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Glow discharge spectroscopy for determination of uranium isotope ratios*

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We have developed a technique for uranium isotope ratio determinations in field settings. Such a technique will be invaluable to investigators for rapid analyses during on-site inspections, where immediate data can help guide a sampling campaign. The method encompasses glow discharge sputtering from pressed sample hollow cathodes, high resolution laser spectroscopy using conveniently tunable diode lasers, and optogalvanic detection. Upon completion of an analysis, most of the sample cathode remains and can be archived as evidence or returned to a laboratory for further examination. Using this technique, we determined the analytical figures of merit (sensitivity, accuracy, linearity, and precision) for 235U/(235U+238U) isotope ratio measurements for uranium samples with enrichments as low as "depleted" (0.3% 235U). At 10% 235U enrichment and above, the observed precision was ± 3%; it declined to ±15% for 0.3% samples. Oxide powder samples were amenable to this method, even though the U-O bond is tenacious; glow discharge sputtering was sufficiently energetic to yield gaseous uranium atoms. To optimize the method, different discharge gas conditioning methods were examined to study the corresponding effect on the observed optogalvanic signal strength. A prototype instrument was constructed and will be described. It was tested by analyzing an enriched uranium oxide sample.

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