Materials science and engineering comes of age

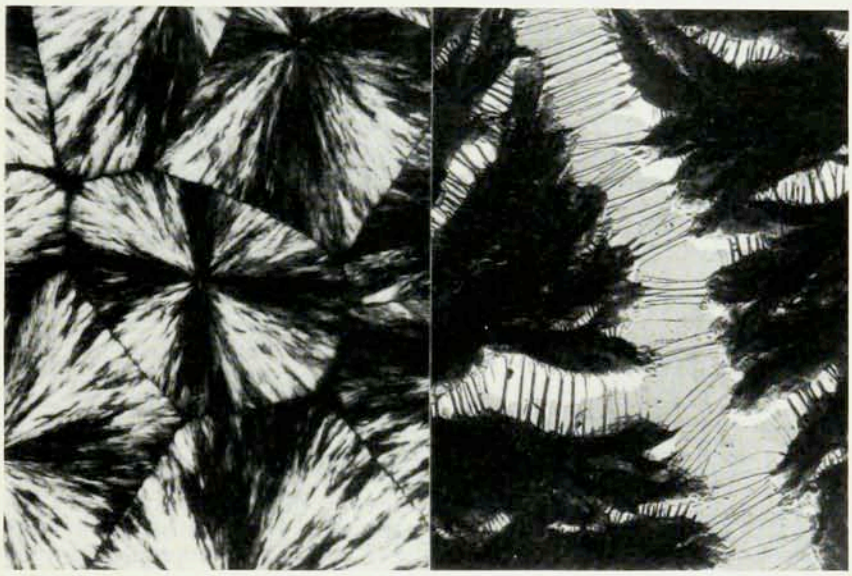
Encyclopedia of Materials Science and Engineering

Michael B. Bever, Editor in Chief
6105 pp. 8 vols. Pergamon, Oxford; MIT Press, Cambridge, Mass., 1986. $1950.00

Reviewed by Charles B. Duke

This handsome set of volumes celebrates a new era: the emergence of materials science and engineering as a multidisciplinary field in its own right, as distinguished from its roots in physics, chemistry and engineering. According to its editor in chief, Michael B. Bever, "this encyclopedia is based on the conception of materials science and engineering as a scientific field and a body of technological expertise with proved viability and continuing promise.... Materials science and engineering is now a reality." It is his intention that the appearance of the *Encyclopedia of Materials Science and Engineering* mark the birth of the field.

The unique feature of the encyclopedia is its attempt to define the scope of the field. The editors have done a splendid job of selecting and organizing the topics to achieve a credible blend of the chemistry of materials synthesis; the physics of the properties of materials; the technology of their commercial fabrication; the economics of their uses; the public policy issues posed by their production, utilization and disposal; and the history of their multifaceted applications across the ages. In addition to traditional articles on scientific data and technological practice, the editors include a generous sampling of descriptions of national materials policy, the history of materials usage in both recent and ancient times, life cycle costing, resource recovery and recycling, and other topics in the politics and economics of materials. Volume 8 systematically outlines materials science and engineering and gives author and subject indexes that themselves are important contributions to the definition of the field. I suspect that the scope and organization of this work will stand the test of time and in retrospect will appear to have constituted a present to materials science and engineering that greatly facilitated its rapid and orderly future development.



Structures in polymers. At left, an optical micrograph of large spherulites in a polypropylene film taken with crossed polarizers; the long axis of the central polygon is about 200 microns. At right, an electron micrograph of a boundary between spherulites in polyethylene, showing intercrystalline links both within and bridging the spherulites; the gap between the two (dark) spherulites is about 1 micron. The illustrations appear in an article on the morphology of polymers in the *Encyclopedia of Materials Science and Engineering*, reviewed here.

Like all newborns, however, the field must grow and develop considerably before it reaches maturity. Works analogous to the new encyclopedia, characteristic of material science's older brothers, chemistry and chemical technology, include the *Kirk–Othmer Encyclopedia of Chemical Technology* (Wiley Interscience, 25 volumes and 1 supplement) and the *Encyclopedia of Polymer Science and Technology* (Wiley Interscience, 16 volumes and 2 supplements). These three encyclopedias overlap considerably in coverage especially in the areas of the synthesis, properties, processing and uses of polymers. An important practical distinction between the materials science encyclopedia and its predecessors concerns the comprehensiveness and standardization of the contributions. The articles of the latter have standardized contents, use uniform notation and materials classification schemes, and are uniformly comprehensive in covering the literature. Unfortunately all of these qualities are lacking in the *Encyclopedia of Materials Science and Engineering*, so articles range all the way from lucid, comprehensive treatments of their topics (for example, the article on phase diagrams) to indications of "what I and my buddies have been working on lately" and accounts of "the best I could throw together in a day or so after the deadline passed." The use of graphical and photographic material

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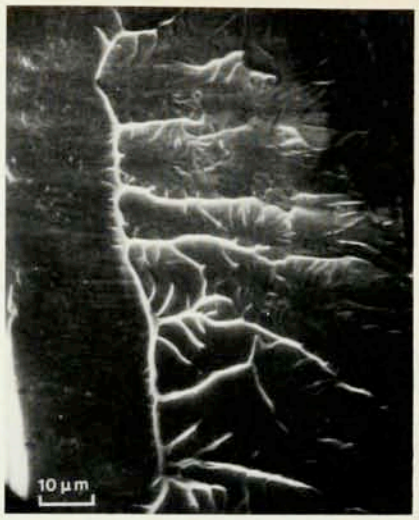

Scanning electron micrograph of the fracture surface of an amorphous metal ribbon broken in the ductile fracture mode. The illustration appears with an article on metallic glasses in the *Encyclopedia of Materials Science and Engineering*, reviewed here.

also varies widely. The article on acoustic microscopy, for example, uses photographs and block diagrams to excellent effect, but many other articles contain neither photographs nor graphics, and highly limited standard reference data—if any at all. While such deficiencies are natural characteristics of youth rather than fatal flaws in the product, they detract from the encyclopedia's usefulness to the various specialized constituencies it might serve; the serious contributors will thus probably lose readership because of their less conscientious colleagues.

The editor in chief envisages that the encyclopedia "will serve the needs of faculty members, researchers and students in academic institutions and of researchers, engineers and managers in industry. It should . . . be valuable to any organization with a professional interest in materials, as well as to individuals pursuing independent studies." To the extent that it is used as a supplementary source defining the broad scope and coverage of the field, I would agree. As a general reference on the nature of materials science and engineering this encyclopedia is unsurpassed. As a specialized reference source on specific topics, however, the lack of uniformity of coverage, the absence of comprehensive tabulations of standard reference data, and the sometimes parochial references to the literature render these volumes seriously flawed. In my opinion, considerable improvements in subsequent editions of this encyclopedia are required before it reaches the standards defined by the two comparable chemistry and chemical engineering encyclopedias.

Books are expensive—increasingly so in recent years. Thus any new reference must justify its place in the collections of both individuals and institutions. At a cost of approximately $250.00 a volume, the *Encyclopedia of Materials Science and Engineering* is clearly beyond the means of any but the most affluent individual professional. It is most suitable for a collection whose audience requires a broad yet detailed knowledge of the field. Certainly it should be included in research libraries at institutions specializing in some aspect of materials science such as industrial laboratories and university materials research programs. The high cost and the lack of uniform coverage will limit this work's attractiveness for general library collections and specialized research groups, respectively. Above all, these volumes are historically significant. Since their appearance marks the emergence of materials science and engineering as an independent field of endeavor, they constitute important reference works for future historians of science.

Supermanifolds

Bryce de Witt
316 pp. Cambridge U. P., New York, 1984. $59.50

By now a number of books and monographs have appeared discussing various aspects of the subject that we may justifiably term "super" mathematics. *Supermanifolds* by Bryce de Witt is a welcome addition to the field, being a tightly focussed and very useful exposition of the mathematical tools and techniques used in the field.

The reader should not expect to learn differential geometry, Lie algebra, or even space–time supersymmetry from this book, as de Witt has written this book for a mathematically and physically sophisticated audience. For the practitioner in the field, however, this book provides a delightful and unique *tour de force* as it carefully exhibits the mathematical structure of supermathematics. Starting from a simple beginning discussing the supercomplex numbers, the book then parallels the usual technical discussions of ordinary differential geometry. The book provides a very detailed and readable guide to subjects such as superanalyticity, supervector spaces, supermanifolds, superforms, super Lie groups, and super Lie algebras. The book is then rounded out with a number of elementary applications: the Bose and Fermi oscillators and supersymmetric quantum mechanics.

The author has performed a very