Intense Terahertz Radiation from a Relativistic Laser Plasma

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Terahertz (THz) pulses from solid targets, such as Al and a strong polyester film (Mylar), irradiated by ultra intense laser pulses were measured by a liquid-Helium-cooled Ge:Ga detector. The irradiating intensity of the Ti:Sapphire laser was more than 10^{18} W/cm^2. The maximum pulse energy and pulse duration on the target were 300 mJ and 30 fs, respectively. To prevent the UV, visible and IR radiation from being measured by the detector, we used ITO films as selective mirrors for the THz radiation. The reflectivity of the ITO film for the THz radiation is 10 times higher than that for the visible and IR wavelength range. Figure 1 shows the polarization characteristic of the THz radiation from a Al foil excited by ultra intense laser. We were found that the polarization of the radiated THz signal is p-polarization. This result correspond to Hamster et al. reported that[(1)]. Simultaneous with the THz radiation, we observed a proton signal and a hard x-ray signal from the laser induced plasma using by Faraday Cup(FC) and x-ray photodiode(XPD), respectively. Figure 2(a) shows the hard x-ray signal versus the THz signal and Figure 2(b) shows the proton signal versus the THz signal in each cases of Al and Mylar target. We found that both the hard x-ray signal and the proton signal is correlated to the THz signal for Al target. However, between the THz signal and the other signals are not correlated in Mylar target. Even though a detailed analysis of the relations have not been fully completed, we suggest that the measured THz intensity shows the status of the plasma. Therefore, we can be assumed that this measured THz intensity can be useful tools of properties of laser induced plasma. We expect that this intense and wide-band the THz radiation could be a useful source for various THz applications. We will investigate the spectral characteristics of the radiation for measuring the properties of the laser wakefield of the relativistic plasma.

References

(1)H. Hamster, A. Sullivan, S. Gordon and R. W. Falcone, "Short-pulse terahertz radiation from high-intensity-laser-produced plasmas," Phys. Rev. E **49**, pp. 671-677 (1994).

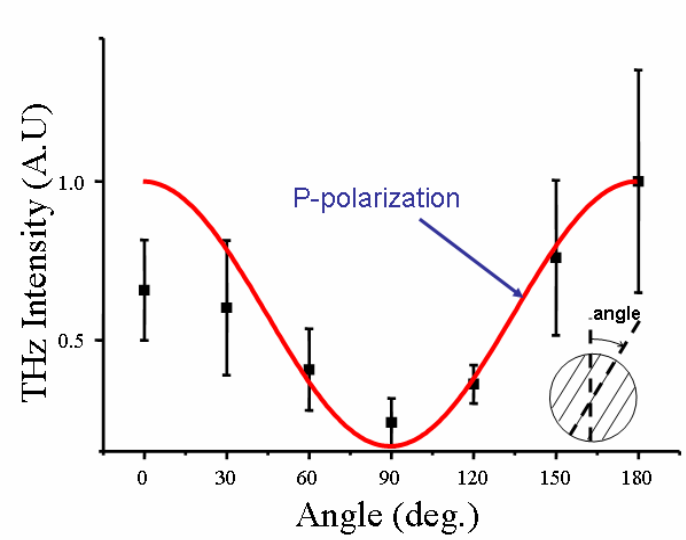

Fig. 1. The normalized the THz intensity versus the rotational angle of the metal grid wire polarizer.

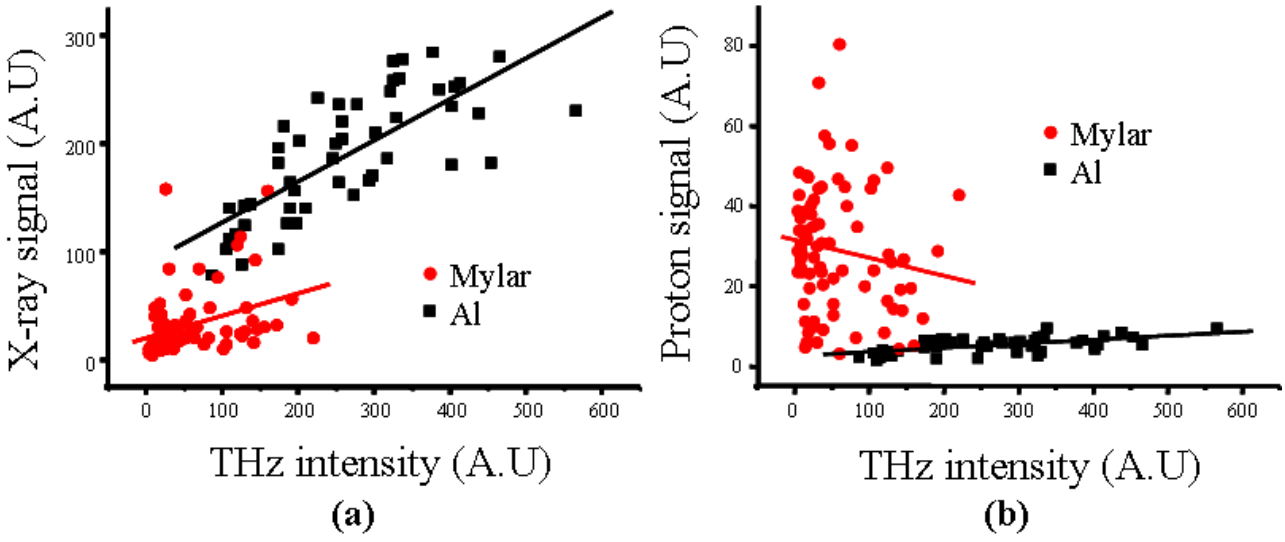

Fig. 2. Correlation between hard x-ray, proton and THz emission from the solid target, such as Al and Mylar. The radiated THz from specular reflection in the backward direction toward the target.