DYNAMIC MASS SPECTROMETRY

Volume 6

EDITORS: D.PRICE & J.F.J.TODD

DYNAMIC MASS SPECTROMETRY

Volume 6

Edited by

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Volume 6

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VOLUME 5, 1978

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AN INTERNATIONAL DYNAMIC MASS SPECTROMETRY SYMPOSIUM

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AN INTERNATIONAL DYNAMIC MASS SPECTROMETRY SYMPOSIUM CONCERNED WITH TIME-OF-FLIGHT QUADRUPOLE AND ICR MASS SPECTROMETERS

VOLUME 3, 1972

Edited by D. Price

REVIEW VOLUME INCORPORATING THE THIRD EUROPEAN SYMPOSIUM OF THE TIME-OF-FLIGHT MASS SPECTROMETER

Preface

An international symposium devoted to dynamic mass spectrometry was held at the University of Kent on 7–10 July 1980. The meeting provided a forum for the discussion of the current usage and future development of dynamic mass spectrometry, and the contributions presented form the basis of the contents of this present volume. Each article has been edited and amended as necessary, then photo-reproduced from authors' texts. The contents form an up-to-date account of the current state of the field of dynamic mass spectrometry.

The chapters have been divided into groups concerned with Instrumentation and Applications, the latter being sub-divided further into specialist areas: Process Control, Monitoring and Analysis, and Reaction Studies. A Bibliography listing references on Instrumentation and Theory is included at the end of this volume. Compared with the contents of Volumes 4 and 5 of the Series, the balance between the types of instrument reported upon at the Symposium has moved back somewhat towards the time-of-flight mass spectrometer as against the quadrupole, and whilst perusal of the literature confirms that the latter is still more popular in terms of breadth of application, there is a growing body of work for which TOF analysis is the method of choice.

The editors wish to thank all the contributors who have made this volume possible. A further symposium is planned for 1983, and contributions and suggestions are welcome.

D. Price
April 1981 J. F. J. Todd

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Delegates attending the International Dynamic Mass Spectrometry Symposium, University of Kent at Canterbury, July 1980

1. D. Price; 2. B.Y. Taillez; 3. J.B. French; 4. S. Hume; 5. A.L. Gray; 6. M. Baril; 7. R.H. Crawford; 8. F.M. Harris; 9. J.H. Scrivens; 10. W.L. Fite; 11. R.S. Houk; 12. A.J.H. Boerboom; 13. R.B. Turner; 14. D.A. Freer; 15. T.W. Ottley; 16. D. Avery; 17. J. Wyatt; 18. P.E. Norris; 19. R.E. Mather; 20. A. Höh; 21. J. Olsson; 22. J.M.B. Bakker; 23. R. Holger Gabling; 24. K. Möller; 25. R.T.B. Parkinson; 26. K.-P. Wanczek; 27. K.A. Lincoln; 28. G.J. Milnes; 29. C. Lukas; 30. R.D. Pilkington; 31. J.F.J. Todd

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Contents

INSTRUMENTATION

Chapter 1

A Survey of the Current State of Quadrupole Mass Spectrometry

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1. *INTRODUCTION*

This is the third survey of progress in quadrupole mass spectrometry which I have contributed to this series of International Symposia on Dynamic Mass Spectrometry, the previous ones having appeared in 1976 [1] and 1978 [2]. The developments which are described in the following review have, in the main, been reported since mid-1977. The material covered relates principally to the mass filter; a chapter concerned specifically with quadrupole ion traps is contained elsewhere in this Volume [3].

Compared with the earlier surveys, a significant change has been the reduction in the number of new types of instrument appearing in the literature. Thus in 1976 I was able to give accounts of the 'ELFS' modification which led to greatly improved quadrupole sensitivity and resolution, of multiple mass spectrometers; of the focussing dipole and of the use of rectangular wave excitation. Some of these topics were again considered in 1978 when attention was also drawn to advances in the theory of quadrupoles, but rather more emphasis placed upon the rapidly expanding applications of these instruments. Not surprisingly, this general trend has continued for the past three years, and whilst no fundamentally new types of quadrupole appear to have been reported, the range of applications has increased dramatically. The purpose of this survey is, therefore, to highlight those developments which have come to the attention of the author, including those applications which possess a degree of novelty and/or draw upon some of the unique characteristics of the quadrupole mass filter.

2. *THEORY*

One of the most significant contributions to the development of the theory of ion motion in RF quadrupole electric fields has been the introduction of the method of phase-space dynamics pioneered by Baril and Septier[4], and an important further study of the fundamental properties of the Hill equation in relation to the design of the mass filter has been published by Baril[5]. Several authors have utilised the phase-space approach to predict the behaviour of the mass filter in certain specific applications, thus providing a basis for comparison with