

Book Review

A. BENNINGHOVEN, F. G. RUDENAUER and H. W. WERNER
Secondary Ion Mass Spectrometry—Basic Concepts, Instrumental Aspects, Applications and Trends
 Wiley, New York, 1987, 1277 pages.

Secondary ion mass spectrometry has suffered greatly from the lack of a thorough text which summarizes the phenomenology of secondary ion emission, outlines the instrumentation required and reviews the main areas of application, highlighting the benefits and problems of SIMS analysis.

The authors of this book all have considerable reputations and experience in various areas of SIMS. They have produced a very long book, over 1000 pages, which goes some way to fulfilling the need outlined above. However, in view of the length, the coverage is surprisingly very variable. Some aspects are covered with extreme thoroughness whilst other areas are treated very briefly.

After a brief introduction (chapter 1) the basic phenomenon of atom sputtering and ionization is covered in 270 pages in chapter 2. Clearly this is an extensive topic with an enormous experimental and theoretical literature. The length is therefore justified, however whilst the chapter covers the sputtering aspect thoroughly, the generation of secondary ions is only dealt with experimentally, a discussion of the various theories being postponed to a rather short treatment in chapter 3.

Chapter 3 is concerned with the difficult problem of SIMS quantification. It is a very useful and concise account of the various attempts made to convert ion yields into elemental concentrations. Whilst quantification problems are essentially concerned with the ionization process, and therefore it is appropriate to introduce the theories of ionization in this context, yet their description and discussion is coloured by the context. Thus the reviewer would have preferred the theories to be introduced in the context of the general data of ion emission to help the reader to understand the process of ionization as a whole.

Instrumentation is given an enormous 335 pages in chapter 4. A very extensive account of ion gun and mass spectrometer design is provided followed by detailed descriptions of about 24 instruments from early devices to the present

day instruments but not including the time-of-flight instruments described elsewhere in the book. This coverage seems excessive and over-detailed. The reader wants to know the main principles of instrument design and operation with an indication of the types of configuration required for different applications. If further detail is required surely the bibliography can be used.

Chapter 5 covers the various operational modes: static SIMS (100 pages), depth profiling (151 pages), imaging (11 pages) and sputtered neutral mass spectrometry (SNMS) (26 pages). In view of the brevity of the following 'Applications' chapter the coverage of static SIMS excessively reflects the author's interests in the oxidation of metals and thin layers of organic compounds rather than being comprehensive. Whilst the value of SIMS in generating surface mass spectra, which give detailed information on chemical structure, is clearly evident from the spectra of the organic and bio-organic layers described, little is provided which illustrates the extension of this potential to real problems of surface analysis where others have shown SIMS to be so valuable. There is a rapidly growing literature on the use of static SIMS for the characterization of surface chemical structure on a large number of materials. Particular success has resulted in polymer, catalyst and metal characterization.

The section on depth profiling is fairly comprehensive and useful but that on SIMS imaging is far too short. Imaging is one of the great growth points of SIMS. Its potential in applied surface analysis and 3-dimensional depth profiling is enormous. As analyser transmission rises the possibility of a chemical 'microscopy' is real. Some deeper discussion of the possibilities and problems, with more illustrations of usage, would have been welcome.

SNMS is an exciting possibility but with some real problems to overcome. The description is about right although a little more on laser post-ionization would have been appropriate. One must sympathize with the authors, however, the field is moving so rapidly it is difficult to be completely up to date. rapidly it is difficult to be completely up to date.

Accounts of applications (chapter 6) which should demonstrate the undoub-

ted power of SIMS both for very high sensitivity elemental analysis and the characterisation of surface chemical structure are covered disappointingly in a mere 72 pages. Indeed the actual examples are covered in only 32 pages. Obviously there are many examples illustrating particular points throughout the book but it is often in the detailed descriptions of practical analytical problems that readers really appreciate the power of a technique as it relates to their particular interests. There is almost nothing illustrating the use of SIMS to analyse the surface chemical structure of a material. This is one of the most exciting uses of static SIMS.

When comparison is made with other techniques of surface analysis, particularly the most widely applied techniques XPS and AES, it can be seen that the SIMS surface mass spectrum yields far more detail and precision as to chemical state than any other technique. This is not even discussed in chapter 7 where SIMS is compared with other techniques. This chapter is rather short. Nothing is addressed in any detail which makes it rather unsatisfactory. Laser microprobe which has a clear relationship to SIMS is briefly described (0.5 page) but there is no comment as to how the spectral data relate to that obtained from SIMS.

Finally, there is a useful chapter on future/new developments which fills some of the holes mentioned earlier on, for example, SIMS imaging.

In the Acknowledgement section at the beginning the authors admit that the book is largely composed of adaptations of relevant articles which have appeared elsewhere. Good articles bear repetition, however the consequence is that the book over emphasises the interests of the authors and under-represents much other important work which forms the field of SIMS and makes it the important and exciting technique it is. Whilst this is a significant criticism it has to be said that no book can be thoroughly fair or exhaustive in its coverage of a subject. This is a useful first text on SIMS, but not for the curious non-specialist, that has still to be written.

J. C. VICKERMAN

Surface Analysis Research Centre,
 UMIST,
 Manchester,
 England.