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Exploring Aligned LA–ICP–MS

NICHOLAS WEST AND DR. C. ASHLEY NORRIS

Norris Scientific

Laser ablation inductively coupled mass spectrometry (LA–ICP–MS) is a powerful analytical technique that can capture almost the entire periodic table at single-digit µm spatial resolution [1]. In recent years, the transit time of the ablated aerosol from the sample to the mass spectrometer has been improved ("fast washout," typically < 50 ms washout to 1 %), supported by laser systems firing at hundreds of Hz. Lasers with higher repetition rate, combined with faster washout times raises the potential for shorter total analysis times and higher peak signal intensity, but the probability of experimental conditions that produce aliasing or "spectral skew" is also increased [2]. Active alignment allows the firing of the laser to be synchronised with the mass scan ("sweep") of a sequential ICP–MS, to eliminate aliasing and to avoid timing drift over long analytical sessions. Our alignment device [3] (now called "QuadLock") typically reads the high-voltage DC signal of the quadrupole mass filter directly, and aligns the laser timing to this signal. We have modified a QuadLock sensor to interface with the control signals for the "NexION" range of quadrupole ICP-MSs from Perkin Elmer. This interface bypasses the high–voltage stage of the circuit, simplifying the connection of the sensor to the mass spectrometer. We tested a NexION 2200, which is claimed to have a faster settling time between each mass jump of the quadrupole. This gives the potential to improve detection efficiency, particularly for faster mass scans (e.g < 20 ms total sweep time). We compare mass scans of the same method across different instruments, and quantify the potential improvement from faster settling times. Furthermore, QuadLock is able to log each sweep of the quadrupole and identify those when the laser was firing. This new feature allows for an improvement in data reduction, as all ablation intervals can now be perfectly identified without concern for clock synchronisation between instruments.

[1] Chew, D., et al (2021).*Chemical Geology*, 559, p.119917.

[2] Hattendorf, Bodo et al, (2018). *Analytical and Bioanalytical Chemistry*, 411(3), pp.591–602.

[3] Norris, C.A., et al (2021). *Journal of Analytical Atomic Spectrometry* 36. pp.733–739.