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Imaging XAFS study of uranium oxide

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Introduction

We have developed the imaging XAFS measurement system by using a direct X-ray CCD camera. It has some remarkable advantages as follows,

(1) position sensitivity
(2) quick measurement around several minutes
(3) high compatibility with the normal XAFS work
(4) easy to handle output video file .

In this method, there are some limitations such as 8-bit gray scale problem. Information obtained from the imaging XAFS is valuable, though it is thought to be unsatisfactory as a tool of precise structural analysis. In the present study, we reported the imaging XAFS result of very small amount of uranium oxide.

Experimental

The imaging XAFS measurement system in the present study is very simple and easy to use as shown in Fig.1. Only the ionic chamber after the sample is replaced by the X-ray CCD camera (Hamamatsu Photonics K.K., C6086-03). Pictures from the CCD camera are stored as movie files by way of the video capture system.

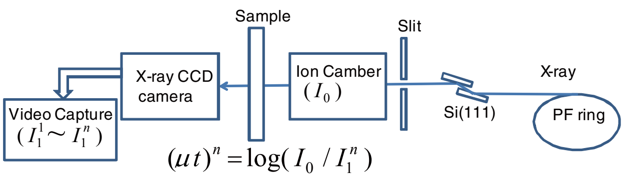

Fig.1 Layout of the imaging XAFS measurement system

X-ray absorption spectrum μt is obtained as well as a normal XAFS technique in the transmission geometry. Transmission X-ray intensity is obtained by gray scale of each pixel in the CCD picture. The XAFS data concerning an arbitrary area of the picture can be obtained from a summation of corresponding pixel values.

The sample used in the measurement is uranium oxide (triuranium octaoxide, U_3O_8). Very small amount of the oxide (totally less than 10mg) is scattered in an epoxy resin matrix sheet (20mm×30mm×2mm**t**).

Results and discussion

The measurement (capturing the CCD output) was performed by scanning energetic range from 16.8 to 18.2keV at the BL-27B[1]. The measurement time was about 150s. It is shorter than that of the normal XAFS measurement and almost comparable to the time required in the QXAFS[2] technique. The CCD picture at E=17.200keV just over the U L_3-absorption edge (E_0=17.166keV) and its close-up are shown in Fig.2. It can be seen that the oxide exists as small particles (about 100μm in diameter).

XAFS spectrum calculated for one of the particles in the Fig.2 (the square of 9×9 = 81 pixels) is plotted in Fig.3, together with the spectrum data obtained from the normal XAFS measurement. We can easily evaluate the specified small particle in the Fig.2 is triuranium octaoxide, U_3O_8. It is concluded that the imaging XAFS technique in the present work is enough for a qualitative analysis.

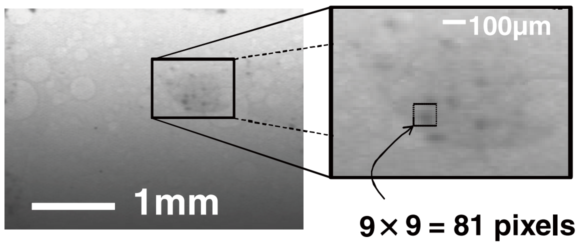

Fig.2 The CCD picture and its close-up at E=17.200keV.

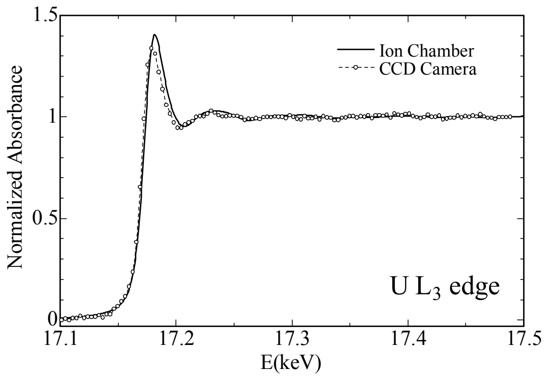

Fig.3 Normalized XAFS spectra of uranium oxide.

References

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