Hermann Wollnik, J Chromatogr Sep Tech 2017, 8:3(Suppl)
DOI: 10.4172/2157-7064-C1-024

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Precision mass measurements by time-of-flight mass spectrometry in the laboratory and in space missions

The masses of atomic and molecular ions have been studied successfully since more than 100 years with the highest mass resolving powers being reached by "Fourier Transform Ion Cyclotron Resonance" (FTICR-MS) mass spectrometry and by "time-of-flight mass spectrometry" (TOF-MS). While FTICR-MS systems can reach very high mass resolving powers m/Δm. However, the required heavy usually superconducting magnets limit their use to special laboratories. TOF-MS systems on the other hand are built in most cases as lightweight systems and can very well be used for on-line applications in stationary or transportable laboratories and in extreme cases even in space crafts. The achievable mass resolving power in time-of-flight mass analyzers (TOF-MA) systems increases with the use of shorter and shorter ion packets as well as with longer and longer ion flight paths. Such long flight paths are often achieved by using the same path repeatedly for instance in sector field ion storage rings or in systems in which ions are reflected again and again between electrostatic ion mirrors. Such systems can reach mass resolving powers m/Δm of several 100,000 and probably soon even higher values, when better and better power supplies can be used. Examples of different TOF-MAs will be shown with applications to the mass identification of short-lived nuclei at heavy ion accelerators as well as for the analysis of molecular ions in chemistry laboratories and in spacecraft systems. Such TOF-MAs are often used as stand-alone systems. However, in increasingly many cases they are used in combination with mobility analyzers, which distinguish molecule ions by their shape.

Biography

Hermann Wollnik is professor at the Universität Giessen, in Giessen, Germany and adjunct professor at the New Mexico State University in Las Cruces, NM, USA. He has published the popular book "optics of charged particles" and is author of 374 publications in refereed scientific journals with 5693 citations. In the late 1970s he has started time-of-flight mass spectrometry and used this technique for the precise mass determination of short-lived nuclei as well as for molecule identifications in space missions like the ROSETTA mission to a comet.

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