Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices

Rainer Waser, Editor
(Wiley-VCH GmbH & Co. KgaA, Weinheim, 2003)
1001 pages, $90.00
ISBN 3-527-40363-9

Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices is a major work covering a very broad range of topics underlying nanoelectronics and information technology. The breadth of the coverage is obvious immediately from the size of the book—just over 1000 pages—as well as from the major topical areas covered. Indeed, 40 topical areas are surveyed in eight general categories: fundamentals, technology and analysis, logic devices, random-access memories, mass storage devices, data transmission and interfaces, sensor arrays and imaging systems, and displays. The topics are by no means focused narrowly. On the contrary, sections span a rich variety of subjects including organic molecules, neurons, superconducting digital electronics, quantum computing, molecular electronics, holographic data storage, atomic force microscopy-based mass storage, neuroelectronic interfacing, and electronic noses. Enhancing the coverage of these discussions are sections dealing with the traditional nanoelectronics topics such as single-electron devices for logic devices, carbon nanotubes for data processing, and advanced materials and alternative concepts for sub-100-nanometer-gate-length silicon metal oxide semiconductor field-effect transistors. Moreover, sections on supporting technologies—such as lithography, film deposition methods, and material removal techniques—focus on materials and issues relevant to techniques applicable at the nanometer scale. Taken together, these topics encompass a very broad range of foundational and forefront topics on nanoelectronics and information technology with an emphasis on advanced electronic materials and novel devices.

In section after section, lucid explanations are presented, and supporting references include both seminal works and acclaimed texts in the field. The extensive index provides a powerful tool for searching the contents of the book and for identifying related but distinct discussions in the separate sections of the book. The illustrations are consistently of high quality and they add greatly to the overall presentation as a result of their appropriateness as well as their attractiveness. The extensive use of color illustrations and easy-to-read font sizes contribute further to the value of the numerous illustrations.

Many of the widely acknowledged experts in nanoelectronics and information technology have written sections for this book. The depth of coverage is sufficient to make the various sections useful both as summaries of relevant information and as valuable pedagogical discussions leading to fundamental insights and the explanation of underlying concepts. Overall, this book covers an impressive variety of topics and—at the same time—provides insightful discussions on nanoelectronics and information technology.

***Reviewer:** Michael A. Stroscio is a professor of bioengineering, electrical and computer engineering, and physics at the University of Illinois at Chicago and has been active in nanoelectronics and nanoscience for almost two decades, with nearly 200 of his publications and about a dozen of his patents dealing with nanoelectronics and related topics.*

Dictionary of Engineering Materials

H. Keller and U. Erb
(Wiley-Interscience, Hoboken, NJ, 2004)
1314 pages; $225.00
ISBN 0-471-44436-7

This extensive work is not so much a dictionary, as indicated in the title, but rather a glossary focused on the *names* of materials in 10 broad classes: metallic; polymeric; ceramics and glass; composites; wood and paper; textiles and leather; adhesives, sealants, and caulking; abrasives; electrical, photonic, optical, and magnetic materials; and others (including elements, minerals, coatings, construction materials, biomaterials, pigments, dyes, and additives). The many definitions of woods, mineral species, and fabric types are especially to be noted, as they are seldom included in most materials glossaries.

The ~40,000 entries are divided almost evenly between trademarks (A-Alloy to Zytel) and technical names (abaca to zwieselite). The latter class of names may be either generic (e.g., "ceramic fibers") or specific (e.g., "lanthanum nitride" or "porcelain-enameled sheet steel"). The definitions or elaborations presented of the listed terms provide answers to such questions as "What type of material is this?", "What are its general properties?", and "What are its applications?" The compilation is restricted to names of materials as just outlined; hence, terms relating to processing, structure, and properties of materials are not included.

The completeness of coverage of the work was measured by checking 140 terms selected at random (in 20 term batches) from each of seven other materials glossaries.[1–7] More than 80% of the terms in this test sample were found to be included in Keller and Erb, a high score indeed! The completeness of coverage of the present work was also assessed with a converse test on randomly selected terms from it for inclusion in the other glossaries cited. A test sample of 130 terms (no trade-names) was checked. Even the best (ref. 6) defined only 46 terms of the test sample, and the other glossaries did much more poorly, despite the fact that, apart from the NASA glossary (ref. 7), all others had an intended scope similar to that of Keller and Erb. The omitted terms identified in the first test were found to be distributed over a variety of classes—minerals, oils, industrial agents, chemicals, intermetallic phases, and such, with no obvious categorical omissions. Nonetheless, the omission count is significant and indicates that no such work can ever be truly exhaustive.

The editors' aim was to emphasize "engineering materials" in the broadest sense, whether they be used in architecture, building construction and civil engineering; biomedicine, biotechnology, and dental engineering; aeronautical and aerospace engineering; electrical engineering, electronics, telecommunications, and information technology; automotive and mechanical engineering; materials science and technology; environmental engineering; and other fields.

The audience to whom this work is directed is very broad, including students, scientists, engineers, technicians, writers, and the general public. Thus some will find certain of the definitions and explanations too technical, while others will find them too crude and lacking in specificity, despite the editors' earnest effort to find an effective compromise. While Keller and Erb's book is a useful first reference, recourse to a materials encyclopedia or materials text or monograph will usually be required for in-depth understanding of the term in question.

Most entries are simple, single-sentence definitions, identifying the material, be it specific or generic. Others, however, comprise a mini essay describing the composition, properties, and applications of the material in question. No illustrations are included. Terms within a definition that are themselves defined elsewhere in the book are italicized. No standard thesaurus relationships such as "broader term," "narrower term," or "related term" are usually provided, although sometimes for an entry a preferred term is indicated (e.g., "lake ore, See bog iron ore") or synonyms or related terms are given by a so-called directional cross-reference, "See also…." Nevertheless, these references within a main entry are not complete, even for the terms included in the book. For example, for the entry "cast irons," six subclasses are indicated, entries for each of which can be examined at their alphabetic location, as well as names for several specific cast iron types. Yet, one would have to seek through several of these referenced entries to be directed to "nodular iron," which surely belongs in the group. Sometimes symbols and abbreviations for an entry term are included.

A 12-page appendix is added at the end of the work that provides bibliographic references, helpful sources of information, abbreviations, and acronyms. This listing of 460 sources is apparently restricted just to those the authors used, since many more materials glossaries are readily found by a search on the Internet. This appendix also has some surprising omissions: ASM's *Thesaurus of Metallurgical Terms*, the SAE *Dictionary of Aerospace Engineering* by W.M. Cubberly, the Elsevier *Dictionary of Metallurgy and Metal Working* (on CD)¸ AISI's *Glossary of Steel Terms and Concepts*, and the *Ceramics Terminology Word List*. An article by this reviewer, "Materials Databases," included in the online version of Elsevier's *Encyclopedia of Materials Science and Technology*, lists many more materials databases than Keller and Erb show. Readers may also wish to refer to the review of Novikov's *Concise Dictionary of Materials Science* that appeared in *MRS Bulletin* **29** (April 2004) p. 289.

In sum, we have here a massive, authoritative work, fascinating to browse and easy to use, yet occasionally incomplete and uneven in its treatment of individual terms.

References

1. P.M.P. Walker, N.St.J. Braithwaite, P.R. Lewis, K. Reynolds, and G.W. Wiedermann, eds., *Chambers Materials Science and Technology Dictionary* (Chambers, 1993); 346 pages.
2. *McGraw-Hill Dictionary of Materials Science* (derived from the *McGraw-Hill Dictionary of Science and Technology*) (McGraw-Hill, 2003); 432 pages.
3. J.R. Davis, ed., *ASM Materials Engineering Dictionary* (ASM, 1992); 555 pages.
4. A.D. Merriam, ed., *A Concise Encyclopedia of Metallurgy* (Mac Donald and Evans, London, 1965); 1178 pages.
5. G.S. Brady, ed., *Materials Handbook, 10th Edition* (McGraw-Hill, 1965); 1045 pages.
6. U.S. Bureau of Mines, *A Dictionary of Mining, Mineral, and Related Terms* (Dept. of the Interior, 1968); 1269 pages.
7. *NASA Thesaurus*, Vol. 3: Definitions, NASA SP-7064 (1988); 142 pages.

***Reviewer:** Jack H. Westbrook is owner of and principal consultant with Brookline Technologies, a consulting firm in Ballston Spa, N.Y., where he consults on materials and technical information systems. He is chair of the* MRS Bulletin *Book Review Board and serves on the* MRS Bulletin *Editorial Board.*