

Exact Mass for the Masses – The Exactive Benchtop FT Mass Spectrometer

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Over the past three years the combination of Orbitrap technology with a linear ion trap has become an established platform for high-resolution, accurate mass LC/MSⁿ analysis. The high resolving power, mass accuracy and dynamic range of the orbitrap analyser allow rigorous characterization of complex mixtures even in the absence of precursor ion mass selection. Based on this observation, a non-hybrid mass spectrometer has been developed wherein a stand-alone orbitrap mass analyser is combined with an atmospheric-pressure ion source (API). The instrument layout, the main analytical parameters and typical applications will be presented in this work.

Method

Samples are introduced to the API source by either direct infusion or an HPLC system. Ions are transferred from the API source through four stages of differential pumping using RF-only multipoles into a curved RF-only quadrupole (the C-trap). In the C-trap ions are accumulated and their energy dampened using a bath gas (nitrogen). Ions are then injected through three further stages of differential pumping using a curved lens system into the orbitrap analyser where mass spectra are acquired via image current detection.

Results

The major analytical challenge to the usability of any stand-alone ion trap is control of the ion population in the trap. When ion populations are not accurately maintained it can result in large variations in the quality of data due to rapidly changing ion flux, such as occurs during HPLC analysis. The high space charge capacity of both the C-trap and orbitrap allows the implementation of automatic control of the number of ions by sensitive measurement of total ion charge without using an electron multiplier.

This allows the instrument to achieve analytical performance (resolving power, mass accuracy and dynamic range) which is comparable with a hybrid linear ion trap - orbitrap mass spectrometer. More importantly, use of a single mass analyser and the very high transmission characteristics of the entire ion optical system allow high resolution mass spectra to be detected, processed and recorded at high scan rates compatible with the narrow peak widths observed in ultra high performance chromatography (UHPLC) analyses. The analytical parameters of the new instrument will be demonstrated by means of both infusion experiments and LC/MS analyses. In addition, examples from screening applications and elemental composition determinations will be discussed.

