

On-line column chromatography of ^{88}Nb with 52 wt% Aliquat 336 resin from HF media for Db experiment

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The elements with atomic number ≥ 104 are called super-heavy elements. Aqueous chemistry experiments with these elements have been performed often by using the Automated Rapid Chemical Apparatus (ARCA). In particular, an anion-exchange experiment of element 105, Db was successfully performed in 13.9 M hydrofluoric acid solution.¹⁾ However, the complex formation of Db with the fluoride ion is still not clear, and further investigation of extraction behavior of Db in various concentrations of HF is needed. We have been studying the solid-liquid extraction behavior of group-5 elements, Nb and Ta, which are lighter homologues of Db, with Aliquat 336 resin in various HF solutions.²⁾ The obtained results showed that this extraction system is applicable to the on-line column chromatographic experiment of Db with ARCA. In this work, the solid-liquid extraction of Nb was conducted with 52 wt% Aliquat 336 resin in HF solution by the batch method and by using ARCA.

A 52 wt% Aliquat 336 resin was prepared by mixing MCI GEL CHP20/P30 with Aliquat 336 dissolved in methanol for about 1 day, which was followed by drying in an oven at 80 °C.³⁾ The isotope ^{88}Nb was produced in the $^{nat}\text{Ge} (^{19}\text{F}, xn)^{88}\text{Nb}$ reaction, at the RIKEN K70 AVF Cyclotron. The batch experiment and on-line column chromatographic experiment of ^{88}Nb were conducted to examine the suitable experimental condition for the Db experiment. The experimental procedure of the batch experiment was almost the same as described in ref. [4]. In the on-line column chromatographic experiment of Nb with ARCA, the reaction products transported by the He/KCl gas-jet system were deposited on the collection part in ARCA for 300 s. Then, the products were dissolved in 2.7-27 M HF solutions and loaded on a chromatographic column (1.6 mm i.d. \times 7.0 mm height) filled with the 52 wt% Aliquat 336 resin at a flow rate of 1.0 mL/min. The effluent was collected into 7 sample tubes as primary fractions for a few seconds each. The remaining products in the column were stripped with 6 M HNO_3 /0.015 M HF solution at a flow rate of 1.0 mL/min. The effluent was collected in another sample tube as a secondary fraction. These samples were then subjected to γ -ray spectrometry using a Ge detector.

Figure 1 shows the distribution coefficients, K_d , of ^{88}Nb obtained in the batch experiment as a function of initial HF concentration, $[\text{HF}]_{\text{ini}}$. The K_d values of long-lived ^{95g}Nb and ^{179}Ta isotopes obtained in the previous batch

experiment at 1.0-27 M HF⁴⁾ are also shown in Fig. 1. The K_d values of ^{88}Nb at 2.7 M and 27 M HF obtained in the present batch experiment are in good agreement with those of ^{95g}Nb obtained in the previous study. However, at 5.4 M and 10 M HF, the K_d values of ^{88}Nb showed higher values compared to those of ^{95g}Nb . The reason for this discrepancy is under investigation. In the on-line column chromatographic experiment, the elution curves for ^{88}Nb were measured at 2.7 M HF, and the K_d value of ^{88}Nb was calculated from eluted the volume peak, V_p , based on the Glöckauf equation.²⁾ The obtained K_d value for ^{88}Nb in column experiment at 2.7 M HF is in accordance with the results of batch experiment of both ^{88}Nb and ^{95g}Nb . Therefore, the same fluoride complex of Nb may be formed in both on-line and batch experiments at 2.7 M HF. After these experiments, a Db experiment with 52 wt% Aliquat 336 resin in 2.7 M HF was conducted. The results of the Db experiment are now under analysis.

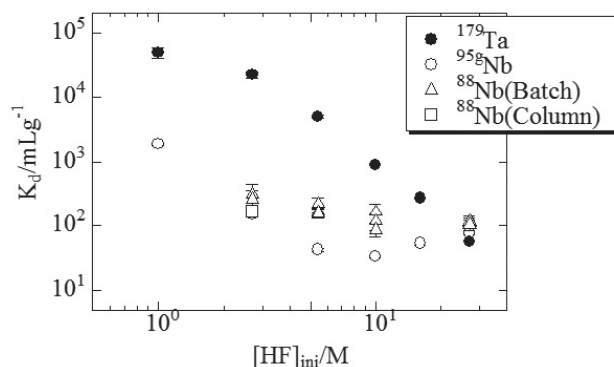


Fig. 1. Comparison of adsorption behavior of ^{88}Nb with that of ^{95g}Nb on 52 wt% Aliquat 336 resin as a function of $[\text{HF}]_{\text{ini}}$.

References

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