

XAFS characterization of dissolution behavior of fine alloy in nitric acid

Sayaka CHIBA^{1,*}, Koya YAMAZAKI¹, Haruaki MATSUURA¹, Isamu SATO¹ and Haruka TADA²¹ Tokyo City University, 1-28-1 Tamazutsumi, Setagaya-ku, Tokyo 158-8557, Japan² IHI Corporation, 1, Shin-Nakahara-cho, Isogo-ku, Yokohama, 235-8501, Japan

1 Introduction

An alloy of Ru-Rh-Pd-Mo-Tc in the insoluble residue liquid waste would be mixed with the high-level radioactive liquid waste [1]. It is thought that the composition of the alloy fluctuates with changes in fuel burn-up, but the mechanism of alloy dissolution into the high-level liquid waste has not been clarified. Since alloys in insoluble residue may affect process control in the glass melter, it is necessary to elucidate the dissolution behavior of platinum group metals (e.g. chemical behavior of Ru is not predicted) in the melting process. Therefore, in this study, Mo, Ru and a quaternary simulant fine alloy of Ru-Rh-Pd-Mo have been dissolved in nitric acid at various concentrations and the dissolution behavior of each element has been compared to elucidate the mechanism of dissolution of platinum group metals into nitric acid.

2 Experiment

A dissolution test had been performed for 240 hours. Totally, four times of tests have been carried out: 1.0 g of Mo metal powder was added into 50 ml of 1.0 M and 1.5 M of nitric acid and 0.5 g of Ru metal powder and simulated alloy powder were added to 25 ml of 7.0 M of nitric acid. Thereafter, XAFS analysis was performed on the insoluble matter collected and air-dried at 24 hours.

3 Results and Discussion

Fig. 1 shows the Mo-K edge EXAFS radial structure functions for residue when Mo metal powder is dissolved at room temperature. From Fig. 1, it is observed that the radial structure function shows a first coordination peak similar to that of MoO₃, unlike Mo metal powder before dissolution.

Looking at the Mo-K edge XANES spectra, it was confirmed that the feature of the absorption edge of the spectrum was in between the 0-valent corresponding to Mo metal powder and the hexavalent corresponding to MoO₃ at both 1.0 M and 1.5 M nitric acid concentrations.

On the other hand, the local structure of the Ru metal powder and the Mo-Ru-Rh-Pd quaternary alloy powder, showed almost no change in the local structure before and after dissolution as shown in Fig. 2.

It may be due to the low solubility of Ru and alloys. In addition, the dissolution of Mo in the alloy is also suppressed compared to that of Mo only, but this is thought to be due to the fact that Mo is encapsulated in the crystal in the host alloy structure of Ru metal.

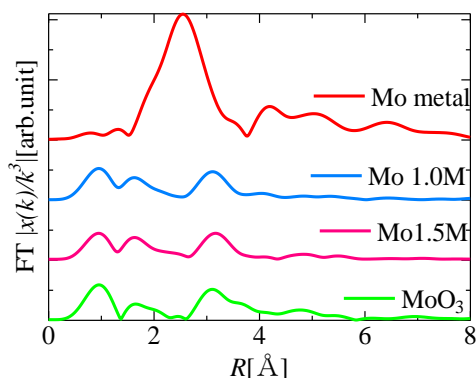


Fig. 1: The Mo-K edge EXAFS radial structure functions for residue when Mo metal powder is dissolved at room temperature.

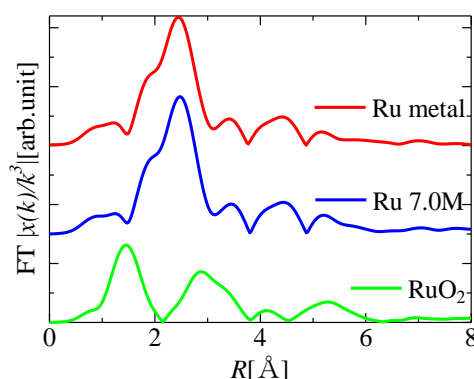


Fig. 2 The Ru-K edge EXAFS radial structure functions for residue when Ru metal powder is dissolved at room temperature.

Acknowledgement

This research is a part of the results of the "FY2022 Basic Research Project on Vitrification Technology for Volume Reduction of Radioactive Waste (JPJ010599)" of the Agency for Natural Resources and Energy, Ministry of Economy, Trade, and Industry.

References

- [1] T. Tsukada, *et al.*, Dissolution studies on high burn-up UO₂ and MOX fuels for applying to PUREX reprocessing. CRIEPI Report. T97082 (1998).

* g2381810@tcu.ac.jp, hmatuura@tcu.ac.jp