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Study on Quadrivalent Chemical Species of Rutherfordium in Aqueous Solution by Means of TTA resin

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Rutherfordium (Rf) has attracted a lot of attention in research on the chemical properties of a superheavy element. For the purpose of its speciation in aqueous solution, we aim to observe the chemical behavior of Rf by means of reversed-phase chromatography with a chelate extractant of 2-thenoyltrifluoroacetone (TTA) as the stationary phase. It extracts quadrivalent metal ions preferentially, and, that is, it will make possible determination of a specific complex formation constant of Rf.

Prior to the experiments with Rf, batch experiments of Zr and Hf were performed to determine the time to attain the chemical equilibrium on TTA-resin and the eventual distribution ratios. The resin was brought into contact with ^{88}Zr and ^{175}Hf carrier-free atoms in the acid solutions of 9.5×10^{-5} – 0.10 M HF / 0.1 M HNO_3 and allowed to attain equilibration in a polypropylene tube at room temperature. An aliquot of the aqueous phase was subjected to γ -ray spectrometry using a Ge detector. Similarly, an off-line reversed-phase extraction chromatography of ^{88}Zr and ^{175}Hf was also performed in a teflon tube column (1.6 mm ϕ) or a micro-column (1.6 mm ϕ \times 7 mm) into which the resin was filled. Then an on-line reversed-phase extraction chromatography was performed with $^{89\text{m}}\text{Zr}$ and ^{175}Hf , simultaneously produced in the ^{89}Y (p, n) and ^{175}Lu (p, n) reactions, respectively, at the RIKEN K70 AVF Cyclotron.

Finally, the chemical system for the Rf experiment with ARCA (automated rapid chemistry apparatus) with the micro-columns was connected to the automated rapid α /SF detection system at the AVF cyclotron and subjected to the experiment with ^{85}Zr , ^{169}Hf , and ^{261}Rf isotopes produced in the ^{18}O -induced reaction with the targets of natGe, natGa, and ^{248}Cm , respectively. Thus far we have succeeded in obtaining a preliminary α -spectrum of Rf nuclides transferred through a gas-jet system and passing through the ARCA system. We are now ready to proceed to the further experiments for the purpose of obtaining a better statistical data.

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