Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18667

‘Gold Standard Data’; using collision cell approaches to improve the fidelity of detection for particle transient signals in (MC)-ICPMS/MS.

JAMIE LEWIS[1], ANDREW M. DUFFIN[2], MITCHELL A. MANNINO[2], LYNN S. WOOD[2], APRIL J. CARMAN[2], GREGORY C. EIDEN[3], CHRISTOPHER D. COATH[1] AND TIM ELLIOTT[1]

[1]University of Bristol
[2]Pacific Northwest National Laboratory
[3]Idaho National Laboratory

Presenting Author: jamie.lewis@bristol.ac.uk

Accurate and reproducible detection of ions is a crucial requirement of all mass spectrometers. Nevertheless, the fidelity of detector systems for accurately recording their input signals, i.e., mass separated ions from the ion source, cannot always be guaranteed. Considering electron multiplier type detectors, ions striking the detector may not be detected for various reasons, e.g., paralysing and non-paralysing deadtime, insufficient electron cascade intensity (low yield) and blind times at the start or end of integrations. These problems are particularly acute for so-called ‘unruly’ particle transient signals in ICPMS analyses; here we focus on MC-ICPMS. The arrival of a sample particle (µm to nm in scale) in the plasma, from either laser ablation or single particle analysis, creates a transient ion cloud which enters and transits the mass spectrometer quickly, arriving at the detector in a very short arrival window (100’s of microseconds to a few milliseconds) leading to ion ‘pile up’ at the detector, high instantaneous count rates and uncounted ions due to deadtime. Such behaviour is detrimental to analysis, resulting in non-linearity in response (expected *vs.* measured counts) for elemental abundance quantification and inaccurate isotope ratio analyses as the major isotope signal(s) are under-counted relative to the minor.

We present the results of using a collision cell MC-ICPMS/MS to improve the behaviour of these particle transient signals. Gold nanoparticles of various sizes have been used to produce transient signals and a high-speed, time-to-digital converter is used for data collection. A range of collision and reaction gases have been introduced in the collision cell with the goal of spatially and hence temporally spreading out the ion cloud as it transits the collision cell in order to extend the arrival window of ions at the detector and improve the fidelity of the ion detection. The effects of applying an axial acceleration potential have also been investigated. We find that adding collision gas significantly broadens the arrival time of the ions at the detector, greatly improving the linearity of the detection system response. In contrast, applying an axial acceleration potential appears to be detrimental to broadening the arrival time.