MIKES (Mass-Analyzed Ion Kinetic Energy Spectrometry): History & Significance

The mass-analyzed ion kinetic energy spectrometry (MIKES) instrument was designed and constructed at Purdue University in the period 1971-1973 by J. H. Beynon, J. W. Amy, R. G. Cooks, W. E. Baitinger, and T. Y. Ridley. It was built to allow the characterization of ions by their metastable and collision-induced dissociation processes. It combined the utility of its predecessor, the ion kinetic energy spectrometer, with the ability to mass-select precursor ions. The precursor ion is mass-selected using the magnetic sector and its dissociation products are mass analyzed using the electric sector (a kinetic energy/charge analyzer, but a mass/charge analyzer at constant ion velocity). The details of the peak shapes revealed in the electric sector can provide information on the kinetic energy release in the course of fragmentation and on the kinetic energy uptake in the course of ion-collision processes. Dispersion of velocities due to kinetic energy release leads to the characteristic wide metastable peaks observed using the MIKES technique.

The MIKES spectrometer is a reverse-geometry (BG) mass spectrometer unit and was the first tandem mass spectrometer used for analysis of mixtures. This application was launched with the addition of a chemical ionization source to the instrument, allowing mixtures of compounds to be converted to the corresponding mixtures of molecular ions. The experiment, which came to be known as tandem mass spectrometry (MS/MS), showed improved signal-to-noise ratios through the elimination of chemical noise when used for the analysis of trace components in complex mixtures. Subsequent instrumental developments, seeking to overcome the limitations of the MIKES spectrometer, led to the development of other tandem mass spectrometers such as the triple quadrupole, the quadrupole/time-of-flight (Q/TOF) and other hybrid instruments, such as the BQQ and BBQQ which mixed sectors with quadrupole mass filters.

Photograph of the MIKES spectrometer at Purdue University, ca 1981

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