Development of 50 Hz Laser-Produced Plasma Soft X-ray Source Using Tape-Target

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We are researching basic technologies of photoelectron microscopy equipments. As a part of the research, we have been constructing laser-produced plasma x-ray sources which can be operated at 50Hz repetition rate. The system consists of a Q-switched YAG laser (4-8 ns, 0.6 J), a focusing optics with combination of concave and cylindrical lenses and a target chamber containing a debris prevention system and an open reel tape-target driver. We developed the debris stopper consisting of rotating thin glass-plate and metal-disk with a small hole. A reel of tape can be irradiated three times within its width and be operated as long as 2 hrs without exchanging the reel.

When aluminum tape-target was used, the dominant spectral line appeared around 13 nm with the incident laser power density of 2×10^{11} W/cm^2. The spatial distribution of 13 nm radiation was investigated by using space-resolving soft x-ray spectrograph. It was found that it peaked around 1 mm distant from the target surface. By settling a small aperture near the source at the peak position, we can extract nearly monochromatized soft x-ray from laser-plasma source without using any dispersion optics.

Furthermore, we have newly developed a simple EUV calorie monitor which consists of a multilayer mirror, a thin filter and an absolutely calibrated silicon photodiode. By using this calorie meter, we measured the absolute radiation energy of 13 nm x-ray at the source position. The result was about 2 mJ/2π str./nm BW/pulse. This calorie meter could be useful for the other x-ray sources.

We have also been developing the tape-target coated with boron for 6 nm x-ray source.

Acknowledgement

A part of this work was performed in the grant-in-aid for scientific research program supported by MEXT and in industrial technical utilization development support program supported by NEDO.