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Behavior of Ru in high-temperature simulated high-level waste glass melt

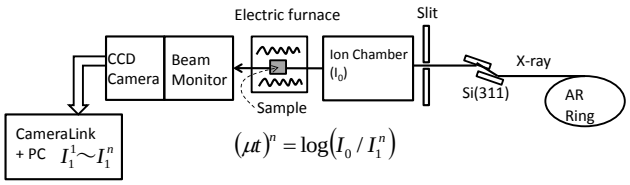
Yoshihiro Okamoto*[1], Masami Nakada[1], Mitsuo Akabori[1], Satoshi Komamine[2], Toshiki Fukui[2], Eiji Ochi[2], Hiroaki Nitani[3], Masaharu Nomura[3]
[1]JAEA, Tokai, Ibaraki 319-1195, Japan
[2]JNFL, Rokkasho, Aomori 039-3212, Japan
[3]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

1 Introduction

High-level radioactive liquid waste(HLLW) generated in reprocessing of spent nuclear fuels is solidified with borosilicate glass in stainless canisters. They are cooled and stored in the storage facility. Understanding behavior of fission product elements in a glass melting furnace is important for safe and efficient management. In the present work, behavior of ruthenium in the simulated glass melt was examined by using an imaging XAFS technique at high temperature..

2 Experiment

Imaging XAFS measurement was carried out at the NW10A beamline. The imaging system (Hamamatsu Photonics,K.K.) which consists of the beam monitor AA40 and the high-sensitive CCD camera C9300-221 is used in place of an ion chamber[1] as shown in Fig.1. The image from the CCD camera was stored as 12bit TIFF files. The resolution of this imaging system is 10μm.



Fi.1 Layout of the X-ray imaging measurement

X-ray absorption images of the simulated glass sample melt containing fission product elements like Ru were recorded at 22.20keV of X-ray energy (just after (Ru K-absorption edge E_0=22.117keV). Position sensitive X-ray absorption spectra were also obtained by scanning energetic range from 21.8 to 22.6keV.

3 Results and Discussion

X-ray imaging measurement including imaging XAFS was performed several times to observe behavior of the ruthenium element. In most cases, condensation and sedimentation of the ruthenium element were observed in the glass melt above 1200℃. The imaging XAFS result of the frozen glass after the heating is shown in Fig.1 The condensation of the ruthenium can be confirmed by the gray-scale change between the two CCD images at 22.05keV and 22.20keV. From the imaging XAFS analysis shown in the Fig.1, it can be seen that the chemical character of the condensation object is RuO_2.

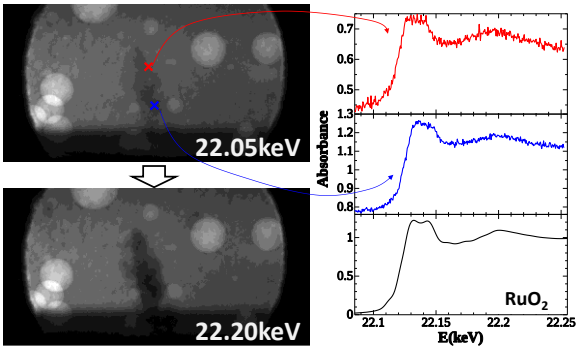


Fig.2 Imaging XAFS result of the frozen sample

In the next step, we tried to obtain imaging XAFS spectrum of high-temperature glass met by a quick scan of the X-ray energy. Fig.3 shows the imaging XAFS result obtained at 1300℃. The imaging XAFS spectrum at the bottom of the cell is close to the XAFS of RuO_2.

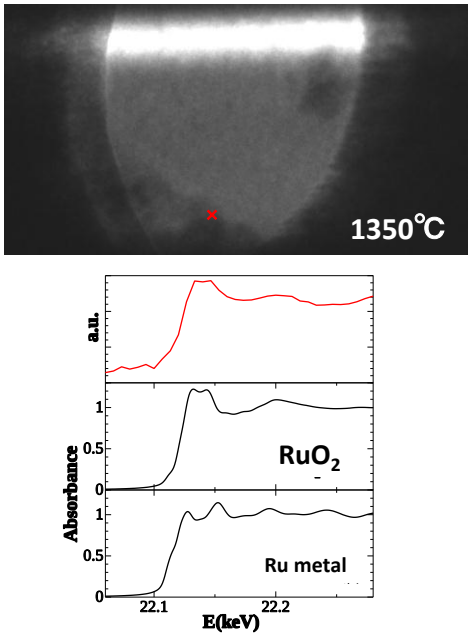


Fig.3 Imaging XAFS result of the molten sample

References

[1] Y. Okamoto *et al.*, Trans. Atom. Energ. Soc. Jpn. **11** (2012) 127.

* okamoto.yoshihiro@jaea.go.jp