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XRF imaging with wide-band-pass high flux photons at MPW beamline

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Introduction

Recently, a mutilayer monochromator was commissioned for X-ray fluorescence (XRF) imaging experiments with a multi-pole wiggler (MPW) source at BL-16A1 [1]. The research requires an extremely high photon flux of quite a large size (~10mm(H) × ~0.2mm(V)). Although the issue in the initial stages was the method to be used for cooling the 1st multilayer, it has since been found that simple indirect water-cooling works well in practice. This report demonstrates the performance of the monochromator.

Experimental

Fig.1 shows the optics of the beamline. A single flat beamline-mirror (Rh coated, 4.5 mrad fixed incidence) was used for removing high-energy X-rays. A W/B_4C multilayer monochromator (2d=50.4Å, 125 layer pairs, 20mm×50mm×5mm, Osmic Co., Ltd.) was installed in the experimental hatch (~35.5m from the source). A Si PIN detector (XR-100T, Amptek, energy resolution ~200 eV at 5.9keV) was employed for calibrating the incidence angle for the 1st multilayer by ascertaining the photon energy of air scattering from an X-ray path. The exit beam is always at the same height (6 mm distant from the direct beam) for X-ray energy ranging from 5.5 to 13.0 keV.

Results and discussions

The energy resolution of the monochromatized beam was evaluated by a Si PIN detector put near the exit window of the vacuum tank for multilayers. As shown in Fig.2 and Table 1, the FWHM observed was wider than the intrinsic resolution of the detector. The estimated ΔE and ΔE/E are 300~500 eV and ~5%, respectively. Fig.3 shows an XRF image of a piece of printed circuit board. In this case, the exposure time was very short, 0.2 sec. Since the incident energy was 10 keV (above Cu K-edge), the copper wire looks bright. We preliminarily estimated the flux intensity as at least 300 times larger than that of a normal monochromatic beam at a bending magnet beamline, where our previous experiments have been performed. The authors wish to thank Professors A. Iida, H. Sawa, Y. Wakabayashi and Y. Uchida for their kind cooperation in the present research.

References

[1] K.Sakurai, M.Mizusawa and A.Iida, Photon Factory Activity Report 2001 #19, 222 (2002).

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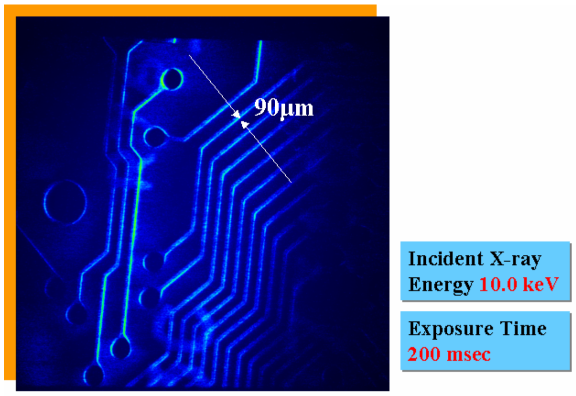
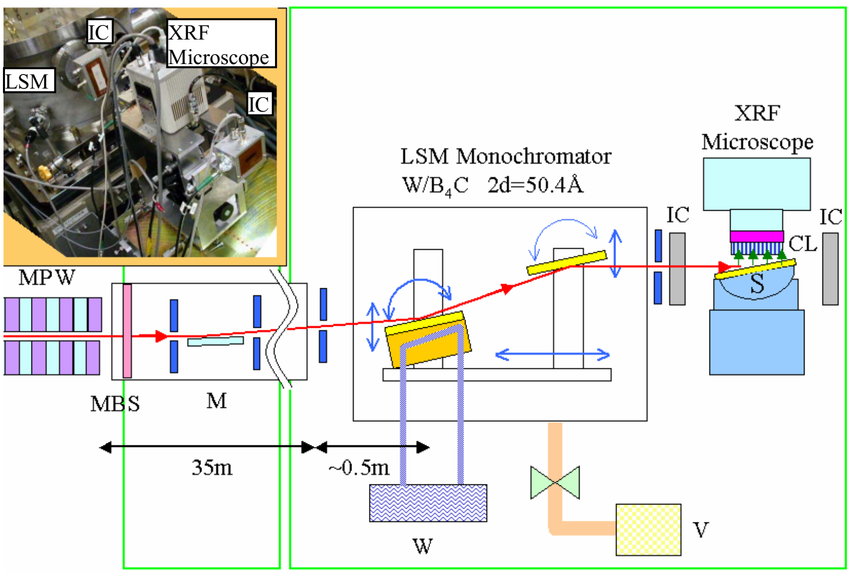


Figure 3 XRF image of printed circuit board.

E [eV]	ΔE [eV]	ΔE/E [%]
10000	490	4.9
8000	400	5.0
7200	350	4.9
6000	330	5.5

Table 1 Bandwidth of the photon energy monochromatized by multilayers



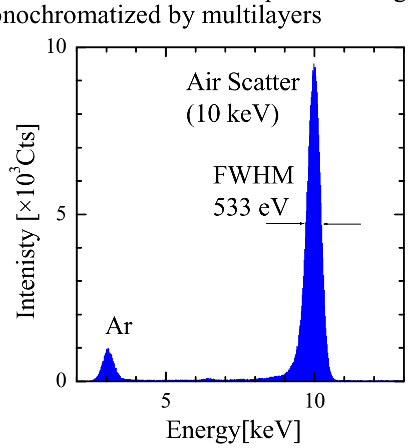


Figure 1 (top) Schematic view of beamline optics for XRF imaging.
Figure 2 (right) Typical X-ray energy spectra for the primary beam.