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ABSOLUTE CALIBRATION OF SPACE-RESOLVING SOFT X-RAY SPECTROGRAPH FOR PLASMA DIAGNOSTICS

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Introduction

Measurements of spatial and temporal variation of spectra in the wavelength range from vacuum ultraviolet (VUV) to soft x-ray (SX) are necessary to determine radiation power losses and ion density profiles which directly relate to the impurity transport, confinement and sources in magnetically confined plasmas. We developed space- and time-resolving VUV (150-1050 Å) [1, 2] and SX (20-350 Å) [3, 4] spectrographs and applied for impurity diagnostics in the tandem mirror GAMMA 10.

For quantitative analyses of emission lines, it is important to characterize the absolute sensitivity of these spectrograph systems throughout their wavelength ranges. Previously we measured the absolute sensitivities of VUV spectrograph with changing the incident light angle into the VUV spectrograph. By changing the incident angle of the VUV spectrograph, we can change the observing spectral range of the VUV spectrograph. [1, 2] In this report, we show the spectra of the spectrograph when we changed the incident light angle into the SX spectrograph in a beam line 12A (BL-12A).

Experiments

In the space- and time-resolving SX spectrograph, a concave grating ruled with varied spacing (Hitachi P/N001-0266) is used, which has a nominal groove density of 1200 g/mm and a ruled area of 50 × 30 mm^2. The incident angle is 87 ° and the effective braze wavelength is 100 Å. The entrance slit is a 6-mm in height and 100 µm in width. A MCP intensified detector (Hamamatsu F2814-23P) having 50 × 50 mm^2 active area is set on the flat field output plane. The recording system of spectral image is a high-speed solid state camera (Reticon MC9256) with a fast scanning controller. The resolution of video image is eight bit. The frame rate with full image size, 256 × 256 pixels, can be changed from 4 to 106 frame/s.

The experiments have been carried out at BL-12A. The incident photon intensity was monitored just behind the entrance slit by using an absolutely calibrated XUV silicon photodiode (IRD AXUV-100G). The output spectral image was recorded using a high-speed camera. Measurements are repeated for wavelength range from 2 nm to 39 nm at the BL-12A with 1 nm intervals. We changed the incident light angle into the spectrograph by changing the entrance slit position of the spectrograph. Nominal entrance slit position is 32.0 mm (87.0 ˚). We changed the incident slit position as 31.0 (87.3 ˚) and 33.0 mm (86.7 ˚) in order to study characteristics of the SX spectrograph.

Results

Fig. 1 shows the spectra observed in the SX spectrograph with the incident angles of 87.0 ˚ (red solid line), 87.3 ˚(blue dotted line), and 86.7 ˚ (green dotted line) for the incident beam wavelength of 15 nm. The sensitivity of the SX spectrograph depends on the incident beam angle. The observable spectral position in the detection system is changed about 0.3 nm with the incident angle. We plan to carry out the more precise experiments for diffraction efficiency against the incident angle of the SX spectrograph.

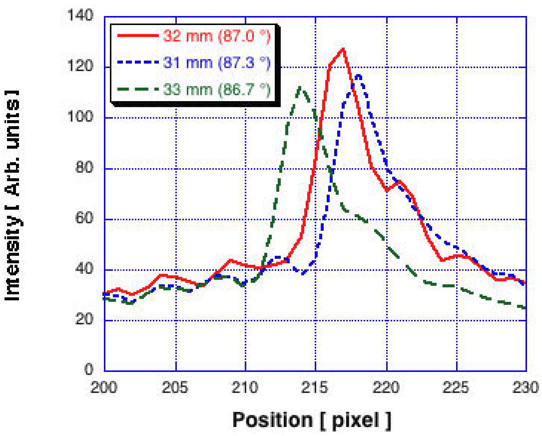

Fig. 1 Spectra observed in SX spectrograph with the incident angles of 87.0 ° (red solid line), 87.3 ° (blue dotted line), and 86.7 ° (green dotted line) for the incident beam wavelength of 15 nm.

References

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