12A/2002G033

ABSOLUTE CALIBRATION OF SPACE-RESOLVING VUV 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 (15-105 nm) [1, 2] and SX (2-35 nm) [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 under incident polarized light conditions for wavelength range from 15 nm to 105 nm [2]. By changing the incident light angle of the VUV spectrograph, we can change the observing spectral range of the VUV spectrograph. In this report, we show the spectra of the spectrograph when we changed the incident light angle into the VUV spectrograph in beam line 12A (BL-12A).

Experiments

In the space- and time-resolving VUV spectrograph, a concave grating ruled with varied spacing (Hitachi P/N001-0266) is used, which has a radius of curvature of 500 mm, a nominal groove density of 1200 g/mm and a ruled area of 48 × 48 mm^2. The incident angle is 51 ° and the effective braze wavelength is 60 nm. The entrance slit is a 6-mm in height and 100-μm in width. A MCP intensified detector 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 for shorter wavelength range. The incident photon intensity was monitored just behind the entrance slit by using an absolutely calibrated XUV silicon photodiode (IRD AXUV-100G) and then the output spectral image was recorded by a high-speed camera. Measurements are repeated for wavelength range from 24 nm to 35 nm at the BL-12A with 0.5 nm intervals. We changed the incident light angle into the spectrograph by changing the entrance slit position of the spectrograph. Normal entrance slit position is 34.2 mm (51.0 ˚). We changed the incident slit position as 32.0 (50.3 ˚) and 30.0 mm (50.0 ˚) in order to change the observing spectral range.

Results

Fig. 1 shows the spectra observed in VUV spectrograph with the slit position of 32.0 mm (50.3 ˚, solid line) and 30.0 mm (50.0 ˚, dotted line) for the incident beam wavelength of 28 nm. There are higher order diffraction lights in these spectra. The sensitivity of the VUV spectrograph depends on the entrance slit position that means the incident beam angle. This shows that the observable spectral position in the detection system is changed with the incident angle. We plan to carry out the more precise experiments for diffraction efficiency against the incident angle of the VUV spectrograph.

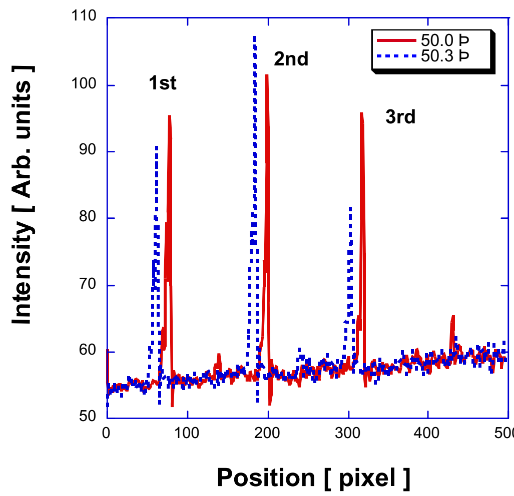

Fig. 1 VUV spectra for the two different incident angles of 50.3 ° and 50.0 ° for the incident beam wavelength of 28 nm.

References

[1] N. Yamaguchi et al., Rev. Sci. Instrum. **65**, 3408 (1994).
[2] M. Yoshikawa et al., Photon Factory Activity Report #18, 2001, Proposal No.2000G015.
[3] N. Yamaguchi et al., J. Plasma and Fusion Res. **71**, 867(1995).
[4] M. Yoshikawa et al., Nucl. Instrum. Methods Phys. Res. **A 467-468**, 1533 (2001).

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