Hollow-cored toroidal-coil (HTC) detector for fast transient signals in ICP-MS

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Mass spectrometry methods are used from elemental analysis to the identification of large organic compounds. For all the mass filters a longer signal acquisition time leads to improved spectra and a wider m/q range that can be scanned. Mass analyzers instead such as Time-Of-Flight enhance their performance with short transients.
However, limitations from space charge and/or the requirement to compress the time-domain m/q phase-spread do limit the use for ultrafast transient from small sample amounts. In Fourier transform (FT) mass spectrometry one looks at the frequency domain, which help to overcome time-domain constratints. However, in methods like orbitrap-MS and ICR-MS the m/q range can only be investigated at a narrow dynamic range due to the space charge effect, making longer measurement times and higher sample uptake necessary for obtaining the complete mass spectra.[1] Furthermore, the longer transient will lead to spectra with a better resolution, sensitivity and signal to noise ratio.[1]
In depth profiling analysis of coatings using Laser ablation ICP-MS, where depth resolved elemental composition is of interest, the measurment time cannot be simply extended. To circumvent this problem, we realized an induction detector that can measure different ions simultaneously. The hollow-core toroidal (HCT) detector is a differerentiator.[2] It measures changes in the ion current wavefunction. As the induction goes, the sensitivity is all the best for faster current changes. This dramatically enhances the sensitivity for ultrafast transients and makes it blind to DC background. Figure 1 shows the basic proposed setup for the HTC detector in an ICP-MS.
In this work we show preliminary experimental results from measurments with the coil and investigate which data treatment methods that are readily used in orbitrap-FT-MS and ICR-FT-MS could also be applied to this new detector.[3]

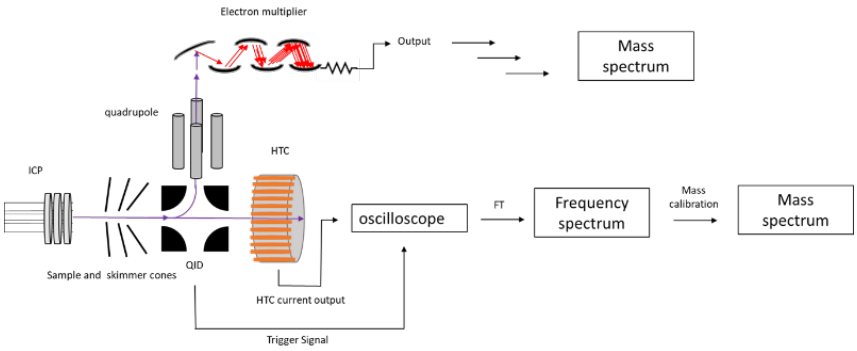

Figure 1: Scheme of the HTC detector placed inside an ICP-MS and the working steps for obtaining a mass spectra.

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[2] Y. Arbelo, D. Bleiner, *Rev. Sci. Instrum.*, **2017**, 88, 024710
[3] Y.O. Tsybin, K.O. Nagornov, A.N. Kozhinov, Fundamentals and Applications of Fourier Transform Mass Spectrometry, **2019**, Elsevier, 113-132