BOOK REVIEWS

Liquid Chromatography/Mass Spectrometry Applications in Agricultural, Pharmaceutical, and Environmental Chemistry

Edited by Mark A. Brown,
American Chemical Society,
Washington, DC,
1990, \$69.95

Book review by R. F. Browner,
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Applications of liquid chromatography/mass spectrometry (LC/MS) have grown dramatically in recent years as workers have attempted to analyze compounds either too thermally labile or too involatile for direct gas chromatography/mass spectrometry analysis. This has been made possible through the availability of several reliable aerosol-based interfaces that also allow a reasonable choice of chromatographic conditions. This book, Volume 420 in the American Chemical Society, (ACS) Symposium Series, is based on papers from an ACS Division of Agrochemicals-sponsored symposium held at the 1989 Spring ACS meeting in Dallas, Texas. It contains 18 chapters grouped under three basic headings: (1) Agrochemicals: Pesticide Metabolism and Degradation, (2) Pharmaceuticals and Metabolism, and (3) Environmental Analysis. There is also a brief introductory chapter, providing a history of LC/MS. The techniques covered are primarily thermospray and particle beam LC/MS, with a small component of moving belt LC/MS and some discussion in several chapters of LC/tandem mass spectrometry (MS/MS) for confirmation purposes. No LC/continuous-flow/fast-atom bombardment, atmospheric pressure ionization, or electrospray work is included.

This book provides a snapshot image of LC/MS applications at a time of rapid technological development, basically in the context of industrial and governmental applications. Although most chapters discuss one technique applied to a single problem, one paper, that by Voyksner et al., is notable for focusing more generically on the type of structural information provided, in this instance, by particle beam and thermospray LC/MS and comparing the information content of each with MS/MS. In my opinion, this chapter alone would justify the cost of the book because it addresses the important issue of how these key technologies complement one another, each with its strengths and weaknesses, rather than simply applying the instrumentation at hand. With the rich and varied choices in LC/MS currently available, this is an approach that needs to be strongly emulated. This book is recommended reading in a highly important area, currently served only thinly by reference material.

Mass Spectrometry (Analytical Chemistry by Open Learning)

Reg Davis, Martin Frearson, and F. Elizabeth Prichard,
John Wiley and Sons, Inc., Chichester, England,
ISBN 0-471-91389-8 (paperbound),
copyright 1987, reprinted 1990, 603 pp., \$54.95

Book Review by Jeanette Adams,
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I had high hopes that this book would end my search for a textbook suitable for my graduate course in analytical mass spectrometry. I have been looking for a textbook that covers the theory and applications of current mass spectrometry, including instrumentation, gas-phase ion chemistry, and kinetics. Alas, my search continues.

The basic premise behind these *Analytical Chemistry by Open Learning* texts is superb. Following each short section that deals with a specific concept are a few problems that require the application of the immediately preceding material. There are also small learning aids interspersed throughout the text that require the student to think about other aspects of chemistry that are related to the topic. At the end of each chapter is a brief summary and a list of items that the student should have learned from the chapter. At the end of the book is a more detailed section that contains problems and answers, which permit the student to undergo self-assessment. This excellent approach to teaching maximizes the students' comprehension and recall of the subject.

It is therefore truly unfortunate that the overall content of the text is unsuitable for graduate level chemistry. The basic mass spectrometry equations leave out "e" (Oops!). The only ionization methods discussed are electron ionization, chemical ionization, field ionization, field desorption, fast-atom bombardment (FAB), and spark-source ionization. Accuracy and resolution are confused. The only mass analyzers discussed are magnetic, double-focusing, and quadrupole, and no stability diagrams are shown for the latter. The kinetic energy spread of ions leaving the ion source is repeatedly described as being Gaussian (Oops!). Metastable ions are only discussed in relation to a single-focusing magnetic sector instrument. The only detector described is the electron multiplier because other methods of electrical detection "are relatively rarely used" (Oops!). Emphasis is placed on using a photographic strip-chart recorder (I used them when I was in graduate school eons ago!). The tiny section on quasi-equilibrium theory is full of errors and incorrect simplifications. It is repeatedly stated that covalent bond energies are from 10 to 20 eV (WOW!), that bond frequencies are 10^{10} – 10^{12} Hz, and that energy is "moved around" a molecule. The ability

of alkyl groups to stabilize a positive charge is described incorrectly as being an "inductive" effect, and their ability to similarly stabilize a negative charge is ignored. The McLafferty rearrangement is drawn incorrectly. (It is also abbreviated as "McL," which I presume is pronounced as "nickel," Fred.) The only liquid chromatography/mass spectrometry (LC/MS) techniques described are thermospray and moving belt, and thus the state-of-the-art in upper mass detection for LC/MS is claimed to be 3000 Da, with the 5000-20,000-Da range being "impossible to separate and characterize" (Oops!).

I would like to see the excellent basic teaching approach of this book applied to a text that covers truly modern mass spectrometry. Specifically, items that were not discussed or mentioned were the following: plasma desorption, liquid secondary ion/mass spectrometry (LSIMS), laser desorption (LD), matrix-assisted LD, and electrospray ionization (ESI); continuous-flow/FAB, D(LSIMS), and ESI as high-performance liquid chromatography interfaces; time-of-flight, ion traps, and ion cyclotron resonance/Fourier transform mass analyzers; tandem mass spectrometry, collision-induced dissociation, and surface-induced dissociation for dissociation of biomolecules; photomultipliers, array detectors, channel plates, and ion counting in detection; the powerful capabilities of modern data systems; Rice-Ramsperger-Kassel-Marcus theory, kinetics, $P(E)$ distributions, $\log k(E)$ versus E curves, and the use of metastable ion decompositions for elucidating reaction paths; and experimental and theoretical gas-phase acidities and basicities of organic molecules. Perhaps several of us in the mass spectrometry community should each contribute a chapter and write such a textbook. Any volunteers?

Fundamentals of Gas-Phase Ion Chemistry

Edited by Keith R. Jennings,

Kluwer Academic Publishers, Dordrecht, The Netherlands,

ISBN 0-7923-2412-9, 1991, \$119.00

Book Review by Chrys Wesdemiotis,

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This book reports the proceedings of the NATO Advanced Study Institute on fundamentals of gas-phase ion chemistry held in Mont Ste. Odile, France, in June/July 1990. Twenty-six chapters present a broad spectrum of experimental and theoretical approaches

for studying gas-phase ion chemistry. Although the volume is not divided into sections, three subjects are the focus of most chapters. These are (1) the use of lasers to study state-selected ions, (2) cluster ion chemistry, and (3) studies of the unimolecular and/or bimolecular reactions of organic ions. Eighteen of the 26 chapters are built around the invited lectures and give up-to-date accounts of the described subject. The remaining chapters are summaries of panel discussions and workshops. With few exceptions, these latter contributions resemble a compilation of short abstracts with few references or figures.

The increased use of lasers in mass spectrometry is reflected by several chapters covering inter alia multiphoton ionization, laser desorption, photodissociation, measurement of onset energies, and spectroscopy of ions. Most of these chapters presuppose some familiarity of the reader with the subject; nevertheless, they provide short reviews over a wide area of laser applications and contain many useful references.

The first half of the book is largely concerned with the preparation of ions in selected energy states to assess the role of electronic and vibrational excitation in unimolecular dissociations and ion-molecule reactions. Internal energy and ion size effects are primarily illustrated with transition metal ions and atomic as well as molecular clusters. Notable topics are the dynamics of ion-molecule reactions with clusters, metal ion chromatography, and differentiation of reactions in and on clusters.

In contrast to the first half of the book, which emphasizes the physical chemistry of the studied processes, the second half is written by organic mass spectrometrists. These chapters concern the study of the structures and reaction mechanisms of organic ions. The various authors present a palette of experimental methods for the characterization of structures, mechanisms, and reaction intermediates. Examples include investigation of labeled stereoisomers, time-resolved studies using field ionization kinetics, tandem mass spectrometry and MS/MS/MS, and charge permutation. The book concludes with two chapters on industrial uses of gas-phase ion chemistry.

Comprehensive textbooks on gas-phase ion chemistry are not available. This compendium does not cover every fundamental aspect of gaseous ion chemistry; for example, biomolecules are barely included. The book reviews, however, a wide area of topics that have developed within the past years. It should therefore be of particular value in graduate and postgraduate courses.