clearly displayed. Readers of *J Am Soc Mass Spectrom* may be especially interested in the group of papers on biological applications, including the progress being made toward imaging of biological samples for particular molecular components, the growing use of cluster and molecular ions as primary ions, and the continuing progress in polymer analysis by time-of-flight and other versions of the SIMS experiment. What they might look for and not find is much material on the mechanism of organic SIMS, a subject that is still undergoing active development. The lack of a subject index is a hindrance in searching out such material.

As a principal source of current information on SIMS and allied topics, this book follows the standards set by its predecessors. It will serve the SIMS community well.

Inductively Coupled Plasmas in Analytical Atomic Spectrometry, Second Edition

Akbar Montaser and D. W. Golightly, Eds.
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VCH Publishers, New York

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One of the most important developments in analytical atomic spectrometry over the past 30 years has been the utilization of the atmospheric pressure argon inductively coupled plasma (ICP) as a vaporization and excitation source for atomic emission spectrometry (i.e., ICP/AES) and as a vaporization and ionization source for inorganic mass spectrometry (i.e., ICP/MS). These two techniques, commercialized in 1974 and 1983, respectively, have revolutionized the field of trace element analysis over the past 20 years. The first edition of *Inductively Coupled Plasmas in Analytical Atomic Spectrometry*, published in 1987, contained a single chapter devoted to ICP/MS. The explosive growth of ICP/MS since that time is one of the reasons cited by the editors for publishing a second edition only five years after the first.

The second edition is about one-third larger than the first; its 20 chapters, contributed by a total of 34 authors, include 5 completely new chapters. The 19 chapters that follow a brief overview of the various types of plasma sources other than ICPs (e.g., DC plasmas, microwave plasmas, and glow discharges) that have been used in analytical spectrometry are organized into three parts, entitled Atomic Emission Spectrometry with the Inductively Coupled Plasma, Complementary Techniques, and Focus on Sample Introduction, Plasma Generation, and Mathematical Modelling. Although the reader primarily interested in ICP/MS will find much useful information throughout the text, it is the contents of Parts II and III that will be of greatest interest.

Part II, Complementary Techniques, includes the three chapters devoted to ICP/MS. Chapter 12, ICP/MS for Elemental Analysis, contributed by Gary Horlick and Youbin Shao, provides a generic description of ICP/MS instrumentation and a description of basic signal measurement conditions that includes discussion of optimization of instrument settings and of recognition and control of spectroscopic interferences and matrix effects. An outline of the steps in a typical quantitative analysis is illustrated by results from the determination of some trace elements in stainless steel. The chapter concludes with a brief survey of current and future trends in ICP/MS, including the use of plasmas other than 100% argon plasmas and of sample introduction systems other than the standard pneumatic nebulizers. This chapter provides an excellent introduction to the technique, which is complemented by 253 references. Chapter 13, Fundamental Aspects of ICP/MS, by D. J. Douglas, is devoted to a fairly rigorous treatment of the physical chemistry of the properties of the ICP as an ion source and of the sampling of ions from the ICP. The author assumes some prior knowledge of ICP/MS, either from Chapters 12 and 14 of this book or from previous reviews. This chapter will be especially useful to those seeking a better understanding of the origins of interelement interferences in ICP/MS (e.g., isobaric interferences arising from doubly charged ions and polyatomic ions), and suppression of sensitivity by space charge effects in the ion optics. The chapter concludes with a section on future directions that points out the relative inefficiency of the ICP as an ion source and raises the intriguing possibility of using electrospray ionization for elemental analysis. Chapter 14, Analytical Applications of ICP/MS, by H. E. Taylor and J. R. Garbarino, provides a survey of the types of analysis (semiquantitative, quantitative, and isotopic) possible by ICP/MS, with illustrative examples from the literature. Applications are grouped into four areas: biological, geological, environmental, and industrial. In addition to a providing a few examples of quantitative analysis in each of these areas, the authors illustrate the use of ICP/MS isotope ratio measurements for stable isotope tracer studies in biology, for geochronology, and for isotope dilution analysis of environmental samples.

Given the strong similarity between the ICP hardware and sample introduction systems currently used for ICP/MS and those which have been in use for many years for ICP/AES, it is not surprising that much of the material in Part III of the book, and especially the three chapters on introduction of liquid, solid, and gaseous samples to the ICP, will be useful to readers primarily interested in ICP/MS. Chapter 15, Liquid Sample Introduction into Plasmas, by A. G. T. Gustavsson, is a thoroughly updated version of the author's contribution to the first edition, which in-

cludes, for example, a description of the coupling of flow injection and liquid chromatographic apparatus with the ICP, topics that are highly relevant to current ICP/MS development. The discussion of plasma solvent loading, and of means to reduce it, is pertinent to much ongoing work on the reduction of polyatomic ion interferences in ICP/MS. The bulk of the material in Chapter 16, Introduction of Solids into Plasmas, by C. W. McLeod, M. W. Routh, and M. W. Tikkanen, is organized into four main sections on direct sample insertion, electrothermal vaporization, arc and spark ablation, and laser ablation. Although all of these techniques have been evaluated for ICP/MS, electrothermal vaporization and laser ablation enjoy particular popularity at present. The contents of Chapter 17, Injection of Gaseous Samples into Plasmas, by D. T. Heitkemper, K. A. Wolnik, F. L. Fricke, and J. A. Caruso, are organized into sections on hydride generation, direct gaseous sample introduction, and coupling of gas chromatography with the ICP. Both the ICP/AES and the ICP/MS literature are extensively reviewed, and information on figures of merit, such as detection limits and applications, is presented in convenient tabular form.

Another chapter of Part III that is particularly relevant to much ongoing ICP/MS research is Chapter 19, Inductively Coupled Plasmas in Gases Other than Argon, by Akbar Montaser, K. D. Ohls, and D. W. Golightly. After a brief summary of the advantages and limitations of using plasmas other than argon plasmas for ICP/AES or ICP/MS, the authors describe the generation and properties of mixed-gas plasmas (i.e., plasmas in which some other gas is added to the argon), molecular gas (e.g., air) plasmas, and helium plasmas. ICP/AES and ICP/MS observations are combined in the section on fundamental and analytical properties of these plasmas. As in Chapter 17, much information is presented in convenient tabular form.

Although Part I of the book is devoted primarily to ICP/AES, two chapters in it will also be useful to readers primarily interested in ICP/MS: Chapter 4, Common RF Generators, Torches, and Sample Introduction Systems, by Stanley Greenfield and Akbar Montaser; and Chapter 8, Fundamental Properties of Inductively Coupled Plasmas, by T. Hasagawa, M. Umemoto, H. Haraguchi, C. Hsiech, and A. Montaser.

In summary, the publication of this book represents a remarkable achievement on the part of the editors and the other 32 authors. Despite the relatively large number of contributors, a fairly uniform style is maintained throughout the text, there is little redundancy, and the material is up-to-date. Chapters that appeared in the first edition have been extensively updated where necessary to take into account the growth in the importance of ICP/MS. Every chapter is complemented by an extensive list of references; the inclusion of the full title of each reference will aid the reader who seeks detailed information on a particular topic. The text of this handsome book is complemented by a total of 312 figures and 250 tables, as well as a fairly comprehensive index. I highly recommend this book, even for those who already have a copy of the first edition; it deserves a place in every laboratory in which the ICP is used for elemental analysis.