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Advances in time of flight LA-ICP-MS using up to 1kHz ablation rates and novel techniques to extend dynamic range, increase sensitivity and remove interferences

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In situ techniques based on Laser Ablation and Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) have been widely used, rapidly evolving into well-established, powerful tools for direct analysis of solid samples.

Recent advances in laser ablation have allowed for particulate plumes from each laser shot to be efficiently transported to the detection system with minimal diffusion, enabling a clear differentiation of each shot at very high ablation rates up to 1000Hz.

Fully leveraging these advances requires a new type of mass spectrometer. Sequential scanning mass spectrometers are unable to measure more than one or two ions during such rapid events, and efforts to do so result in aliasing effects and pixel lag that cannot be resolved through data reduction. A TOF mass analyser solves these issues by detecting virtually the entire mass spectrum quasi-simultaneously at spectral accumulation times in the sub-millisecond timeframe. Data will be shown which demonstrates high speed LA-ICP-TOF-MS at high lateral resolution with full elemental coverage.

We also demonstrate that the previously reported issues of limited dynamic range and poor abundance sensitivity of a TOF-ICP-MS can be resolved using multiple shots per pixel, beam attenuation and closed loop triggering of stage movements to enable a novel technique which can create images showing elements between 100% and sub-ppm levels in one image.

Other applications will show the increased sensitivity available with an increase of the TOF duty cycle when reducing the mass range covered and the specialist interference removal capabilities that allow access to more abundant isotopes not normally used in the laser ablation of certain matrices.