SIMS study on molecular isobaric interferences for the isotope analysis of uranium included in soil matrix

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Isotopic ratios of particles including nuclear materials in environmental samples provide the important information related to undeclared nuclear activities. Secondary Ionization Mass Spectrometry (SIMS) is typically used to measure the isotopic ratio of individual particles, because it can locate uranium particles among others and provide the isotope data within a short time frame. However, the use of SIMS technique is often limited due to isobaric background interferences induced by metal elements contained in environmental samples. The common metal elements such as Pb, Mo, W, and Ba are combined with other organic materials and produce the cluster ions which have the same masses as those of uranium. These cluster ions affect the uranium isotopic measurement for both of major and minor isotopes, so it leads to reduce the accuracy and precision.

In this study, we aim to investigate molecular isobars induced from soil, a matrix of a certain type of environmental samples. We prepared the simulated samples using a uranium standard material (CRM U020a) and a soil reference material (SRM 2587), which does not include a significant amount of uranium. We first analyzed the soil reference material using time-of-flight SIMS, in order to observe the uranium isobars pattern in the soil matrix. Then, we tried to evaluate formation rates of molecular isobars in the soil matrix using sector-field SIMS. Lastly, a uranium-soil mixed sample was analyzed to figure out which isotope is mostly influenced by the interferences.