Laser-based debris-free x-ray sources for picosecond x-ray diffraction

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Ultrafast time-resolved x-ray diffraction studies using laser induced x-ray pulses from solid targets have been extensively performed and revealed new phenomena such as ultrafast melting. Recently, the development of the laser-based x-ray sources using cluster targets has attracted a lot of attention. This is because, compared to the solid targets, cluster targets produce less debris and are easy to handle. Thus cluster targets have been suggested as clean sources of x-rays for various purposes.

We have investigated x-ray radiation properties of relativistic cluster plasmas created by the action of super-intense laser irradiation [1]. In order to demonstrate the practical capability of x-rays thus produced, the pulse x-ray diffraction is examined from Si(111) crystal with this source [2]. Figure 1 shows the typical CCD image of the diffracted x-rays. The diffraction pattern consists of well resolved *K*-shell emissions from highly ionized Ar ions. The number of photons in a 4□ sr solid angle for $He_{\square 1}$ resonant line of Ar (□=3.9491 Å, 3.14 keV) was calculated as 4□10^8 photons/s/pixel. Thus we have demonstrated that x-rays produced from the laser-irradiated clusters are strong enough to utilize as a debris free light source for time-resolved x-ray diffraction studies.

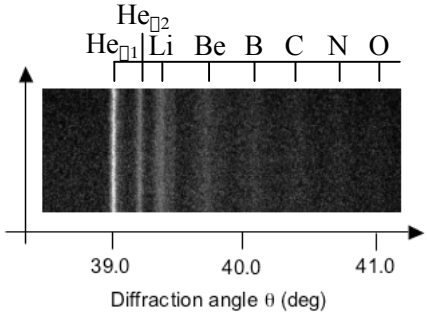

Fig. 1 The typical CCD image of diffracted x rays measured at the peak intensity of 6□10^{18} W/cm^2 with 30-fs pulse duration.

[1] Y. Fukuda et al., Laser Part. Beams **22**, 215 (2004).

[2] Y. Fukuda et al., Appl. Phys. Lett. **85**, 5099 (2004).