport and Chemical Rate Phenomena**, Nickolas J. Themelis. Gordon & Breach Publishers, Amsterdam, 1995. Cloth, 381 pp., \$82.00, ISBN 2-88449-127-9.

**Ultrafast Diode Lasers: Fundamentals and Applications**, Peter Vasil'ev, Artech House, Boston, 1995. Cloth, 285 pp, \$88.00, ISBN 0-89006-736-8.

**VossPlot: A Software Tool for Scientific and Technical Graphics**, Richard F. Voss, Springer-Verlag, New York, 1995. Paper, 210 pp, \$29.95, ISBN 0-387-14215-0.

**"You Do Teach Atoms, Don't You?" A Case Study in Breaking Science Curriculum Gridlock**, Lyman Lyons and Susan Bolyard Millar. The LEAD Center, Madison, 1995. Paper, 90 pp., \$10.00.

**Journals**

**Plasma and Polymers: An International Interdisciplinary Journal**, Plenum Publishing Corporation, 233 Spring Street, New York, NY 10013-1578. Quarterly; first issue: January 1996. Subscription rate: \$50.00 in the U.S. and Canada/\$59.00 elsewhere. □



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