§14. Characteristics of Terahertz Imaging Camera for High-Temperature Plasma Diagnostics

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For utilizing the terahertz wave for high-temperature plasma diagnostics, some device components need to develop. Recently, a high sensitive THz range video camera has been developed and is commercially in use. If such a video camera is possible to detect for a THz pulse, the real-time plasma imaging measurement is available. Before this research, however, the availability to a THz pulse was open question, because the development was done using by several continuous THz waves. Therefore, we need to know the availability. Also, we test the frequency resolved system which is consisted with a band pass filter.

Test system configuration is shown in Fig. 1. The THz pulse which frequency range is 0.1-2.5 THz is output from photo-conductive antenna with silicon lens. The output beam is led to THz camera (NEC: model IRV-T0831 with a f=28.2mm lens) via combination parabolic and plane mirrors. Figure 2 show the obtained image of THz pulse. Here, a lock-in operation is utilized for a sensitive detection of pulse signal. Quite clear image can be obtained and the signal to noise ratio is 130. When the band pass filter of metal mesh[1)] is inserted, the transmission power of THz beam is decreased and it might be led the degradation image.

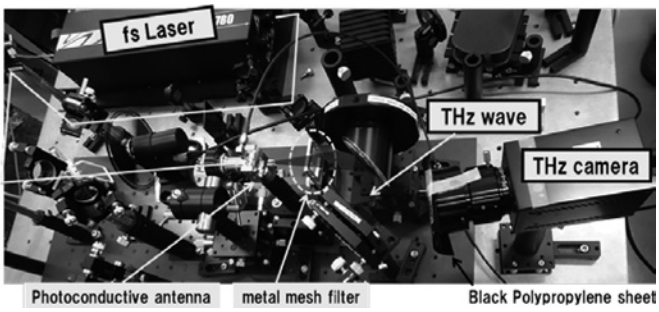

Fig. 1. Photograph of test system configuration. Femto-second laser light pumps up the THz wave at the photo-conductive antenna and it is led to THz camera.

Figure 3 shows the example of the image passing through the band pass filter which has the center frequency of 400 GHz, the bandwidth of 18 %, and the transmissivity of about 40 %. The observation condition is the same as figure 2. It can be still distinguished, but the signal to noise ratio decreases to 13 which is 10 times worse than the reference. It is found that the optimization and developments of filter design and detection configuration is needed for the plasma diagnostics.

We thank to Prof. N. Okajima and Dr. K. Nakayama (Chubu Univ.) and Dr. N. Oda (NEC Corporation) for collaboration work.

1) Tani, M. et al. : Ann. Rep. NIFS (2011-2012) 147.

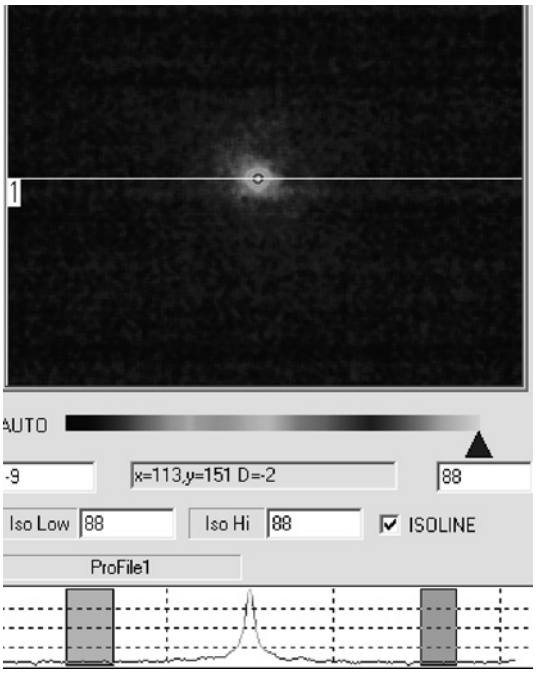

Fig. 2. Beam pattern of THz pulse. S/N ratio is 130. The setting parameter of the camera is follows: Lock-in operation of 3.75Hz, frame integral is 16 times, spatial filter is 4x4, and lens (IRV-TL028) is used.

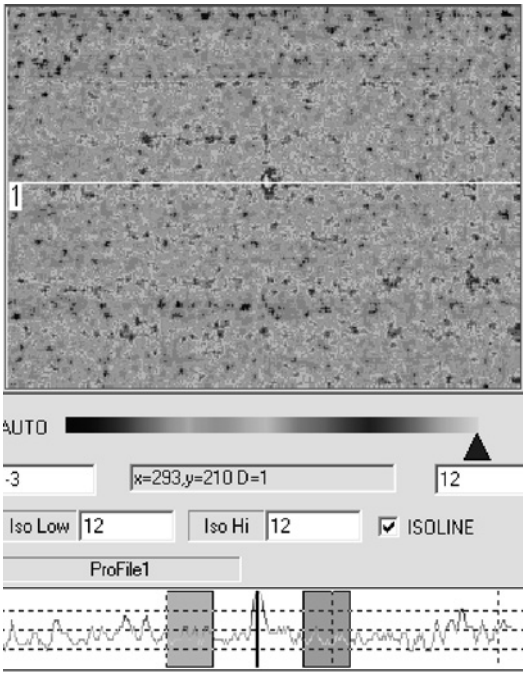

Fig. 3. Beam pattern of THz pulse with the band pass filter which the center frequency is 400 GHz and the bandwidth is 18 %.. S/N ratio is 13.