Improvement in S/N Ratio of Our Soft X-ray Spectro-Reflectometer with a Laser-Produced Plasma Source

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We constructed a spectro-reflectometer with a laser-produced plasma (LPP) source in the previous work [1]. While the measurement error of 2% was achieved, the performance has been unstable for evaluation of soft X-ray multilayer mirrors, which was mainly caused by intensity fluctuation of the LPP source. For the purpose of signal to noise ratio improvement, we developed a novel intensity monitoring system using a grazing incidence beam splitter. We also improved detection electronics and software.

The optical system of the spectro-reflectometer is shown in Fig. 1. A Nd:YAG laser (Quanta-Ray DCR-2A, 1064 nm, 10 Hz, 800 mJ) is used to produce plasma on a samarium rod target. The monochromator consists of a spherical pre-focusing mirror of a radius of curvature of 5 m at a grazing incidence angle of 6°, a spherical grating (R = 3 m, 600 grooves/mm) and a pair of slits. A rotating debris shutter was designed and added in front of the pre-focusing mirror. A 2.5 nm thick Ru film supported by a Si_3N_4 membrane (NTT-AT corp.) was set as a beam splitter at the entrance of a sample chamber at a grazing incidence angle of 20°. The transmitted main beam toward the sample is used for reflection or transmission measurements with an EMT (Hamamatsu, R515). The reflected beam is used for intensity monitoring with another EMT. After the improvement of the detection electronics and software, a 1% shot to shot fluctuation of the intensity ratio of transmitted and reflected beams was achieved. The photon flux at a wavelength of 13.5 nm with 0.6 mm wide slits was estimated to be 1.75×10^5 photons/pulse.

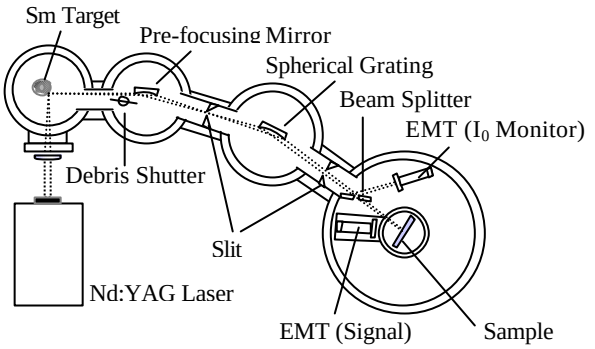

Fig. 1: Schematic plan view of the spectro-reflectometer.

[1] S. Nakayama, M. Yanagihara, M. Yamamoto, H. Kimura and T. Namioka, *Phys. Scr.*, **41**, (1990), 754-757.