Solvent extraction of short-lived radioisotopes of Mo and W from oxalic acid solution with Aliquat 336 for chemical studies of seaborgium (Sg)

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Thus far, few studies of seaborgium (Sg) in an aqueous phase have been reported, where only a few events of Sg were detected after batch-wise cation-exchange chromatography.1,2) There have been few chemical studies of Sg owing to the experimental difficulties caused by its extremely low production yield and short half-life. To overcome the difficulties, we are developing a new rapid continuous chemistry apparatus based on the solvent extraction technique. We have been also studying solvent extraction behavior and extracted species of molybdenum (Mo) and tungsten (W), which are lighter homologs of Sg, to apply obtained results to development of the new apparatus and to compare extraction behavior among the homologs including Sg. Because it is well-known that Mo and W form polyoxometalate complexes, Mo and W should be extracted on a tracer scale for comparison of extraction behavior of their mononuclear complexes with that of Sg, which can exist only as single atoms. In a previous report, the solvent extraction of W from oxalic acid solution into toluene with Aliquat 336 was carried out with long-lived radionuclide, 181W (T1/2 = 121.2 d).3) In this paper, we report on the extraction behavior of Mo using short-lived radioisotope along with W. The extracted species of these two elements will be discussed.

Short-lived radionuclides 93Mo (T1/2 = 6.85 h) and 177W (T1/2 = 2.25 h) were produced in the irradiation with a 50-MeV α beam supplied from the RIKEN K70 AVF cyclotron on a metallic natZr and natHf target foils. Nuclear reaction products recoiling out of the targets were transported by a KCl/He gas jet method at a He gas flow rate of 2.0 L/min. The transported products were deposited on a small plastic piece (Naflon®) for 1 min. Then, the deposited products were dissolved with 100 µL of 0.01 M H2C2O4 (oxalic acid)/0.1 M HCl/0.9 M LiCl solution. The solution was then pipetted to a plastic tube in which 600 µL of aqueous solution and 700 µL of Aliquat 336 in toluene had been added. After shaking with a Vortex mixer for 5 min, the mixed sample was centrifuged for 30 s. From both the phases, 500 µL of aliquots were separately taken into two vials. These two samples were then subjected to γ-ray spectrometry with a Ge detector. The distribution ratio (D) of 93Mo and 177W was calculated using the equation of D = (Aoq / Voq) / (Aaq / Vaq), where Aoq and Aaq are the radioactivities in organic and aqueous phases, respectively, and Voq and Vaq are the volumes of organic and aqueous phases, respectively.

![Fig. 1. Variation in the distribution ratio of 93Mo, 177W and 181W from 1.0 × 10-2 M oxalic acid with 0.1 M HCl/0.9 M LiCl as a function of the concentration of Aliquat 336.](image)

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References