Chemistry

27B/2010G047

Position sensitive XAFS study of neptunium dioxide

Y. Okamoto*[1], T. Nishi[1], M. Nakada[1], H. Shiwaku[2], S. Suzuki[1], T. Yaita[2], M. Akabori[1]
[1]JAEA, Tokai, Ibaraki 319-1195, Japan
[2]JAEA, Sayo, Hyogo 679-5148, Japan

Introduction

We have developed position sensitive XAFS method using synchrotron radiation based X-ray imaging technique [1]. X-ray absorption intensity is obtained as gray-scale value of the CCD image in the imaging XAFS analysis. An arbitrary area in the CCD image, which means position sensitivity, can be used to obtain XAFS spectrum.

In the present work, we measured imaging XAFS of neptunium dioxide and compared the imaging XAFS spectrum with that of normal XAFS technique.

Experimental

Layout of the imaging XAFS experiment is almost the same as the normal XAFS measurement. Only the ionic chamber after the sample is replaced by the X-ray CCD camera (Hamamatsu Photonics K.K., XCUBE H8481). Pictures from the CCD camera are stored as movie files by way of the video capture system. Transmission X-ray intensity is obtained as gray scale value of each pixel in the CCD picture.

The sample NpO_2 (^{237}Np:0.18MBq) mixed with epoxy resin (old checking source prepared in 2002) was used to study the imaging XAFS. Energetic scan ranging from 17.1 to 18.7keV was carried out to obtain Np L_3-edge XAFS spectrum (Np L_3: E_0=17.610keV). The time required for the measurement was about 7 min. A foil of niobium metal was used to calibrate X-ray energy.

Results and discussion

X-ray CCD image of the NpO_2 sample obtained at E=17.1keV is shown in Fig.1. It can be seen that neptunium element is scattered in the epoxy resin. XAFS spectrum of the intersection area (11×11=121 pixels) in the figure was obtained by gray-scale analyses.

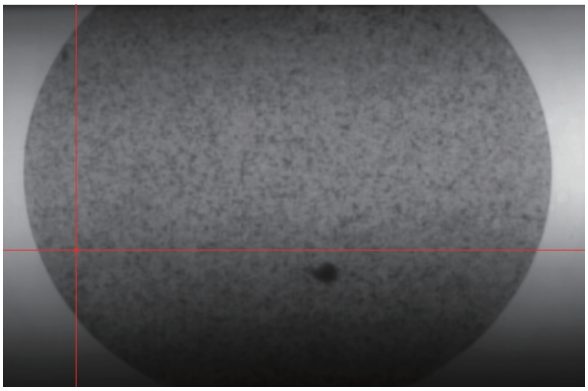


Fig.1 CCD image of the NpO_2 sample at E=17.1keV

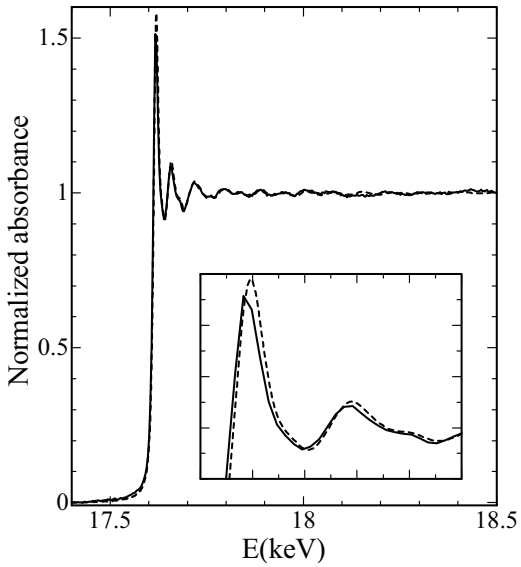
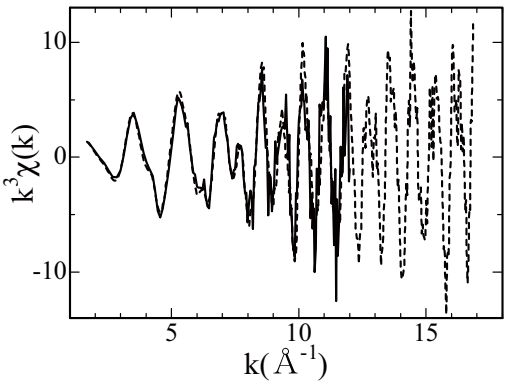


Fig.2 Imaging (solid) and normal (dashed) XAFS spectra of the NpO_2 sample

The imaging XAFS is compared with the normal XAFS in Fig.2. The difference is hardly found between the two spectra. In the next step, k^3-weighed EXAFS functions $k^3\chi(k)$ are plotted in Fig.3. The function of the imaging XAFS spectrum is almost the same as that of the mormal XAFS. However it is impossible to obtain EXAFS oscillation at higher k region in the imaging technique.



References

[1] Y.Okamoto et al., Adv. X-ray Chem. Anal. 42, 183 (2011).

* okamoto.yoshihiro@jaea.go.jp