X-ray absorption fine structure imaging by a non-scanning X-ray fluorescence microscope

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Introduction

X-ray absorption fine structure (XAFS) imaging using XRF intensity [1] is a very strong scientific tool because it provides spatial distribution on chemical composition as well as structural phases. Unfortunately, the imaging usually requires a fairly long measuring time, because the technique uses 2D scans. Our previous experience [2,3], however, indicates that non-scanning imaging can be a good alternative for quick observation. This report describes that this novel XRF microscope is suitable for recording XAFS imaging with 1 M pixels.

Experimental

The main idea of the present non-scanning XRF microscope has been described elsewhere [2]. A grazing-incidence arrangement is employed to make primary X-rays illuminate the whole sample surface. Parallel-beam optics and extreme-close-geometry (the clearance is ~0.5mm or less) are adopted in order to detect XRF from the sample. A CCD camera is mounted on the frame with a downward-looking arrangement like a usual optical microscope, while conventional scanning XRF imaging uses a sideways-looking arrangement, which means the sample is stood up and has a vertical rotation axis. The view area is 12mm(H)×12mm (V). The pixels are around 1000×1000. To perform XAFS imaging, the exposure has been repeated during scanning of the primary photon energy. The typical exposure time is 60 sec/point. XAFS spectra were obtained by integration of the XRF intensities in the interested pixels.

Results

Figure 1 shows typical Fe K XAFS spectra obtained from XRF intensity from a specific area (the dark part in the photograph) of the rock sample. One can confirm XAFS oscillation is successfully recorded, and in principle, detailed atomic-structure is available. Although the present case is quite simple, it is possible to perform structural imaging, even for rather complicated samples including different phases, e.g., amorphous and several different crystalline materials. Another feasible experiment is chemical state imaging based on the selective-excitation of specific chemical species by means of absorption edge shifts. The authors would like to thank Prof. A. Iida for his valuable assistance.

References

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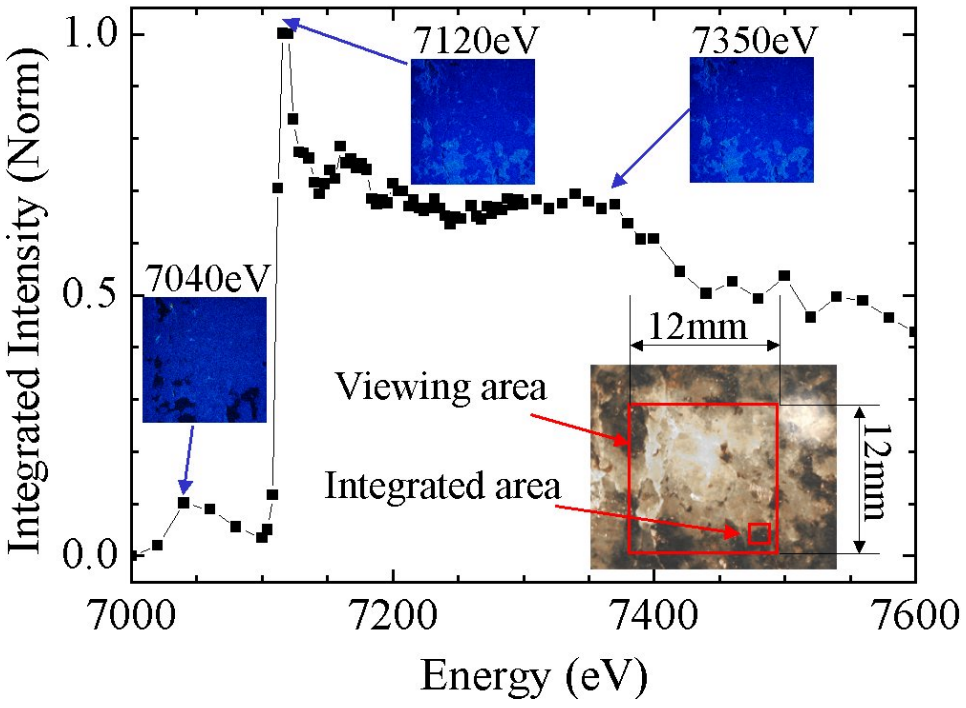

Figure 1

Example of XAFS imaging. The spectra are from a specific area (the dark part in the photograph) of the rock sample, Amphibole Gabbro, collected at the top of (Mt. Tsukuba. The set of image data includes such spectral information for each pixel. Measuring time, 60 sec for one point.