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Structural analysis for development of minor actinide recovery process using diglycolamide extractants

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1 Introduction

Development has been carried out for the realization of a recovery system for trivalent minor actinides (MA: Am and Cm) by separation processes such as solvent extraction and extraction chromatography for high-level radioactive liquid waste. At present, a process using diglycolamide (DGA) extractant in group separation process has been considered. For tetraoctyl diglycolamide (TODGA) impregnated adsorbents, the problem was that the elution rate of adsorbed MA and rare earth elements was low [1]. It is necessary to establish the optimum conditions when using each extractant in order to reduce the volume and the harmfulness of radioactive waste. In this research, focusing on tetraethylhexyl diglycolamide (TEHDGA), which is expected to have higher elution performance than TODGA, the nitric acid concentration dependence of the complex structure in the adsorbent impregnated with both DGA extractants was investigated by EXAFS.

2 Experiment

An adsorbent was prepared by impregnating porous silica particles coated with a styrene-divinylbenzene copolymer (referred to as SiO_2-P) with 33 wt% of TODGA and TEHDGA extractant, respectively. As an adsorption test, it was shaken for 3 hours at a ratio of 1:20 of an adsorbent and a metal solution containing Eu and Nd, using nitric acid concentration as a parameter. After the shaking test, the supernatant was subjected to ICP-OES analysis, and the dried adsorbent was subjected to EXAFS analysis. EXAFS measurement was carried out at High Energy Accelerator Research Organization Photon Factory BL-27B, in transmission mode, using EuL_{III} and NdL_{III} absorption edges.

3 Results and Discussion

By the previous research of solvent extraction, it has been confirmed that the adsorption degree of the two adsorbents is different, so we considered the factors that cause the difference from the structural change [2]. The absorption edge jump of the X-ray absorption spectrum by EXAFS measurement does not show a difference at high nitric acid concentration as shown in the ICP-OES analysis, but the difference between these variation trend is larger at low nitric acid concentration. And it turned out that the adsorption degree becomes larger with the TODGA adsorbent.

Figure 1 shows the nitric acid concentration dependence of the structural functions in the case of Eu. Since the nitric acid concentration dependency of the structural functions of the two adsorbents was confirmed from Fig. 1, the fitting analysis was performed using the first coordination element as oxygen. As a result, the nearest oxygen coordination number was confirmed to have the same nitric acid concentration dependency as increasing the absorption edge jump. Therefore, there is a correlation between the amount of adsorption and the contribution of oxygen atoms around the rare earth element. From these results, it is considered that the two adsorbents differ in the acid concentration dependency of the extractant contributing to the extraction depending on the structure of the side chain, and the TEHDGA adsorbent has higher elution degree.

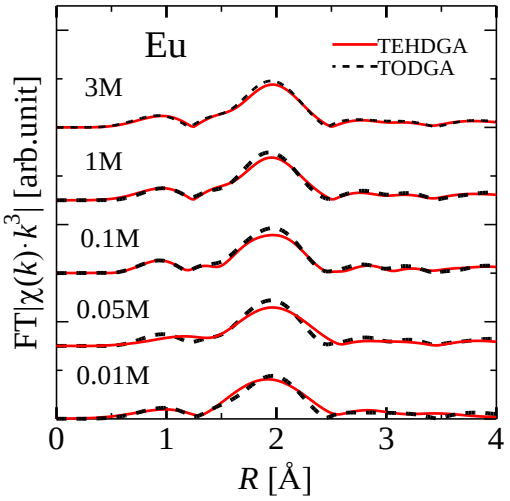

Fig. 1 Nitrate concentration dependence of the structural functions of Eu.

References

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