Driving Force, the Natural Magic of Magnets

James D. Livingston
(Harvard University Press, Cambridge, 1996)
xiv + 311 pages, $24.95
ISBN 0-674-21644-X

Jim Livingston has written a splendid combination of history, legend, science, music, art, technology, medicine, warfare, and more—all of it woven, or perhaps tangled, together by magnetism. The book is explicitly intended for adults, but will surely be useful and interesting to high school students with a flair for science. It contains no equations (thereby largely avoiding the vexing question of units in magnetism), but is firmly grounded in science and technology as a result of the author's 30-years experience at the General Electric Research Laboratory and further years of teaching at the Massachusetts Institute of Technology.

Chapter 1 lists eight "Facts about the Force." Fact 1 is "If free to rotate, permanent magnets point approximately north and south." Fact 8 is "Changing magnetic fields induce electric currents in copper and other conductors." These "facts" replace what would be equations in a text and are used throughout the book to explain the working of a magnetic compass, a generator, a refrigerator magnet, and many other familiar and less familiar gadgets. We learn about the earth's magnetic field and lodestones, about magnetic recording, about magnetic resonance imaging, about Anton Mesmer (hence to "mesmerize") and his theories of animal magnetism, about radar and levitated trains and superconductivity and a number of other things. There are quotations from Cosi fan Tutti, Lewis Carroll, Albert Einstein, and W.S. Gilbert, among others.

The book is written in a breezy and personal style, contains useful elementary treatments of a wide range of technical topics related to magnetism, and is a gold mine of anecdotes and quotations to use as introductory remarks in technical presentations, or as the basis for talks to general audiences about the excitement and importance of science and technology. The book makes good reading; a fine example of "popular" science writing that will hold the interest of the professional as well as the amateur.

Reviewer: *C.D. Graham, Emeritus Professor of Materials Science at the University of Pennsylvania, has worked in industry and academia on various kinds of magnetic and superconducting materials and devices.*

Atom Probe Field Ion Microscopy

M.K. Miller, A. Cerezo, M.G. Hetherington, and G.D.W. Smith
(Clarendon Press, Oxford, 1996)
xi + 509 pages, $120.00
ISBN 0-19-851387-9

This book is the first thorough monograph on analytical field ion microscopy which can be used as a reference guide by scientists working in this area but even more important it can serve as an introduction into the field for all graduate students, postdoctorates, and professors, many of whom may be fascinated by the results of the new generation of three-dimensional atom probes. They reveal positions and atomic numbers of the atoms within a volume of about $10 \times 10 \times 100$ nm^3. See the colored pictures between pages 404 and 405 and you fall in love with the technique. The progress leading to the 3D-atom probe became possible after the recent and independent development of a two-dimensional detector in Oxford and Rouen universities. Therefore, the authors being at the frontier in Oxford had the necessary expertise in writing an up-to-date book. They also had the necessary enthusiasm as revealed in the poetic preface. The method, its physical principles, the instrumentation, and the many applications are described in a way that for the most part graduate students can comprehend. Together with the numerous references given after each chapter, all the details are at hand for building an atom probe by oneself. This is especially useful as the atom probe has not been commercialized properly yet or what is available may be too expensive. In addition, previous monographs dealing with the same subject are either incomplete or not up-to-date. Whether the technique (and the book) will spread over more than a few laboratories in the world will also depend on the success of competing techniques. However, and this is my only criticism, there is no comparison of advantages and drawbacks with scanning tunneling microscopy or high resolution electron microscopy giving atomic resolution in real space as well.

The history of field ion microscopy is well-described in the introduction of the book. The pioneer Erwin Müller was the first scientist producing images of atoms by field ion microscopy. Since then the technique has made progress coupled with the progress in electronic equipment and data processing. Still it remains a complex technique limited to conducting materials and, therefore, the number of groups devoted to it is rather small. I have inherited an atom probe from Peter Haasen in 1993 and, although it demands considerable commitment with respect to personnel and financial resources, it pays back with total satisfaction when looking into the structure and composition on an atomic scale.

Reviewer: *Reiner Kirchheim is a Full professor at the Institut für Materialphysik, University of Göttingen. His research areas and interests are in hydrogen in metals, thermodynamics of alloys, interstitial solution and diffusion in glasses (metals, oxides, polymers, and semiconductors), solute-atom segregation at and diffusion in internal interfaces, passivity of metals, electromigration in metals, and plasticity of glassy polymers and positron annihilation in polymers.*

Understanding Smart Sensors

R. Frank
(Artech House, Norwood, Massachusetts, 1996)
xvi + 269 pages
ISBN 0-89006-824-0

Sensors are increasingly becoming part of daily life although, in many cases, we are not aware of their presence; we are only aware of the beneficial effects that they offer in the control of our cars and other appliances such as televisions and mobile telephones. Although the actual sensors form an essential part of any system, the sophisticated electronics allow the signal from the sensor to become "smart." It is the latter that this book deals with almost exclusively, which is appropriate from the viewpoint of the electronic engineer as the innovations in electronic circuitry have probably been greater than sensor development. The author uses as his foundation the latest research from industry, universities, and national laboratories and this work is comprehensively referenced.

The majority of the sensors described are based upon silicon technology, with excellent coverage of the techniques of micromachining, film deposition, and etching. Various types of sensor signal are discussed—resistance, piezoresistance, capacitive, piezoelectric, and Hall effect, with a few sentences devoted to chemical sensors. Little discussion is given on the physics and chemistry of the underlying phenomena as much more emphasis is placed upon the circuitry needed to enhance the signal using digital techniques. Various types of the amplifier circuit are described to amplify the low level output that is available from sensor or transducer elements. The text explores how microcontrollers, digital signal processes, and application-specific integrated circuits can be used to increase the accuracy and quality of the measurements and to add diagnostics and other intelligence to any type of sensor. Proportional integral derivative control is the basis of many control systems but the newer artificial intelligence approaches of fuzzy logic and neural networks are succinctly covered. Their combination, the text points out, may allow the use of sensors with lower accuracy and therefore lower cost.

Interesting chapters also cover remote sensing and micromechanical systems which include microvalves, micromotors, micropumps, microdynamometers, and micro-optics. Other stimulating topics discuss the future capabilities of semiconductor systems and how much technology will be needed and who is going to supply this technology to the field of smart sensors as well as the latest sensor concepts.

Understandably, given the author's background at Motorola, this book is intended for professional electronic engineers who wish to use the latest technology to integrate sensors into circuits to give an overall control device. However, it is also very useful to materials scientists developing sensors to gain an insight into how their device can be packaged to make a useful contribution to control technology. Without the important chapter on acronyms, the nonengineer would find the text difficult to comprehend.

The book is well-written with plenty of high quality diagrams and photographs of industrial products. The references and index are comprehensive and the book can be strongly recommended to those interested in developing sensor systems or those scientists, who are researching materials for novel sensors, to ascertain the exciting electronic capabilities which exist to enhance their performance.

Reviewer: Derek Fray is a professor of materials chemistry at the University of Cambridge with research interests in sensors for the control of materials processing.

CLASSIFIED

Positions Available

TENURE-TRACK POSITION
Department of Materials Science and Mineral Engineering
University of California, Berkeley

The College of Engineering at the University of California, Berkeley invites applicants for a tenure-track position in biomaterials with expertise in the response of tissues to engineering materials. The preferred candidate will utilize the Advanced Light Source at the Lawrence Berkeley National Laboratory as part of his/her experimental investigations of the biological and chemical processes occurring at the interfaces between tissues and bioengineering devices. Preference will be given to an appointment at the tenured level, although appointment at the assistant professor level will be considered for a recent PhD degree recipient with exceptionally strong promise.

Appointment in any department with the College of Engineering is possible. An appointment partially within the Department of Materials Science and Mineral Engineering is likely.

The successful candidate will be responsible for teaching undergraduate and graduate courses in the College and must engage in high quality research. A doctoral degree in an appropriate field is required. The position is available in the Spring Semester of 1999.

Interested persons should apply (include resume, statement of interest, copies of publications, names and addresses of references) by **June 1, 1998** to:

Professor Thomas M. Devine, Chair
Department of Materials Science and Mineral Engineering
577 Evans Hall #1760
University of California
Berkeley, CA 94720-1760
Telephone: 510-642-3801
E-mail: devine@socrates.berkeley.edu

The University of California is an Equal Opportunity/Affirmative Action Employer

POSTDOCTORAL RESEARCH POSITIONS
Norwegian University of Science and Technology

A new strategic program in high performance ceramics and heterogeneous materials has been initiated at the Norwegian University of Science and Technology. The program is a collaboration between three research groups at the Department of Inorganic Chemistry (Assoc. Profs. M-A. Einarsrud, T. Grande, K. Wiik) Department of Physics (Prof. R. Høier), and Department of Physical Electronics (Prof. J. Grepstad). The program invites qualified applicants for two postdoctoral research positions in the areas of non-oxide ceramics and perovskite-related oxide materials with mixed conduction properties, respectively.

Successful candidates must have completed a PhD degree in ceramics, material science, solid state physics/ chemistry, or a related field. Demonstrated expertise in several of the following areas is required: scanning/transition electron microscopy, x-ray diffraction, epitaxial thin film growth, and sintering. The positions are for three years starting preferentially July 1, 1998. Annual starting salary: NOK 287,000 (approx. USD 38,000).

Interested candidates should send their résumés including information on availability, the name of three references, current visa status, and copies of selected relevant publications to:

Dr. Mari-Ann Einarsrud, Department of Inorganic Chemistry
Norwegian University of Science and Technology
N-7030 Trondheim, Norway

Applications will be accepted until **May 1, 1998**. Further information can be obtained from Mari-Ann.Einarsrud@chembio.ntnu.no,Ragnvald.Hoier@phys.ntnu.no, or Jostein.Grepstad@fysel.ntnu.no.

ASSISTANT IN RESEARCH
National High Magnetic Field Laboratory

The National High Magnetic Field Laboratory is recruiting for an Assistant in Research. This is a 12-month, non-tenure earning, research faculty position. This position is responsible for development of magnet technology for insert magnets based on High Tc superconductors as part of the development of a 1 GHz NMR facility. Responsibilities include detailed analysis of the critical properties of materials and products, development of manufacturing methods, construction, extensive testing and analysis of model coils, and publication of results. The position will also a) supervise the facilities for critical current characterization of HTS, assure quality of results, and expand capabilities; b) initiate and sustain collaborations with appropriate industries and research institutions; and c) represent the NHMFL in the multi-national VAMAS program on HTS.

Minimum qualifications include an MS degree or equivalent, three years experience with high temperature superconductor applications development, and a record of publication. Application deadline is **April 30, 1998**. To apply, submit a letter of application (reference position #63814) and vitae to Ms. Jocelyn Clarke, National High Magnetic Field Laboratory, 1800 E. Paul Dirac Drive, Tallahassee, FL 32310.