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Analysis of single U-rich particles by fission track laser ablation ICP-MS

The isotopic analysis of single U-rich particles that are collected during IAEA inspections by means of cotton swipes is an important tool in nuclear safeguards to help verify the absence of undeclared nuclear material and activities. Two methods that are routinely used within the IAEA Network of Analytical Laboratories to determine particles' U and/or Pu isotopic compositions are fission track thermal ionization mass spectrometry (FT-TIMS) and secondary ion mass spectrometry (SIMS). However, another method that has aroused interest as a complementary technique for particle analysis in the international safeguards community during the last decade is laser ablation coupled to inductively coupled plasma mass spectrometry (LA-ICP-MS).

U-rich particles that are collected during IAEA swipe sampling have sizes in the μm and sub- μm range and can typically not be identified with cameras mounted in laser ablation systems. In order to avoid determining "mixed" isotope ratios from two or more particles with different isotopic compositions, the location of the particles of interest (POI) needs to be identified prior to the LA-ICP-MS analysis. Here, a fission track technique, where natural U particles were deposited on Si wafers and irradiated at the Research Center Rez, Czech Republic, was used for selecting POIs for the subsequent LA-ICP-MS analysis. The fission tracks are a good indicator for both enrichment and particle location. Coordinates were confirmed by scanning electron microscopy (SEM) analysis using a LYRA 3 FIB-SEM system (Tescan). The relocation accuracy between instruments was better than 20 μm .

The isotopic analysis of the selected particles was performed by LA –multi collector –ICP-MS, using a J200 fs-laser ablation system (Applied Spectra, Inc.) and a Neptune "Plus" MC-ICP-MS (Thermo Fisher Scientific). The determined $^{234}\text{U}/^{238}\text{U}$ and $^{235}\text{U}/^{238}\text{U}$ isotope ratios were overlapping within uncertainties with the certified values.

The presented work demonstrates very well the high potential of FT-LA-MC-ICP-MS for single particle analysis for environmental inspection samples.

Which "Key Question" does your Abstract address?

TEC5.1

Which alternative "Key Question" does your Abstract address? (if any)

TEC5.5

Topics

TEC5

Primary author: Dr KONEGGER-KAPPEL, Stefanie (IAEA Environmental Sample Laboratory)

Co-authors: Mr HORAK, Felix (IAEA Environmental Sample Laboratory); Dr LORINCIK, Jan (Research Center Rez); Ms REZANKOVA, Klara (Research Center Rez); Ms SIHELKA, Kristina (Research Center Rez)

Presenter: Dr KONEGGER-KAPPEL, Stefanie (IAEA Environmental Sample Laboratory)

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