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Increasing Stability of Hydride Generation Toward Improving Isotope Ratio Analysis

MICHAEL W MANHART, WILL SWENSON AND PAUL FIELD

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Isotope ratio measurements provide critical insights into geochemical cycling, environmental processes, and biological systems. Certain analytes of interest, including selenium (Se) and mercury (Hg), require chemical conversion to volatile hydride species to achieve efficient introduction and optimal sensitivity in multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS). Traditional hydride generation systems employ peristaltic pump-driven mixing of sample with concentrated acid and a chemical reductant. While effective, this approach is prone to signal instability, arising from pump pulsation and, more significantly, from reductant gas bubble entrainment. These bubbles cause extreme signal instability during analysis.

Here, we present a simple add-on hydride generation module directly interfaced with our Isotope2 autosampler to improve stability and precision during measurements. The system utilizes programmable syringe loading of sample volumes up to 2000 µL, followed by syringe injection that controls mixing sample, acid, and reductant while preventing gas bubble introduction. This produces a flat injection profile free of signal dips and spikes, <3% percent relative standard deviation (%RSD) versus >10% for peripump. Syringe-driven injection provides precise control over sample delivery rate, allowing optimization of hydride formation efficiency for specific analytical conditions.