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Research of Spectroscopic Method by means of photo-absorption in metals

S.MUTO[1], K. MORI[2], and K. HYODO[3]
[1]National Institutes for Fusion Science, Toki 509-5292, Japan
[2]Ibaraki Prefectural University of Health Sciences, Ami 300-0394, Japan
[3]Photon Factory, Tsukuba 305-0801, Japan

1 Introduction

In plasma sciences it is necessary to use high dynamic-range-imaging detectors, since the intensity is strong. For the purpose the application of photo-absorption technique is proposed for the spectroscopy[1). In the present research an assembly of CCD camera is calibrated to measure the x-ray spectral images.

2 Experiment

Figure 1 shows the schematic view of the assembly equipped with an aluminium filter. The x-ray detector is a 1-mm-thickness-CsI implemented CCD. The dynamic range is 16 bit. The experiment is carried out at the BL-14C of photon factory in KEK. In the experiment the rotation velocity of the filter is set to 1 rpm. The exposure time of the CCD is set to 1 s. The gray scale images obtained with the CCD are depending on the thickness of the filter.

In the present experiment it is monitored whether the optical axis is highly stable as shown in FIG.2. The secondary diffracted beam can go through the pin hole, since the horizontal width of the beam is approximately 0.3 mm.

Figure 3 shows the total intensities of the images presented in FIG.2. The time-evolution of the transmitted intensity is consistent with the calculation predicted from the motion of the filter and the absorption coefficient. The spectrum, intensity, and optical axis of the x-ray beam are proved to be enough stable in order to obtain the calibration data.

3 Results, Discussion, and Future Prospect

It is the advantage of BL-14C for the present calibration of an assembly of CCD camera that the optical axis is enough stable. The calibration is carried out in an energy range from 20 keV to 40 keV. The energy step is 1 keV. From the calibration data, the energy resolution depending on photon energy will be estimated. The energy resolution is predicted to be proportional to the detected intensity in bits. The coefficient will be also estimated from the data.

In the next experiment, the intensity profiles of the fundamental and secondary diffractions from the monochrometer is precisely investigated to prepare two-color-image diagnostics at BL-14C.

References
[1] S.Muto *et al.*, Plasma and Fusion Research (2013), **8**, pp.2402140-1~4.

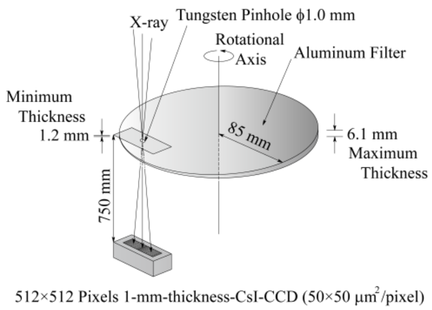

FIG.1. The schematic view of the assembly. The thickness of the aluminum filter on the optical axis is continuously changed by the rotation. The rotation velocity is adjustable from 1 to 10,000 rpm.

FIG.2. Measured image (64×64 pixels) of secondary diffracted beam (E = 30 keV) through 1-mm-diameter-tungsten pin hole from Si(220) tandem crystal monochrometer at the BL-14C. The fundamentally diffracted beam is absorbed with a 10-mm-thickness-aluminum filter. As additional absorber, 8-mm-thickness-aluminum filter is used to prevent from the over flow of the CCD. The maximum signal of the CCD is maintained to be less than half of the dynamic range.

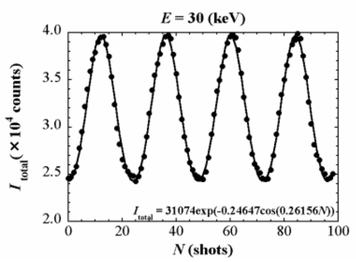

FIG.3. Transmitted total intensities measured with the CCD. The solid circles and line represent measured intensities and a line calculated from the geometry shown in FIG.1, respectively. The vertical and horizontal axes represent the intensities and the number of shot, respectively.