Shock Waves for Industrial Applications

Edited by L.E. Murr

(Noyes Publications, 1988), approximately 528 pages
ISBN: 0-8155-1170-1

This book is aimed at manufacturers and managers of technology for whom shock-wave methods might provide novel fabrication approaches. The book is also meant as a reference for practicing scientists, engineers, and students. The book contains material on industrial applications, results of recent research, and reviews of basic principles and phenomenology. Topics include shock hardening and strengthening; explosive forming, welding, and cladding; shock compaction and consolidation of powders; and shock sensitization and synthesis. Metals and alloys, ceramics, polymers, and composites are considered. The book contains 13 chapters, six written by the editor and his co-workers. The seven other chapters were written by researchers from various countries.

The book shows that the advantages of shock compression are (1) heterogeneous rapid heating, bonding, and quenching at interfaces and (2) the generation of high densities of dislocations and other defects in bulk, which can alter physical properties in attractive ways. The main advantages for manufacturing are (1) simple, versatile, and relatively inexpensive preforms and tooling, especially for work pieces too large for processing by static presses and (2) the ability to produce laminates of materials with substantially different physical properties. These considerations have meant that shock-wave technology has been devoted primarily to producing specialty items with limited production. In the United States this work is done by a few small companies and by contract research institutions.

The first case of the development of an explosive forming machine for production in volume is described in the chapter by H. Steinicke. More than 300,000 automobile axles have been produced in West Germany with this machine. Capabilities in explosive welding are described in chapters by N.V. Naumovich et al. and D.G. Brasher et al. Control of the interface by inhibiting the formation of brittle interfacial intermetallic compounds is one topic of current emphasis.

Chapters by Murr and Staudhammer and by Meyers and Thadhani discuss general principles and results of explosive powder compaction of engineering materials. The main problems discussed with respect to industrial applications are difficulties in producing near-net nonsimple shapes and residual cracking in brittle materials.

Roman and Gorobtsov provide an overview of shock-wave powder compaction and trends in the U.S.S.R. Shock processing is being used to address long-term materials issues. Products developed over the past few years include porous Ti filters, large solid Ti sheets produced by explosive compaction of Ti "sponge," soft ferrites with complex shape and improved magnetic properties, high-temperature cermets, and piezoceramics. (Shock-wave technology has undergone substantial industrial development in the Soviet Union compared to other countries. Thus, this might be a useful area to consider for development of commercial links between the Soviet Union and Western countries.)

A. Sawaoka describes shock compaction results with powders of SiC and cubic-BN. He is addressing residual cracking by using shock-induced exothermic reactions to provide high temperatures *in situ*. The result is a SiC microstructure with substantially fewer cracks. The near-term goal is improved cutting tools; the long-term goal is ceramic heat engine components.

T. Blazynski discusses work in the shock compaction of polymers, pure and composite. Dynamic compaction offers a way to increase compressive strengths and to control electrical and thermal properties.

This book covers a wide range of topics and aims which diffuses its impact and focus. Nevertheless, for those interested in a broad-brush description of the field, it is interesting reading.

Reviewer: William J. Nellis is head of the Shock Compression Group at Lawrence Livermore National Laboratory. His research interests include shock compaction and synthesis and the properties of condensed matter at high shock pressures and temperatures.

Supplementary Volume I: Encyclopedia of Materials Science and Engineering

Edited by Robert W. Cahn

(Pergamon Press and MIT Press, 1988), 653 pages
ISBN: 0-262-03142-6 (v.1) (MIT Press)
0-08-032521-1 (Pergamon Press)

The *Encyclopedia of Materials Science and Engineering* was originally issued as an eight-volume set in 1986. This impressive encyclopedia was designed to set forth the scope and scale of work on the subject, including the synthesis of materials, measurements and predictions of their properties, their commercial fabrication and utilization, and public policy issues associated with all these activities. The scope was bounded by limiting the coverage to durable (as opposed to consumable) materials. Fuels, foodstuffs, and drugs were not considered. Otherwise, the editors of this set attempted to catalog and survey the entire spectrum of activities which comprise the multidisciplinary field of materials science and engineering.

Supplementary Volume I of this encyclopedia is the first of a planned series of supplements designed to update and expand the contents of the original eight-volume main encyclopedia. It was prepared by a new editor, Robert W. Cahn, with the editor-in-chief of the initial volumes, Michael B. Bever, assuming the role of senior advisory editor. Most of the 113 articles in the first supplementary volume constitute expansions in scope of the coverage. A few are replacement articles (e.g., the contribution on "dental implants") or are updates of articles in the initial volumes (e.g., that on "electrically conducting polymers"). All are written in the same format as the original ones, and all cross-reference the contents of the first eight volumes. Two indexes (citation and subject) are provided, but these pertain to Supplementary Volume I alone. A "systematic outline" of the encyclopedia, given in Volume 8, is used as the basis to classify articles in Supplementary Volume I, which also contains an addendum to the original outline.

The articles in this volume are written for readers versed in the concepts and nomenclature of materials science and engineering. Technical terms, mathematical and chemical formulae are common. Therefore, the volume, like the main encyclopedia, is perhaps most useful as a point of entry into the literature for practitioners with at least a bachelor's level technical degree in chemistry, physics, or materials science.

This volume is designed for use in conjunction with the main encyclopedia. Thus, it should be added to the collection of those institutions and individuals which purchased the original eight volumes. Its utility as a stand-alone addition to a personal collection is probably limited to those who possess a special interest in one or more of the topics of the longer articles in the volume.

Reviewer: Charles B. Duke is senior research fellow of the Xerox Corporate Research Group. He has managed and contributed to numerous materials science and engineering projects, and was instrumental in establishing the Molecular Science Research Center at the DOE Pacific Northwest Laboratory.