CHEMICAL STUDIES OF THE HEAVIEST ELEMENTS AT JAEA

Nagame Y.

Advanced Science Research Center, Japan Atomic Energy Agency (JAEA),
Tokai, Ibaraki 319-1195, Japan,
e-mail: nagame.yuichiro@jaea.go.jp

Chemical characterization of the heaviest elements at the farthest reach of the Periodic Table is a challenging and fascinating subject not only in nuclear and radiochemistry but also in general chemistry. One of the most important and interesting aspects is to clarify basic chemical properties of these newly synthesized elements, such as ionic radii, redox potentials, and their ability to form chemical compounds as well as to elucidate the influence of relativistic effects on valence electronic structure of the heaviest elements. The heaviest elements with atomic numbers $Z \geq 101$, however, are all man-made elements synthesized at accelerators using nuclear reactions of heavy-ion beams with heavy element target materials. They can only be identified through measurement of their characteristic nuclear decay or that of their known daughter nuclei using sensitive detection techniques. As both half-lives and cross sections of these nuclides are rapidly decreasing, they are usually available in quantities of only a few atoms or often one atom at a time. Here, we demonstrate highlighted studies of the chemical separation and characterization experiments with the heaviest actinides and early transactinides in liquid-phase chemistry.

The liquid-phase experiments have been accomplished by partition methods with single atoms, such as ion-exchange chromatography. We conducted partition experiments using the automated rapid ion-exchange separation apparatus AIDA (Automated Ion-exchange separation apparatus coupled with the Detection system for Alpha spectroscopy). AIDA enables cyclic column chromatographic separations of short-lived nuclides in liquid phases and automated detection of α-particles within a typical cycle time of 60 s. The recent studies of the early transactinides, rutherfordium (Rf) and dubnium (Db) are briefly reviewed.[1,2] The successful redox experiments with nobelium (No) and mendelevium (Md) based on an atom-at-a-time scale are also reported.

References
1. Kratz J.V., Nagame Y., Liquid-phase chemistry of superheavy elements, In: Schädel M., Shaughnessy D. (eds.), The Chemistry of Superheavy Elements, 2nd ed., Springer, Berlin, 2014, pp. 309-374.
2. Nagame, Y., Kratz, J.V., Schadel, M., Nucl. Phys. A 2015, 944, 641.