Contribution ID: **919** Type: **Verbal**

Analysis of isotopic composition of inhomogeneous samples by LA-MC-ICP-MS

Tuesday, 17 May 2022 14:20 (20 minutes)

Uranium materials are strictly controlled by the international nuclear safeguards system. However, if such materials get out of regulatory control and subsequently seized, a comprehensive measurement is eventually required to assess the posed hazard, intended use and possible origin. Such nuclear forensic analysis focuses on the analysis of these intercepted nuclear or other radioactive materials to provide information for the investigating authority to avoid the diversion and subsequent malicious use [1-3].
Most nuclear forensic samples contain (in)visible inhomogeneity, which possibly provide suggestions for nuclear forensic conclusions. One of the few possible techniques for such measurements is laser ablation inductively coupled plasma multi-collector mass spectrometry (LA-MC-ICP-MS). As LA uses a focused laser beam scaled down to a few micron, LA-ICP-MS analysis can reveal sample inhomogeneity in the material in question and is able to measure the spatial isotopic composition. However, the precise measurement can be hindered by the instrumental parameters (e.g. laser beam size or scan speed) or by the sample characteristics (e.g. grain size or differences in U isotope enrichment) [4].
The present work investigates the qualitative measurement of U isotopic inhomogeneity for nuclear forensics by LA-MC-ICP-MS. To study the important parameters, a synthetic sample was prepared by the mixing of two solid certified standard materials (SRM U-010 and SRM U-030) to mimic an inhomogeneous U sample. The developed LA-MC-ICP-MS method was also measured and compared with the large-geometry secondary ion mass spectrometry. By a rough LA measurement using a line scan or a 2-D area (map) on the sample surface (pre-screening),the points-of-interest in the inhomogeneous sample can be found and selected. After finding the required sample position, a more precise measurement can be performed on the designated small locations. The procedure allows the accurate analysis of the isotopic composition at the relevant spots and significant and the proper identification of the end-products (i.e. the constituting starting materials).

[1] Mayer K, Wallenius M, Varga Z (2013) Nuclear forensic science: Correlating measurable material parameters to the history of nuclear material. Chemical Reviews 113, 884-900

[2] Kristo MJ, Gaffney AM, Marks N, Knight K, Cassata WS, Hutcheon ID (2016) Nuclear Forensic Science: Analysis of Nuclear Material out of Regulatory Control, Annual Review of Earth and Planetary Sciences 44, 555-579

[3] Varga Z, Wallenius M, Krachler M, Rauff-Nisthar N, Fongaro L, Knott A, Nicholl A, Mayer K (2022) Trends and Perspectives in Nuclear Forensic Science, TrAC Trends in Analytical Chemistry, 146, 116503

[4] Varga Z, Wallenius M, Nicholl A, Mayer K (2020) Assessment of uranium inhomogeneity and isotope imaging for nuclear forensics, Spectrochimica Acta - Part B Atomic Spectroscopy 171, 105920

Primary authors: VARGA, Zsolt (EC JRC Institute for Transuranium Elements); Dr WALLENIUS, Maria (EC Joint Research Centre); Mr NICHOLL, Adrian (EC Joint Research Centre); Dr MAYER, Klaus (EC Joint Research Centre)

Presenter: VARGA, Zsolt (EC JRC Institute for Transuranium Elements)

Session Classification: Nuclear Analytical Methods

Track Classification: Nuclear Analytical Methods