Dynamic multicollector LG-SIMS analysis of mixed U-Pu materials

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We present a method for dynamic multicollector LG-SIMS analysis of uranium and plutonium isotopics. The use of LG-SIMS to measure uranium isotopics (^{234}U, ^{235}U, ^{236}U, ^{238}U, and ^{238}UH) in multicollector mode has been previously demonstrated for safeguards applications [1, 2]. This method is adapted to include Pu isotopics using a dynamic magnet jump and mass dispersion adjustment to analyze ^{239}Pu, ^{240}Pu, ^{241}Pu on the lowest three multicollector detectors. Interfering hydride peaks form at the 239.05 peak (comprising $^{238}UH + ^{239}Pu$), the 240.05 peak ($^{239}PuH + ^{240}Pu$), etc. In polished NIST 610, the U hydride formation is negligible, $\leq 4*10^{-5}$. Similar results were found for Pu-bearing glasses. Hydride formation will be greater for particulates, where the surface area to volume ratio is higher [3]. We have tested this method on polished synthetic glasses with trace abundances of U and Pu. Results show consistent accuracy and precision, with counting statistics being the largest source of uncertainty. The useful yield of Pu is 2.3-2.5 times higher than U in glass, similar to what has been reported in the literature for other materials [3, 4]. This method allows for the determination of interelement U/Pu ratios in the same volume of material, which is critical for inhomogeneous materials or small sample volumes, where two separate measurements are not feasible.

[1] Peres et al. (2013) Surf Interface Anal 45, 561–565. [2] Hedberg et al. (2015) J. Anal At Spectrom 30, 2516-2524. [3] Ranebo et al. (2010) Anal. Chem. 82, 4055-4062. [4] Stoffels et al. (1994) J Am Soc Mass Spectrom 5, 852-858.

Goldschmidt2019 Abstract