

## §12. Terahertz Device Developments for High-Temperature Plasma Diagnostics

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For utilizing the terahertz wave for high-temperature plasma experiment, some device components need to develop. Especially, the application of time-resolved diagnostics demands the band pass filter in terahertz regime. For example, conventional millimeter radiometer has high temporal resolution and measure the electron temperature fluctuation. It is composed of filter bank and detectors. On the other hand, for measuring the electron density fluctuation in the high dense plasma, a terahertz pulse has a possibility as an active diagnostic source. When we design the combined system of terahertz pulse and filter bank detection, one of the key issues is the frequency selective band pass filter.

One of several ideas is utilized a metallic mesh shown in Fig. 1. It is a simple component and easy to apply the quasi-optical system. The characteristics of mesh filter were studied by using a terahertz time-domain spectroscopy system. The terahertz pulse is penetrating through the mesh filter and detected by the optical sampling technique. Example of detecting terahertz pulse is shown in Fig. 2. Here, *Signal* means the detector output through the mesh filter which the center frequency is 405 GHz and the bandwidth is 10 %. The transmissivity is calculated that the output signal is subtracted from the *Reference* signal which the terahertz wave travels in free space. Each transmissivity of two mesh filter is shown in Fig. 3. The difference of these filters is the band width. The designed each band width is 10 % and 18 %, respectively. The measured value is almost same with the designed one. It is

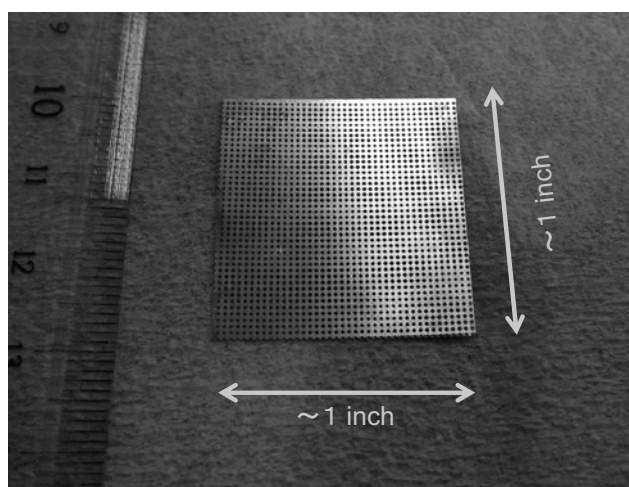


Fig. 1. Photograph of mesh filter. The size is 1 inch rectangular and thickness is  $3\mu\text{m}$ .

found that the mesh filter is used as the band pass filter and the band width can be designed. Also, higher frequency component is slightly still remained and we found to need the additional filter for reducing these components. Therefore, it follows that we can design and apply the filter bank system of detecting terahertz wave.

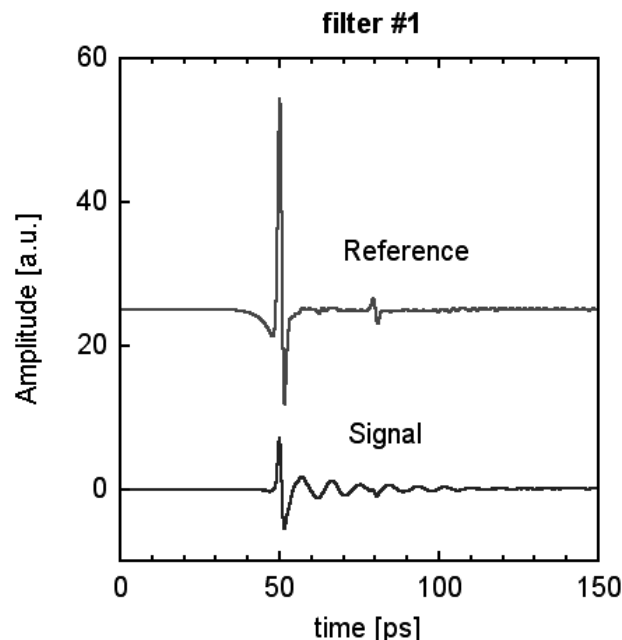


Fig. 2. Time traces of Terahertz pulse signal. *Signal* means the output through the mesh filter. Also the case of no filter is shown as *Reference*.

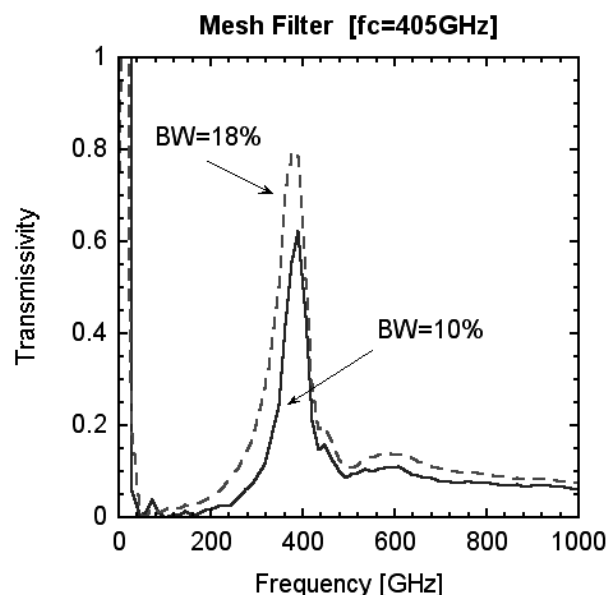


Fig. 3. Frequency spectra of each mesh filter outputs. The solid line shows that band width is 10 % and dotted line shows that of 18 %.