Inorganic Mass Spectrometry—Fundamentals and Applications

Christopher Barshick, Douglas C. Duckworth, and David H. Smith, Eds.
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As part of Marcel Dekker's Practical Spectroscopy series, the editors have compiled a very useful and informative reference source for current practitioners and those interested in learning more about inorganic mass spectrometry (IMS). The book focuses primarily on the interpretation of mass spectral data generated from the detection of atomic ions. As such, it contains 12 chapters that describe the impact of various ion sources, analytical methods, and mass spectrometers on trace element and isotopic analysis. A review of the literature indicates that the publication of this book is timely (necessary), given that the only other work of similar scope (Inorganic Mass Spectrometry, Eds. Adams, Gijbels and Van Grieken) was published over 10 years ago.

The first four chapters of this book describe some of the most routinely used ion sources in IMS. In Chapter 1, Smith describes the basic theory and operation of thermal ionisation as a source for isotope ratio mass spectrometry and applications therein. Chapter 2 focuses on the application of glow discharge (GD) sources for mass spectrometry. The fundamental description of the source, its operation and the typical mass spectrometry configurations used in GDMS given here provide a nice transition for the novel applications discussed in later chapters. In particular, Marcus (Chapter 7) describes the use of GDMS for elemental analysis of trace components in nonconducting solid materials, nicely illustrating that the capabilities of GDMS extend beyond those of conducting solid samples. In Chapter 3, Olesik provides a good general description of the application, operation, and fundamentals of the inductively coupled plasma (ICP) as an ion source for mass spectrometry. This also includes a discussion on the recent application of ion–molecule chemistry to reduce spectral interferences. Although ICP MS has become the workhorse for liquid sample introduction, this chapter also discusses alternative sample introduction techniques, such as hydride generation and laser ablation. Christy provides a thorough discussion of the theory and current instrumentation used for secondary ion mass spectrometry (SIMS) in Chapter 4, with application to static and dynamic profiling, and imaging of surfaces based upon their elemental composition and isotopic abundance. As such, it provides a good background for the discussion of the application of SIMS to geological materials and related geological applications described by Riciputi in Chapter 11. In Chapter 6, Delorme details the development of a novel source in which ions are emitted directly from high temperature condensed phase materials. The chapter is written from a research and development perspective and targets the effect of sample matrix composition on ion formation mechanisms with application to isotope ratio measurements and elemental analysis.

Isotope dilution mass spectrometry (IDMS) is considered one of the definitive methods of analysis and is therefore often an integral part of any accurate analysis by mass spectrometry, especially when certification is required. A clear description of IDMS methodology is given in Chapter 5 by Smith, accompanied by numerous areas of application.

In Chapter 11, Sutton, Ackley, and Caruso describe how the elemental detection capability of plasma ion sources can be extended to provide speciation information, primarily by coupling these sources to separation methods. The Chapter describes the basic "*how to*" for coupling a variety of HPLC methods, GC methods, supercritical fluid chromatography and capillary electrophoresis methods to the source and corresponding areas of application. In addition, the use of alternative plasma sources for speciation measurements, a field that is rapidly growing in research popularity, is described in a limited manner.

Three of the chapters in this book describe the application of modern mass spectrometers and their impact on elemental and isotopic mass spectrometry. Chapter 8 covers the basic theory of operation, performance, and application areas of four different commercially available high resolution multiple-collector mass spectrometers coupled to ICP sources. In addition to listing some of the figures of merit for these instruments, it also describes some of the necessary criterion for the acquisition of accurate isotope ratio information. Duckworth, Eyler, and Watson in Chapter 9 describe the recent application of various ion trap mass spectrometry technology, incorporating internal ionization (lasers) and external ionization (GD and ICP sources) for elemental analysis. Presently, however, there are no commercially available products dedicated to elemental analysis and, as such, these systems serve largely as research instruments. Although limitations exist, specific benefits have been clearly demonstrated in addition to those associated with trapping alone, one being the high degree of resolution achievable with the penning trap instruments (e.g., FTICR) making them competitive with other high resolution instruments. The

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ability to reduce spectral interferences through ion–molecule reactions is another benefit which can be implemented in either Paul (quadrupole ion trap) or Penning trap instruments. In Chapter 12, Myers, Ray, and Hieftje detail the adaptation of time of flight (TOF) mass spectrometry to elemental analysis. This Chapter describes the basic theory, development, and areas of application of ICP and GD TOF systems. By discussing both the benefits and limitation of TOF technology, this chapter provides an important reference for those who may be considering cost competitive alternatives to scanning (e.g., quadrupole) mass spectrometry for elemental detection; especially since commercial instruments are now being produced and are *appearing* in laboratories throughout the world.

Despite the breadth of this work, a greater focus could have been given to a number of topical areas. The capability of other techniques such as low powered plasma sources and electrospray sources for elemental and molecular detection and hence elemental speciation measurements is significant in the field of IMS and therefore they should have been more specifically addressed. As well, due to the continued progress in the development of laser ablation sample introduction techniques, a more focused treatment of this subject and its applications may too have been warranted. Also, the layout of this book, in particular, the order in which the chapters appear, could have been better arranged to provide a more consistent flow of thought between the various topics.

In general, however, this book provides a clear, concise, up to date account of inorganic mass spectrometry. It is well written and well referenced, containing an appropriate number of informative/exemplary illustrations and tabulated data. As the preface suggests, this book will be of value to a wide range of users both as a practical guide and as an educational device.

This broad textbook in inorganic mass spectrometry, presents the most important mass spectrometric techniques used in all fields of analytical chemistry. By covering recent developments and advances in all fields of inorganic mass spectrometry, this text provides researchers and students with information to answer any questions on this topic as well as providing the basic fundamentals for understanding this potentially complex, but increasingly relevant subject.Â Applications of inorganic mass spectrometry for analysis of gases and volatile compounds. 7.3. Stable isotope ratio measurements of gases and volatile compounds. 8. Isotope ratio measurements and their application 8.1. Capability of inorganic mass spectrometry in isotope ratio measurements 8.2. Inorganic Mass Spectrometry Fundamentals and Applications. Item Preview. > remove-circle. Share or Embed This Item. EMBED.Â Inorganic Mass Spectrometry Fundamentals and Applications. by. Christopher M. Barshick, Douglas C. Duckworth, David H. Smith. Topics. Natural Sciences, Chemistry, Analytical and Instrumental, Mass Spectrometry. Collection. opensource; community. Start by marking â€œInorganic Mass Spectrometry: Fundamentals and Applicationsâ€ as Want to Read: Want to Read savingâ€¦ Want to Read.Â Providing a theoretical background for inorganic mass spectrometry, this text describes classical applications of four modern mass spectrometers - magnetic sector, quadrupole, time-of-flight, and ion trap - and illustrates how they have impacted elemental and isotopic analysis. The book features examples that concentrate on routine and non-routine applications of inorganic Providing a theoretical background for inorganic mass spectrometry, this text describes classical applications of four modern mass spectrometers - magnetic sector, quadrupole, time-of-flight, and ion trap - and illustrates h Johanna Sabine Becker: Inorganic mass spectrometry. Principles and applications. Article. Full-text available.Â The development and application of analytical methods based on multi-collector inductively coupled plasma-mass spectrometry (mc-icp-ms) for high-precision isotopic analysis of fe in human blood and serum applicable to biomedical investigations. Thesis. Jan 2017. Becker JS (2008) Inorganic Mass Spectrometry: Principles and Applications. John Wiley & Sons, ChichesterGoogle Scholar. 8. Prohaska T, Irrgeher J, Zitek A, Jakubowski N (eds) (2015) Sector Field Mass Spectrometry for Elemental and Isotopic Analysis. Royal Society of Chemistry, CambridgeGoogle Scholar. 9.Â Becker JS, Dietze HJ (2000) Inorganic Mass Spectrometric Methods for Trace, Ultratrace, Isotope, and Surface Analysis. Int J Mass Spectrom 197:1â€“35. doi: 10.1016/S1387-3806(99)00246-8 CrossRefGoogle Scholar. 33.Â Part I. Fundamental Aspects of Surface Ionization. Int J Mass Spectrom Ion Phys 50:1â€“33. doi: 10.1016/0020-7381(83)80001-1 CrossRefGoogle Scholar. 37.