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Projection-type XRF imaging with white X-rays from a bending magnet source (1) Major component element analysis

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Introduction

Projection-type X-ray fluorescence (XRF) imaging is a novel method of performing element mapping with large pixel numbers in a very short measuring time [1]. Although the combination of a multilayer monochromator and a multi-pole wiggler source is no doubt the most promising [2], in terms of practical analysis, it is sometimes desirable to perform experiments at a normal bending magnet source. This report describes quick imaging of major component elements using white X-rays.

Experimental

The instrumental details of a projection-type X-ray fluorescence (XRF) microscope are described elsewhere [2]. The sample measured is earthenware. As shown in Fig.1, it contains iron, copper, zinc, chromium, manganese, potassium, calcium etc, but the XRF intensity of iron is much more intense than that of other elements. The aim of the present imaging experiment is simply to look very quickly at only the major elements like iron in this sample. This is the reason why the use of a white beam is considered. A platinum-coated flat mirror was used to remove higher energy photons above 12 keV.

Results and Discussion

Figure 2 (a) shows an X-ray image, which corresponds to an 8mm×8mm area in the optical microscope photo shown in Fig.2(b). One can see that most of the brown grains found in Fig.2(b) produce a bright X-ray image, while white or black or clear grains are dark. Roughly speaking, if we neglect the segregation of minor components in the meantime, the image corresponds to the distribution of iron, because the XRF intensity of iron is always much stronger than that of other elements. Therefore, the results indicate that the concentration of iron is inhomogeneous and differs fairly considerably among the grains. Since the energy of X-rays entering the CCD device is not distinguished in this case, the analysis has clear limitations. However, the exposure time for one image was only 70 msec. Note that 2~3 min were required when monochromatic X-rays were used at the same beamline [1]. The authors wish to thank Professor A. Iida for his kind cooperation during the experiments.

References

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[2] K.Sakurai and M.Mizusawa, *AIP Conference Proceedings* (SRI- 2003, San Francisco, USA) in press.
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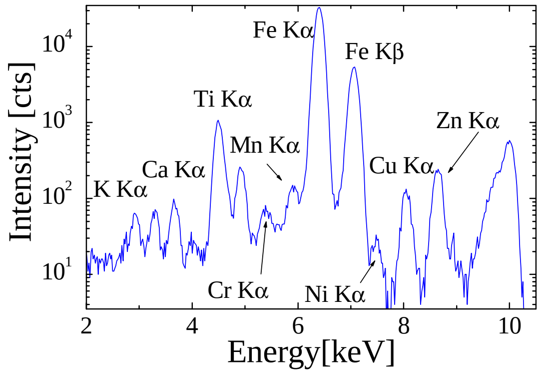

Figure 1 XRF spectra of earthenware, measured with monochromatic X-rays prior to the imaging experiments with white X-rays. Incident X-ray energy 10keV. Measuring time 300sec. The spectra were taken at position X in Fig.2(b).

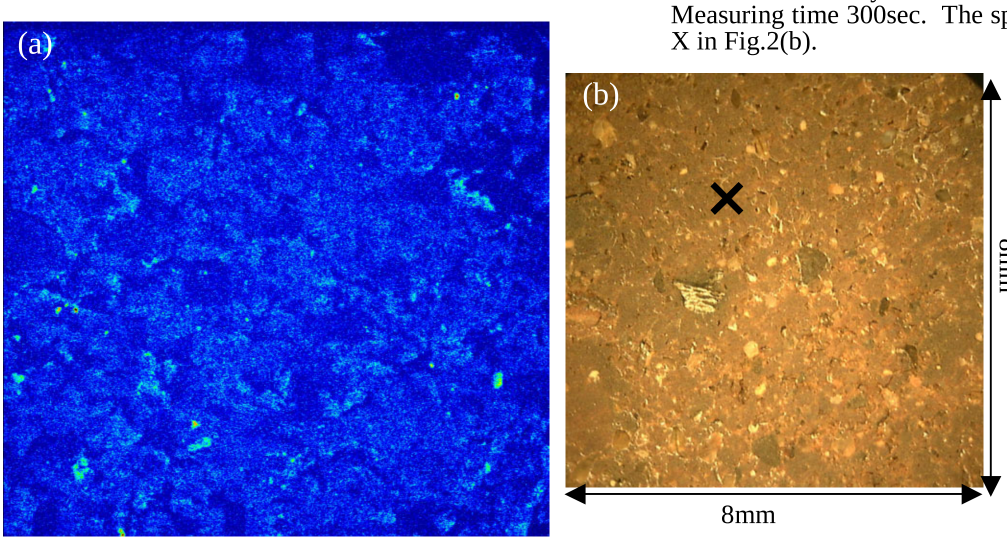

Figure 2 (a) X-ray image of earthenware obtained with white X-rays. Beam size 8mm (H) × 0.2mm (V). Exposure time 70 msec. The image mainly represents a map for iron. (b) Optical microscope photo of the viewing area.