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BOOK REVIEW

MÖSSBAUER SPECTROSCOPY OF ENVIRONMENTAL MATERIALS AND THEIR INDUSTRIAL UTILIZATION, by Enver Murad and John Cashion. (2004) Kluwer Academic Publishers, Norwell, Massachusetts 417 p. ISBN: 1 4020 7726 2. $165.00.

The technique of Mössbauer spectroscopy is celebrating its fiftieth year since Rudolf Mössbauer's seminal paper (1958) that yielded him the Nobel Prize in 1961. Mössbauer spectroscopy has long shared with wet chemistry the distinction of being a gold standard for determinations of Fe^{3+} and Fe^{2+} in solid materials, including a host of geological materials—especially including minerals. Technology and methodology in this discipline have changed rapidly over the past two decades, including such advances as the development of the milliprobe Mössbauer (McCammon 1994; Sobolev et al. 1999) and the development of spectrometers that can routinely acquire spectra of sample masses <2 mg (for Fe-rich samples). Many of the classic book references that describe this technique are badly out of date, and the community has managed with periodic technique descriptions in the form of various review papers.

Into this setting comes the recent book by Enver Murad and John Cashion. Both authors have worked for many years in the study of minerals, soils, and clays using Mössbauer spectroscopy. Happily, they are not only practitioners of this type of spectroscopy, but also articulate in their descriptions of technique itself. Although the title of the book makes it sound like a book for environmental engineers, mineralogists will find many thorough, thoughtful descriptions of the theory and modern instrumentation used in Mössbauer spectroscopy, along with a very useful discussion of the complexities of Mössbauer data analysis and interpretation. Their summary of the factors that can affect the Lorentzian lineshape of a Mössbauer spectrum is especially useful in light of the many different modeling approaches now used in mineralogical studies. The full first quarter of this book is devoted to these discussions of the technique and practice of Mössbauer spectroscopy, and these alone make the book worth buying. For anyone wishing for an in-depth discussion of this technique as it is practiced in the new millennium, this book will be invaluable.

The remainder of the book is devoted to summaries of various mineral groups and rock types that are of interest to different aspects of environmental science. Each of these is covered broadly at an introductory level; the aim is not to be comprehensive, but to give an idea of the breadth of Mössbauer studies on each of these types of materials. Those already familiar with the technique that are interested in thorough coverage of the literature in each of these fields would do better with review papers in the peer-reviewed literature. Chapter 4 summarizes the main conclusions of Mössbauer research on phyllosilicates, with especially useful summary tables giving Mössbauer parameters for key clay minerals such as kaolinite, illite, and nontronite. Chapter 5 on iron oxides has already become standard reading for students in my lab for its clear and uncomplicated descriptions of the major ferric oxides, their compositions, structures and magnetic characteristics. Those interested in the study of the minerals of Mars will find an excellent resource in Chapter 9 on metastable minerals such as green rusts, fine-particle magnetite and Fe sulfates produced in acidic environments (such as acid mine drainages and the martian soil).

For readers seeking to understand industrial uses of Mössbauer spectroscopy, the remaining chapters summarize work on sediments, soils, mixed clays, coals, clay firing and mineral processing with an eye to their commercial uses. Chapter 10 on characterization of coal and coal products discusses the use of Mössbauer spectroscopy to identify iron phases not only in raw coal, but in the products of low-temperature ashing, carbonization, and combustion, as well as chemical treatments. Hydroliquifaction is also discussed at great length. Chapter 11 presents an interesting coverage of the thermal reaction of clay minerals used in production of ceramics; I learned that Mössbauer spectroscopy could be used to assess firing techniques of pottery in situations where the source clays are available. Finally, the mineral processing chapter (12) includes a section on the use of Mössbauer for improving understanding of mineralogy, ore processing and extraction of iron and gold ores.

In summary, this book is an excellent source of information about the current practice of Mössbauer spectroscopy and its industrial applications. The applications presented are useful demonstrations of how the technique can be applied, though they cannot substitute (nor are they intended to substitute) for in-depth literature surveys presented elsewhere. This book will be most useful to mineralogists (and their students) who wish to become better acquainted with the analytical technique of Mössbauer spectroscopy and gain some familiarity with its myriad uses. The background presented here will provide an excellent jumping-off point for further explorations into the many different applications of this technique.

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