11C, 12A/2002G033

ABSOLUTE CALIBRATION OF SPACE-RESOLVING VUV SPECTROGRAPH FOR PLASMA DIAGNOSTICS

Masayuki YOSHIKAWA*[1], Naohiro NUMADA[1], Yuusuke KUBOTA[1], Takayuki KOBAYASHI[1], Masashi Saito[1] and Naohiro YAMAGUCHI[2]
[1]Plasma Research Center, University of Tsukuba, Tsukuba, Ibaraki 305-8755, Japan
[2]Toyota Technological Institute, Nagoya, Aichi 468-8511, Japan

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] 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 150 Å to 105 Å [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 absolute sensitivity of the VUV spectrograph with changing the angle of incidence.

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 nominal 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 (50-350 Å) and at BL-11C for longer wavelength range (350-1100 Å). 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 50 Å to 350 Å at the BL-12A with 10 Å intervals, and for wavelength range from 350 Å to 1100 Å at the BL-11C with 20 Å intervals. We changed the incident light angle into the spectrograph by changing the entrance slit position of the spectrograph. Nominal entrance slit position is 34.2 mm (51.0°). We changed the incident slit position as 32.0 (50.6°) and 36.0 mm (51.4°) in order to change the observing spectral range.

Results

Figure 1 shows an absolute sensitivity of the VUV spectrograph for the first order diffracted light as a function of wavelength. Circles, squares and diamonds show the absolute sensitivities of incident angle of 50.6°, 51° or 51.4°, respectively. The position of a peak (at 600 Å) corresponds to the braze wavelength of the grating used in this spectrograph. By changing the incident angle, 50.6°, 51° and 51.4°, the observable spectral range of the VUV spectrograph is changed, 150-1020, 160-1060 Å and 170-1090 Å, respectively. The sensitivity against incident angle variation is almost the same as that of the nominal incident angle of 51.

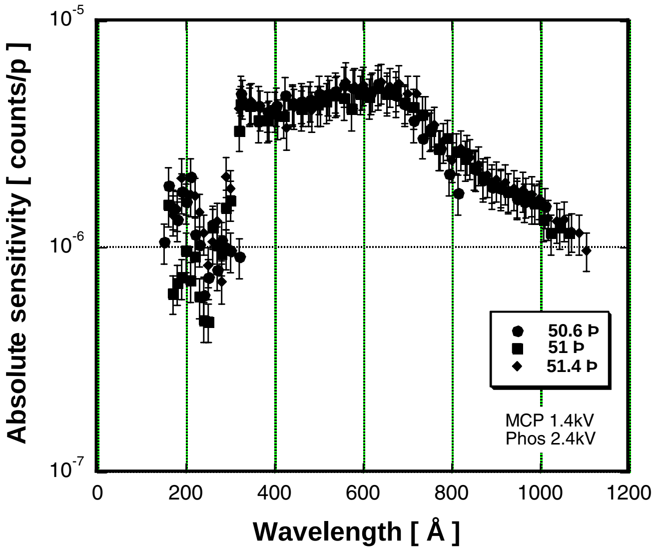

Fig.1 An absolute sensitivity of the VUV spectrograph for the first order diffracted light as a function of wavelength.

References

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* yosikawa@prc.tsukuba.ac.jp