

## Preface to the Second Edition

To all readers of the first edition of *Mass Spectrometry – A Textbook* I would like to express my deepest gratitude. Without their interest in wanting to learn more about mass spectrometry by use of this book, all the efforts in writing it would have been a mere waste of time, and moreover, without their demand for updates, there would be no next edition. I would also like to thank the instructors all over the world who adopted and recommended this book for their own mass spectrometry courses.

Preparing the second edition of *Mass Spectrometry – A Textbook* was not an easy task. The years have witnessed a flood of innovations and detailed knowledge of interrelationships that were previously hardly understood. The time between the editions may have appeared a bit long for many eager scholars. But the author has used the time effectively to improve and update the entire contents, hopefully to the benefit of all who have been patiently bearing with me in anticipation.

So, what's new? The book now comprises fifteen instead of twelve chapters, each of them headed by essential "Learning Objectives". Chapter 9 inserts methods of ion activation such as CID, ECD, ETD, and IRMPD closely related to the instrumental approaches to tandem mass spectrometry. A second additional chapter deals with sampling and ion generation from surfaces under ambient conditions as afforded by DART and DESI, to name the most relevant methods. Finally, a new chapter on inorganic mass spectrometry has been added, for one, to include element speciation that bridges the gap between biomedical and trace elemental analysis and, also, to open a perspective extending beyond the key topics of this book. The chapter on instrumentation has been significantly expanded to cover orbitrap, linear ion traps, TOF/TOF, FT-ICR, and the ever-changing hybrid instruments including IMS-MS systems. More detailed attention is drawn to applications regarding biopolymers, especially in those chapters dealing with MALDI and ESI.

Overall, the book has been expanded by more than 200 pages. No chapter has remained untouched. Numerous passages have been rewritten to improve the clarity of explanations while keeping them short and concise. Care has been taken not only to explain how, but also to why things are done a certain way. Several schemes have been added to clarify interrelationships between different techniques. Tables compiling data for general reference were transferred to the expanded appendix. The book's website has been updated providing new exercises and supplementary material (<http://www.ms-textbook.com>).

Many kind people have supported me in the process of compiling this second edition. I appreciate the detailed knowledge and great thoroughness of Kenzo Hiraoaka, Yasuhide Naito, Takemichi Nakamura, and Hiroaki Sato allocated to the translation of the first edition into Japanese. The valuable and welcome comments from readers from all over the world, and in particular, from book reviewers and colleagues have revealed some shortcomings in the first edition, which now have been eliminated to the improvement of the resulting new edition.

As in the first edition, several well-respected colleagues have contributed to this book by carefully checking contents in their fields of expertise. For the second edition, I want to express special thanks to Jürgen Grotemeyer, Universität Kiel, for checking Chap. 2 (*Principles of Ionization and Ion Dissociation*), Alexander Makarov, Thermo Fisher Scientific, Bremen (Chap. 4, *Instrumentation*), Christoph A. Schalley, Freie Universität Berlin (Chap. 9, *Tandem Mass Spectrometry*), Belá Paizs, German Cancer Research Center, Heidelberg (Chap. 11, *Matrix-Assisted Laser Desorption/Ionization*), Zoltán Takáts, Universität Gießen (Chap. 13, *Ambient Mass Spectrometry*), and Detlef Günther, ETH Zürich (Chap. 15, *Inorganic Mass Spectrometry*). Without their care and help the many new parts would not have reached the present level of accuracy. Despite intense reviewing and proof-reading some errors inevitably may have remained. I apologize for these in advance and would highly appreciate any feedback from the readership in trying to identify and correcting them.

I am indebted to Peter Roepstorff, Odense University, for writing the Foreword with such a personal connotation. Permission to prepare this 2<sup>nd</sup> edition, alongside my official professional duties, by A. Stephen K. Hashmi, Director of OCI, and Heinfried Schöler, Dean of the Faculty of Chemistry and Earth Sciences is sincerely acknowledged. Many thanks to Doris Lang, Iris Mitsch, and Norbert Nieth, for smoothly running the routine analyses in our MS facility. And again, several mass spectrometry companies are acknowledged for supplying new instrument schemes and other figures for inclusion in the 2<sup>nd</sup> edition. Theodor C. H. Cole accomplished a great job in polishing up my English. Finally, I am immeasurably grateful to my family for their patience and solidarity in times when I had to come home late or needed to vanish on Saturdays during the writing of this book.

Have a good time studying, learning, and enjoying the world of mass spectrometry!

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## Preface

When non-mass spectrometrists are talking about mass spectrometry it rather often sounds as if they were telling a story out of Poe's *Tales of Mystery and Imagination*. Indeed, mass spectrometry appears to be regarded as a mysterious method, just good enough to supply some molecular weight information. Unfortunately, this rumor about the dark side of analytical methods reaches students much earlier than their first contact with mass spectrometry. Possibly, some of this may have been bred by mass spectrometrists themselves who tended to celebrate each mass spectrum they obtained from the gigantic machines of the early days. Of course, there were also those who enthusiastically started in the 1950s to develop mass spectrometry out of the domain of physics to become a new analytical tool for chemistry.

Nonetheless, some oddities remain and the method which is to be introduced herein is not always straightforward and easy. If you had asked me, the author, just after having finished my introductory course whether mass spectrometry would become my preferred area of work, I surely would have strongly denied. On the other hand, J. J. Veith's mass spectrometry laboratory at Darmstadt University was bright and clean, had no noxious odors, and thus presented a nice contrast to a preparative organic chemistry laboratory. Numerous stainless steel flanges and electronics cabinets were tempting to be explored and – whoops – infected me with CMSD (chronic mass spectrometry disease). Staying with Veith's group slowly transformed me into a mass spectrometrist. Inspiring books such as *Fundamental Aspects of Organic Mass Spectrometry* or *Metastable Ions*, out of stock even in those days, did help me very much during my metamorphosis. Having completed my doctoral thesis on fragmentation pathways of isolated immo-nium ions in the gas phase, I assumed my current position. Since 1994, I have been head of the mass spectrometry laboratory at the Chemistry Department of Heidelberg University where I teach introductory courses and seminars on mass spectrometry.

When students ask what books to read on mass spectrometry, there are various excellent monographs, but the ideal textbook still seemed to be missing – at least in my opinion. Finally, encouraged by many people including P. Enders, Springer-Verlag Heidelberg, two years of writing began.

The present volume would not have its actual status without the critical reviews of the chapters by leading experts in the field. Their thorough corrections, remarks, and comments were essential. Therefore, P. Enders, Springer-Verlag Heidelberg (*Introduction*), J. Grotemeyer, University of Kiel (*Gas Phase Ion Chemistry*), S. Giesa, Bayer Industry Services, Leverkusen (*Isotopes*), J. Franzen, Bruker

Daltonik, Bremen (*Instrumentation*), J. O. Metzger, University of Oldenburg (*Electron Ionization and Fragmentation of Organic Ions and Interpretation of EI Mass Spectra*), J. R. Wesener, Bayer Industry Services, Leverkusen (*Chemical Ionization*), J. J. Veith, Technical University of Darmstadt (*Field Desorption*), R. M. Caprioli, Vanderbilt University, Nashville (*Fast Atom Bombardment*), M. Karas, University of Frankfurt (*Matrix-Assisted Laser Desorption/Ionization*), M. Wilm, European Molecular Biology Laboratory, Heidelberg (*Electrospray Ionization*) and M. W. Linscheid, Humboldt University, Berlin (*Hyphenated Methods*) deserve my deep gratitude.

Many manufacturers of mass spectrometers and mass spectrometry supply are gratefully acknowledged for sending large collections of schemes and photographs for use in this book. The author wishes to express his thanks to those scientists, many of them from the University of Heidelberg, who generously allowed to use material from their actual research as examples and to those publishers, who granted the numerous copyrights for use of figures from their publications. The generous permission of the National Institute of Standards and Technology (G. Mallard, J. Sauerwein) to use a large set of electron ionization mass spectra from the NIST/EPA/NIH Mass Spectral Library is also gratefully acknowledged. My thanks are extended to the staff of my facility (N. Nieth, A. Seith, B. Flock) for their efforts and to the staff of the local libraries for their friendly support. I am indebted to the former director of our institute (R. Gleiter) and to the former dean of our faculty (R. N. Lichtenthaler) for permission to write a book besides my official duties.

Despite all efforts, some errors or misleading passages will still have remained. Mistakes are an attribute that make us human, but unfortunately, they do not contribute to the scientific or educational value of a textbook. Therefore, please do not hesitate to report errors to me or to drop a line of comment in order to allow for corrections in a future edition.

Hopefully, *Mass Spectrometry – A Textbook* will introduce you to the many facets of mass spectrometry and will satisfy your expectations.

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