has neither the rigid structure and crystalline symmetry of a solid nor the uniformity and disorder of a fluid or a gas. Soft materials under the influence of a weak external action result in large response with unusual properties. Soft matter encompasses all forms of materials with which we are confronted in everyday life, such as polymers (car tires, textile fibers), liquid crystals (all types of displays), emulsions (milk, beauty creams), and colloids (all types of paints). The book also addresses the properties of foams, bubbles, and the wetting de-wetting of surfaces. These materials and properties are discussed from an amusing historical point of view as well as a simple but exact scientific perspective as to the fundamentals of their working. Throughout the book is shown how humankind invented useful materials for which the fundamental understanding of their working came much later, sometimes centuries after. It also shows with simple examples how the basic understanding of the behavior of soft matter creates new prospects for new discoveries and/or better, more efficient use of the old materials. The role and the qualities of the inventor/scientist as well as the role of the individual versus teamwork in scientific research are exemplified with elegant paradigms. The just balance between applied and fundamental research as well as the values and merits of an engineer and a scientist are discussed, in relation to their services to a modern continuously changing society, with elegant metaphoric examples. The important role of a scientist as an informer for society is discussed. Last but not least, the role of education in the preparation of future scientists and, above all, educated citizens is discussed with the pros and cons of the French educational system in contrast to others.

This absorbing and beautiful book does not teach us only about soft matter and the job of a scientist but also about ourselves. It is strongly recommended not only to all scientists and students but also to research managers and decision-making politicians.

***Reviewer:*** *Georges Hadziioannou is professor of polymer chemistry and scientific director of the Materials Science Center at the University of Groningen, The Netherlands. His present research interests are functional polymers, semiconducting polymer materials for photonic and electro-optic applications, and surfaces and interfaces of polymer materials with experimental expertise in polymer synthesis, advanced electro-optical characterization methods, surface forces, and scanning probes.*

## Rare-Earth Iron Permanent Magnets

*J.M.D. Coey, editor*
*(Oxford University Press, New York, 1996)*
*542 pages, $135.00*
*ISBN 0-19-851792-0*

When neodymium-iron-boron magnets burst upon the scene in late 1983, the European scientific community appeared to be standing on the sidelines. An organized effort to correct this situation became known as the Concerted European Action on Magnets (CEAM). It resulted in a sustained activity that produced a wealth of experimental data, theoretical insights, new materials, and a fruitful exchange of ideas among scientists worldwide, all documented in the numerous publications that flowed from this effort. The present book can be seen as one of the records of European permanent magnet research in the past decade and a half, but it is much more. It guides the reader through the important aspects of rare-earth iron permanent magnet basics, properties, processing, and applications. The specialist can profitably concentrate on one or two chapters and expect them to discuss their subjects in considerable depth. The contributors are all recognized experts in their field and have written lucid expositions of their subject matter.

True to its title, the book focuses almost exclusively on rare-earth permanent magnets containing iron as their principal component. The scope of the topics is wide, ranging from permanent magnet basics to recent applications. Despite the multiple authorship, the book represents a coherent whole, and there is almost no overlap of content. Where English is not the native language of the authors there is no loss of clarity. The introduction (Chapter 1), written by the editor, endeavors to tie together all aspects of permanent magnets and provides a fitting entry into the chapters that follow. It is preceded by one of the few common-sense expositions on magnetic units known to this reviewer.

When the basics in Chapter 1 are combined with the sections on intrinsic magnetic properties (Chapter 2) and coercivity (Chapter 5), one must conclude that nearly half of the monograph is dedicated to the theoretical and experimental fundamentals of the subject. The treatment is not in any sense light or simplistic. A novice to the field will do well to come equipped with a solid grounding in physics, as well as considerable patience. To readers already familiar with the physics and materials science of rare-earth permanent magnets, Chapters 8 through 11 dealing with applications (static fields, magnetomechanical applications, motors, actuators) should be well worth their attention because design parameters have changed considerably with the increased magnetic stiffness of the new materials. Coincidentally, readers will learn that read/write heads in computer disk drives represent the largest application for Nd-Fe-B magnets at the present time. Nd-Fe-B magnets have become the real work horse of the rare-earth permanent magnet business because they provide the highest energy product in industrially available magnets, so they get most of the attention in the book. In a more recent development, the favorable intrinsic properties of the nitride $Sm_2Fe_{17}N_3$ have kindled an intense interest in the modification of the materials by interstitial atoms (Chapter 4). One of the ongoing problems of permanent magnet research is how to extract a useful coercive field from the large crystal anisotropy available in rare-earth transition metal compounds. The most recent insights into this question are discussed in Chapter 5. Chapter 6 on microstructure and magnetic domains is closely related because coercivity is intimately tied to the motion of domain walls through major and minor structural features under the influence of a magnetic field. The phase relations in rare-earth alloys are an important topic because it can help us understand how these alloys behave during solidification and subsequent processing and how this affects magnetic properties. This area is covered in Chapter 3.

The editing of this monograph, which must have been a considerable chore, is professional and has resulted in a pleasing and uniform product. In over 500 pages of printed text the number of typographical errors can never be zero, but here it has been held to a minimum. Over 1,000 references support the research results, and a bibliography with 25 entries form a basis for collateral reading. Most names that have been profiled in permanent magnet research in the past decades are found in the references in one form or other. The book is laid out in an attractive fashion and, incredibly, sewn in signatures which means that it is not likely to come unglued. As an added bonus, the reader can expect it to remain open at a desired spot without having to fight the annoying tendency of the pages to flip over unbidden.

If you are a research worker in this field and want to catch up with developments that are peripheral to your direct interests, or need to know more about applications, or if you are an applications-bound engi-

neer who would like to better understand these unique and fascinating materials, this book is for you.

*Reviewer: Hans H. Stadelmaier is Professor Emeritus of Materials Science and Engineering at North Carolina State University, Raleigh. He has Diplom Physiker and Dr. rer. nat. degrees from the University of Stuttgart, Germany.*

## Cellular Solids: Structure and Properties, 2d ed.

*Lorna J. Gibson and Michael F. Ashby*
*(Cambridge University Press, New York, 1997)*
*x+510 pages, $ 120.00*
*ISBN 0-521-49560-1*

Cellular structures, defined as structures having density less than about 0.3 of the theoretical density of the solid, can be found in nature (wood, cork, coral, bones, and of course, the honeycomb of the bee) or can be synthetic (polymeric packaging material or sandwich panels). They afford unusual physical (e.g., thermal and acoustic) and mechanical (e.g., stiffness and energy absorption) properties that make them ideal for selected applications. A quantitative understanding of the mechanisms responsible for these properties is central to not only predicting but also enhancing the performance envelopes in various environments. The scientific publications on this subject spans the fields of materials science, mechanics, botany, physiology, and biomedical science. In the first edition of this book (published about 10 years ago), Gibson and Ashby surveyed the understanding of cellular solids.

In this second edition, the first three chapters quickly run through basic classifications of cellular solids (honeycombs versus foams, both open-celled and close-celled), techniques to produce them (a fairly superficial coverage) and characterize them, and characteristic physical and mechanical properties of the classes of materials that make up these cellular solids. A basic engineering undergraduate background is adequate to understand the information in these three chapters. The clarity in logic and presentation is commended and the approach of periodically reminding the reader of the direction that the authors intended to take in the rest of the book particularly appealed to me.

The next five chapters constitute the heart of the book: The first three of these deal with the mechanical behavior of cellular solids where the mechanics of honeycomb structures and foams are logically developed. The response of such cellular structures to tensile and compression loading is broken down into stages and consideration is given to various classes of materials constituting the cell walls (elastomers, metals, and ceramics). Issues related to anisotropy and multi-axial loading are addressed and yield surfaces are presented. The influence of the presence of fluids on mechanical response of open- and close-celled foams is analyzed. The mechanics throughout is kept to an easily understandable level and the clarity of arguments and presentation style are excellent. The last two chapters in this set of five deal with physical properties of foams (thermal, electrical, and acoustic) and the mechanisms of energy absorption in cellular solids; benefits of presenting these mechanisms using energy absorption diagrams are discussed. The strength of these chapters derives from the constant comparisons of the mechanics prediction to experimental data in the literature. The utility of the mechanics ideas developed in these chapters are clearly demonstrated in Chapter 9 where the authors describe the process of design optimization of sandwich panels using a foam core; two specific examples, the first of a downhill ski and the second of the iris leaf, are used. Chapters 10, 11, and 12 provide three case studies of naturally occurring cellular materials: wood, cancellous bone, and cork. The complexity in structure in each case is illustrated but perhaps intriguing is the ability to cope with such structures reasonably well by extending the basic mechanics developed in the earlier chapters in the book. The authors have been careful in identifying limitations of the analyses developed whenever pertinent, and emphasize the importance of understanding the microstructure carefully to develop meaningful mechanics as evidenced in the analysis on cork.

In summary, this book is very well written, makes for interesting reading, is a valuable addition to any engineer's library and a must for researchers and engineers working in the field of cellular materials.

*Reviewer: K. Sharvan Kumar is a professor in the Division of Engineering at Brown University in Providence, Rhode Island. His field of interest is microstructure and deformation behavior of structural materials.*

## The Art of Molecular Dynamics Simulation

*D.C. Rapaport*
*(Cambridge University Press, New York, 1997)*
*xiv+400 pages*
*$69.95 Cloth, ISBN 0-521-44561-2*
*$39.95 Paper, ISBN 0-521-59942-3*

This how-to book is a welcomed addition to the small library of texts on modern methods in atomic-level simulations. The first two chapters present the basics of molecular dynamics with enough information and code to perform simple simulations without any prior knowledge. Building on this foundation are discussions of equilibrium and dynamical properties of fluids, nonlinear phenomena, rigid and flexible molecules, long-ranged and three-body forces, hard-sphere systems, and algorithms for vector and parallel computers. Throughout the book, the theory behind each topic is presented succinctly with references to the literature. This theory is followed by fully functional code implementing the technique. The code can be obtained from the website (www.cup.cam.ac.uk/onlinepubs/artmolecular/ArtMoleculartop.html), as can a detailed Table of Contents.

One important decision made at the outset is the choice of C for the program examples. In deference to FORTRAN programmers, however, C-specific constructions were avoided, allowing the C to be relatively directly translated into FORTRAN. Although not comfortable with C, I did not find this too difficult. Nevertheless, a couple of side-by-side examples of C and FORTRAN code would have been useful. Also, in some places it might have been clearer if more schematic code had been given, thereby allowing the central idea to be highlighted and explained without being obscured by the detail.

By way of comparison, M.P. Allen and D.J. Tildesley's classic book *Computer Simulation of Liquids* (Oxford University Press, Oxford 1987) provides a somewhat less textbook-like introduction to much of the same material. Rapaport's book is both more structured and goes considerably beyond Allen and Tildesley's in content. At times, however, Allen and Tildesley's somewhat more intuitive approach, illustrated by schematic FORTRAN fragments, is easier to follow. To a great extent, therefore, the two books are complementary, and reading the same subject matter in both is particularly illuminating.

The structured approach and fully functional code make this book ideal for a graduate course in molecular-dynamics simulation, taking the student with no prior knowledge to a position to be able to perform research-level simulations. For the practitioner, it provides a mine of useful techniques. My copy will stand next to Allen and Tildesley's book and will, I expect, receive frequent use.

*Reviewer: Simon Phillpot is in the Materials Science Division of Argonne National Laboratory.*