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Title:

Actinide Measurements by Accelerator Mass Spectrometry at LLNL

Abstract:

We report on the development of an accelerator mass spectrometry (AMS) system for the measurement of actinides at Lawrence Livermore National Laboratory. This AMS system is centered on a recently completed heavy isotope beam line that was designed particularly for high sensitivity, robust, high-throughput measurements of actinide concentrations and isotopic ratios. A fast isotope switching capability has been incorporated in the system, allowing flexibility in isotope selection and for the quasi-continuous normalization to a reference isotope spike.

Initially, our utilization of the heavy isotope system has concentrated on the measurement of Pu isotopes. Under current operating conditions, background levels equivalent to $\sim 1 \times 10^5$ atoms are observed during routine ^{239}Pu and ^{240}Pu measurements. Measurements of samples containing $\sim 10^{13}$ ^{238}U atoms demonstrate that the system provides a ^{238}U rejection factor of $\sim 10^7$. Measurements of known materials, combined with results from an externally organized inter-comparison program, indicate that our ^{239}Pu measurements are accurate and precise down to the μBq level ($\sim 10^6$ atoms). Recently, we have investigated the performance of our heavy isotope AMS system in measurements of ^{237}Np and ^{236}U . Results of these investigations will be presented.

The development of the heavy isotope AMS system was undertaken with particular interest in the measurement of actinides in environmental samples, including air filters, soil, sediment, water, marine biota, and human urine. Further, low-level measurements of Pu isotopes, ^{236}U and ^{237}Np all have a number of applications in the fields of nuclear isotopic forensics, risk assessments for occupational and long-term environmental stewardship, and litigation over occupational, military and/or public exposures. The sensitivity shown by our Pu measurements, combined with the high throughput and interference rejection capabilities of our AMS system, demonstrate that AMS can provide a rapid and cost-effective measurement technique for actinides in a wide variety of studies.

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