American Mineralogist, Volume 89, pages 254, 2004

BOOK REVIEW

APPLICATIONS OF SYNCHROTRON RADIATION IN LOW-TEMPERATURE GEOCHEMISTRY AND ENVIRONMENTAL SCIENCE. P.A. Fenter, M.L. Rivers, N. C. Sturchio, and S.R. Sutton, Eds., Reviews in Mineralogy & Geochemistry, 2002, vol. 49, 579 p. Mineralogical Society of America, Washington, D.C. $36 ($27 for MSA members).

This volume of the *Reviews in Mineralogy and Geochemistry* series encompasses the ever-growing field of synchrotron-radiation-based research within geochemical and environmental research disciplines. The chapters in this work have three general formats. The first set of chapters (by G. Brown, by N. Sturchio, by T. Sham, and by M. Rivers) generously provides the reader with material that carefully reviews the work associated with the field, according to analytical approach and system studied. These chapters also provide a technical introduction to synchrotrons, their physics of operation, history, and construction. The second set of chapters (by P. Fenter, by M. Bedzyk, by L. Cheng, by G. Waychunas, and by C. Hirschmugl) provides highly technical discussions of the physical theory and applications of several specific synchrotron-based techniques, such as X-ray reflectivity, X-ray standing wave analysis, grazing incidence X-ray absorption, and emission spectroscopy and infrared spectroscopy studies. The third set of chapters (by A. Manceau and co-workers, by S. Sutton and co-workers, and by S. Myneni) provides examples and discussions of the application of one or more synchrotron-based techniques (such as microfluorescence, microtomography, and microdiffraction and absorption studies) in the environmental and geochemical disciplines.

All chapters provide highly illustrative and comprehensive examples of environmental and geochemical processes that are being explored using these synchrotron-based techniques. The book examines these processes at a variety of spatial scales (from atom- to field-scale). There are many examples of where imaging techniques (such as X-ray fluorescence elemental mapping) have been combined with spectroscopy or other methods (such as X-ray absorption spectroscopy and X-ray diffraction) to generate spatially resolved spectral and other determinative information. This approach can reveal the complexity of environmental systems and it demonstrates how the synchrotron-based techniques provide great versatility to the user. Some chapters have extensive tables that allow the reader to quickly access key information on the local structural interactions of metals on surfaces (chapter by Brown and Sturchio) and on the characteristic soft X-ray peak positions of numerous carbon- and nitrogen-based molecules (chapter by Myneni). The chapters provide information on data acquisition, methods of data interpretation, and the limitations of current analytical methods. All chapters offer insight on potential future applications of these techniques and they instill scientific imagination and curiosity.

The review of the literature was comprehensive and current. In some chapters, the introduction of unpublished data in a review book should have been more limited (as in chapters by Fenter, Manceau and co-workers, and Sutton and co-workers). Although the unpublished data can often help illustrate a particular concept or support a working theory, the presentation of unreferenced data (i.e., work that has not received an appropriate review as a stand-alone work) in a review chapter does not give the reader ready access to the type of experimental details and other information typically available for data that have been published.

This book has no index or glossary. The terminology varies somewhat from chapter to chapter, although almost every chapter clearly defines the terminology being used. G. Waychunas and P. Fenter present very concise lists of definitions. One chapter (Manceau and co-workers) discusses terminology in a manner that is more conversational than traditional. For example, this chapter uses wording such as "this hellishly difficult task," "it pays to put the beam accurately," a "bump" on a sample and "good" versus "bad" components (in a fit of a multi-component spectrum). Hence, readers less familiar with the material and terminology covered in this book may struggle when transitioning from one chapter to the next.

The level of mathematics required for comprehending the theory behind the analytical techniques in the second set of chapter formats (i.e., those on X-ray standing waves and X-ray reflectivity) is at graduate level. Other chapters are more than suitable for the advanced undergraduate level.

This book it is likely to attract readers within many disciplines, such as the earth and environmental sciences, physics, and material sciences. It will appeal to individuals and research teams with a strong interest in performing environmental and geosciences research at a synchrotron facility and, in general, it would be quite suitable for a graduate-level special topics course.

MARTINE C. DUFF
Westinghouse Savannah River Company
Aiken, SC 29808