Mössbauer Spectroscopy Applied to Magnetism and Materials Science, *Vol. 2*
Gary J. Long and Fernande Grandjean, Editors
(Plenum Press, New York, 1996)
361 pages, $89.50
ISBN 0-306-45398-3

The contents of scientific books devoted to the applications of a technique often remind me of a poem of Jacques Prévert called "Inventaire" (Inventory): (one stone, two houses, three ruins, four grave diggers, one garden, flowers, one raccoon, a dozen oysters, one lemon, one loaf of bread, one ray of sunlight, etc..., another raccoon, etc..., five or six raccoons, etc.). In books such as the one under review, the shared technique provides an obvious link between chapters, but such a link may be artificial in cases when it reduces solely to issues of methodology. Sociological considerations, which are known to be irrelevant in hard sciences, cannot be of further help in understanding the choice of chapter topics. Finally, the only requirement is that the various topics cover the selected field with as little overlap as feasible and also without holes to compose a colorful mosaic as intriguing as the poem by Prévert. Such a patchwork is being progressively constructed in the series edited by Gary Long and Fernande Grandjean, where our raccoon is a Mössbauer spectrum and the elements of the inventory are problems in magnetism and materials science.

It is sometimes misleadingly believed that Mössbauer spectroscopy consists in putting any solid which contains iron or tin into some device to harvest spectra—but it isn't so! Equally erroneous is the belief that Mössbauer spectra can only be deciphered by the chosen few whose activity is partly to fight about their fitting and their meaning. It is one of the purposes of the series edited by Long and Grandjean to persuade materials scientists that useful information is or may be obtained even in cases when all details of spectra cannot be understood or interpreted with certainty. The books of this series are, however, aimed at those readers who have a prior knowledge of the basic features of Mössbauer spectroscopy. Few readers will be interested in all 11 chapters of volume 2, but a wide audience may benefit from a careful and selective reading since most topics are well encapsulated and explained.

The relevance to materials science of the investigated phenomena, materials, or synthesis techniques will become more evident to Mössbauerists, as demonstrated for instance by the exhaustive review on mechanochemistry. Materials scientists will certainly get a feeling for the use and utility of Mössbauer spectroscopy in their field. An example is the remarkable chapter about diffusion studies which shows how the Mössbauer technique offers a unique microscopic view of diffusion dynamics. The book further helps in grasping the clever means which are put to work to study thin films, multilayers, surfaces, interfaces, or solids under high pressures. The chapters on silicate glasses, on the float-glass process, and on commercial galvanized steel coatings demonstrate the interest of Mössbauer studies of industrial materials and processes. The fitting methods and approximations involved in calculations of hyperfine field distributions are clearly discussed and are applied to a refined characterization of amorphous ribbons and wires. As emphasized for about the last 20 years, hyperfine parameter distributions are multivariate and their calculations from spectra, which belong to the class of "inverse problems," are ill-posed. Small changes in spectra may lead to large changes in the sought distributions. Regularization methods are consequently required to extract reliable pieces of information from experiments. Such essential facts have inescapable consequences which explain some of the difficulties expounded in the chapter on quasicrystals.

Inverse problems in Mössbauer spectroscopy are, however, too methodological to be usefully detailed in books on applications aimed at a broad readership. In any case more than just one isolated chapter on spectral analysis would be necessary for a fair exposition of that delicate problem. Some chapters mention the new and exciting extensions of the Mössbauer technique using synchrotron radiation facilities that will hopefully be included in one of the next volumes of the series. To conclude, volume 2 (as well as volume 1) of *Mössbauer Spectroscopy Applied to Magnetism and Materials Science* is a useful tool not only for practitioners of Mössbauer spectroscopy but also for materials scientists who are interested in the original stories often told by nuclear probes.

***Reviewer:** Gérard Le Caër, Ingenieur Civil des Mines (Mining Engineer), is Directeur de Recherche au CNRS (National Center for Scientific Research) Laboratoire de Science et Génie des Matériaux Métalliques (Laboratory of Science and Engineering of Metallic Materials), Ecole des Mines de Nancy (Mining School of Nancy). Le Caër has been using Mössbauer spectroscopy in metallurgy and in solid-state chemistry for about 30 years. He has also been working on amorphous metallic alloys and currently works mainly on nanomaterials and mechanical alloying. He is also interested in some topics in statistical physics where he has been more particularly involved in topological models of disordered cellular structures and in random matrices.*

Current Opinion in Solid State and Materials Science

A.K. Cheetham, M.S. Dresselhaus, and J.M. Thomas, eds.
(Current Chemistry, London)
6 issues/year
Subscription: Personal $240/ On-Line $264; Institutional $960/ On-Line $1,055; Students $120/ On-Line $120 in US.
ISSN 1359-0286

In recent years several short-review journals have appeared to complement the venerable *Annual Reviews and Critical Reviews* series with their format of large, comprehensive reviews. These new publications include the *Trends in...* series, *Polymer News,* and many newsletters covering advances in technology. Since there are no established models, these new journals have great freedom to define their audience and develop their own style.

Current Opinion divides materials into 13 fields (including Electronic Materials, Metals and Alloys, Biomaterials, and Polymers) and visits each once per year. Each has one or two section editors who provide an overview to introduce about half a dozen articles on specific topics. Each article has a bibliography, which is annotated to highlight important papers with titles and, occasionally, brief summaries. The intention is that the bibliography will be a useful source separate from the accompanying article.

These articles are not for experts. In a few pages it is not possible to rise much above an advanced textbook level and not many authors have the courage (or arrogance) really to deliver a personal opinion or a manifesto. In contrast to the theme issues of *MRS Bulletin,* the articles are scattered over a wide range of topics and so cannot build upon one another to provide depth. The articles would be a good source for graduate student papers, for underpinning a lecture or two to seniors, or for passing time on airplanes in keeping up a broad appreciation for materials. In contrast to *MRS Bulletin,* again, it is too expensive to tear out the useful parts and leave the rest for the entertainment of the next passenger.

Breadth of coverage is also likely to be a problem. Two editors will find it difficult to cover all of polymer science, for instance. After a couple of years, there are signs of clustering in some topics. This is bad if an individual buys the journal for broad current awareness but is less of a problem if the journal is an archived source of surveys.

The balance between researchers, libraries, and publishers is clearly shifting, mainly because the mechanics of printing no longer chokes communication and the mechanics of distribution will not be a limit for much longer. Equally obvious is that no one knows quite how to respond. Journals like *Current Opinion* should be praised for trying to open new channels for scientists to talk to one another. Materials science may be a harder nut to crack than most because our research interests tend to be so diffuse, whereas other disciplines are more focused on a common set of problems-du-jour. It does seem a little ridiculous that the main sources of scientific information operate according to models established by the Royal Society three hundred years ago. These experiments deserve our interest and attention.

***Reviewer:** Paul Calvert is a professor in the Department of Materials Science and Engineering at the University of Arizona in Tucson. He is currently working on the application of freeform fabrication techniques to composites and biomimetic materials.*

Forward Recoil Spectrometry: Applications to Hydrogen Determination in Solids

J. Tirira, Y. Serruys, and P. Trocellier
(Plenum Press, New York, 1996)
462 pp, $110.00
ISBN 0-306-45249-9

Among the many ion-beam analytical methods employed in solid state and

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materials science, elastic recoil detection analysis (ERDA) is one of the most recent and successful ones and has gained, during the last decade, widespread use. In particular, depth profiling of light elements and isotopes, like hydrogen, deuterium, carbon, nitrogen, and oxygen, in metallic and ceramics coatings and thin films and in near-surface layers of bulk materials has become important to correlate macroscopic materials properties with the distribution of these elements, and modifications and defects introduced by them. As compared to nuclear reaction analysis (NRA) often used as an alternative method to depth profile light elements, ERDA has the advantage that all light components can be determined simultaneously, that is, from a single recoil spectrum taken with a single beam (at a single energy) and a common detection system.

The book of Tirira, Serruys, and Trocellier describes the various versions of ERDA in much detail. The authors set out with a presentation of the basic physical processes and formulae of elastic scattering including the effects of nuclear, Coulomb, and multiple scattering (chapters 2, 3). Practical aspects, instrumentation, and analysis of the spectra are discussed in chapters 4, 8, 10, and 11. Several experts in the field like Nick Dytlewski, Han Hofsäss, and Guy Ross have contributed to chapters 5, 6, 7, and 9 on various very recent developments of ERDA like time-of-flight and coincidence ERDA and the use of electromagnetic filters in the detection of the ejectiles. Finally, chapters 13, 14, and 15 cover the advantages and shortcomings of high-energy ERDA, hydrogen determination via NRA, and damages introduced in the samples due to ion-beam bombardment.

The book offers a comprehensive treatise of the ERDA method, with a detailed bibliography and a full account of the historical development. I find the chapters by Dytlewski, Hofsäss, and Ross particularly clearly presented and very profitable to read. I guess that students and researchers starting in the field, but having a reasonable background in ion beam analysis and nuclear methods applied to solid-state and materials physics, will make good use of this concise and state-of-the-art presentation.

The other chapters are less concisely written, not as well organized, and more difficult to read. In addition, I find them much too long. A more intuitive organization of the basics of ERDA would have been to illustrate the classical case of pure Coulombian interaction between the target and projectile nuclei in the text, including the relevant parameters and theoretical expressions, and shift the difficulties of nuclear interference and multiple scattering into appendices. Furthermore, most of the cases presented in chapter one (to illustrate the historical background) cannot be understood without having read the following chapters. This makes reading especially difficult for beginners.

Unfortunately, I have found several errors in the formula and basic drawings, of which I will mention a few. The first formula (2.1) is not correct, since a minus sign is missing. And Figure 2.1 is incorrect in which the impact parameter in the C-system is twice the one in the L-system which, of course, cannot be. On page 51, the expression for the quantity η in equation 3.12 is not correct. On page 44, the integration of the differential cross section over the solid angle $\Delta\Omega$ of the detector should give $\sigma_T = (1/\Delta\Omega)\int(d\sigma/d\Omega)d\Omega$. A figure would be very helpful to illustrate this basic quantity.

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