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# Foreword

Ion mobility spectrometry (IMS) has a long history that in many ways parallels that of mass spectrometry; nevertheless, IMS is not widely known in the mass spectrometry community. This special issue will address that knowledge gap, describing recent advances in the area of ion mobility spectrometry both alone and in conjunction with mass spectrometry (IMS/MS). It includes papers that address fundamentals, instrumental advances, and novel applications of ion mobility spectrometry.

Traditional (drift tube) ion mobility spectrometers are analogous to time-of-flight mass spectrometers (TOFMS), wherein a pulse of ions is introduced into a drift tube, where they are propelled along the drift tube by a constant axial electric field, and the time the ions take to reach the detector is recorded. In contrast to TOFMS, the drift tube contains a carrier or buffer gas at pressures ranging from a few mbar (torr) up to an atmosphere. Drift time is dictated by the rotationally-averaged collision cross section of an ion and that ion's charge (i.e., ions are separated by size-to-charge ratio, as opposed to mass-to-charge ratio in mass spectrometry).

As reflected in the papers collected here, there are other instrumental approaches to ion mobility spectrometry. One is to use a series of potential waves propagating along a drift tube to propel ions along. In many ways, this travelling wave ion mobility spectrometer is analogous to the Bennett RF mass spectrometer. Another approach is to separate ions by the difference in their mobility at high and low electric field. This is accomplished by propelling the ions pneumatically between two parallel electrodes, with an asymmetric electric field imposed between them. Such a differential mobility spectrometer or DMS (also termed field asymmetric ion mobility spectrometer or FAIMS) is analogous to a quadrupole mass filter. Finally, ions can be separated by a combination of a gas flow and an orthogonal electric field, termed a differential mobility analyzer (DMA), more familiar for separating aerosol particles.

Advantages of ion mobility spectrometry include rapid separation (on the order of milliseconds, far faster than any chromatographic separation), high sensitivity, compact design (even handheld), and ease of use (no need for a vacuum system). Commercial IMS systems have generally taken advantage of these capabilities for field detection of explosives, chemical weapons, and illicit drugs. As a research tool, however, IMS has been widely used in the analysis of biomolecules ionized by electrospray and MALDI, generally with ion detection by mass spectrometry. The combination of ion mobility separation with MS not only provides more rapid separation than combined gas or liquid chromatography with MS, it also provides information on the size of the ion (useful, for instance, in exploring protein conformation).

This special issue includes 14 articles that address fundamental studies, instrumental advances, and novel applications of these ion mobility spectrometry approaches to a wide variety of areas, ranging from explosives detection to metabolomics to peptide/protein complexes. We hope that you will agree that this focused collection of work will help to advance scientific knowledge in this important area and that you will enjoy reading the articles collected here.

In closing, we sincerely thank all of the authors for their contributions to this Special Issue, and for their patience as it has been assembled. We also acknowledge the anonymous reviewers for their efforts in ensuring the quality of these publications.

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