

Experimental Evaluation of Terajet Produced by a Dielectric Cuboid in the THz Region

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Introduction: A terajet, i.e., a jet with a subwavelength focusing performance in the terahertz (THz, 0.1-10 THz) region, has been attracting a lot of research interests owing to the possibility to enhance the resolution in imaging applications [1]. Although many numerical studies have been reported, the evaluation of the terajet generated from a 3D dielectric cuboid has not yet been verified experimentally in the THz region. Recently, we have proposed a THz-wave measurement system, based on the non-polarimetric self-heterodyne electro-optic (EO) detection technique, to visualize the THz waves in the near-field region [2]. Using this system, we demonstrate the experimental evaluation of the generation of the terajet from a 3D Teflon cuboid.

Experimental results and discussions: The cuboid in our experiment was a 3D mesoscale Teflon ($n=1.46$) with the dimensions $2.4\text{ mm} \times 2.4\text{ mm} \times 2.4\text{ mm}$. The cuboid was illuminated by collimated THz waves at frequency 125 GHz ($\lambda = 2.4\text{ mm}$). The EO sensor was placed at a distance of about 1.2 mm (0.5λ) from the cuboid. Fig. 1(a) and 1(b) show the experimental visualization of the amplitude and the phase of THz waves after interacting with the cuboid, respectively. The measured area in each plane was $20\text{ mm} \times 20\text{ mm}$ ($8.3\lambda \times 8.3\lambda$). The electric-field vector was parallel to the XZ-plane. A green cuboid, drawn from CAD data, is depicted with the experimental results to clarify the position of the cuboid. We can clearly observe a terajet generated from the cuboid in the amplitude image. Fig. 2 shows the relative THz power enhancement along Z-axis between the cases with and without the presence of the cuboid. The experimental results in dots agree well with the simulated results in a solid line. In the experiment, a maximum intensity enhancement of about 7.4 dB and full width at half maximum of 1.44 mm (0.6λ) were obtained at a

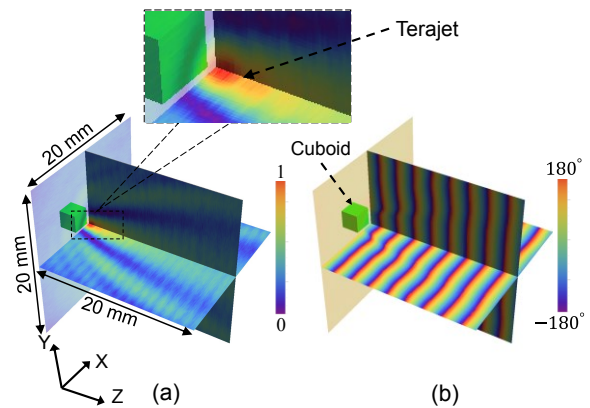


Fig.1 Experimental visualization of terajet produced by a 3D Teflon cuboid at 125 GHz. (a) Amplitude and (b) phase.

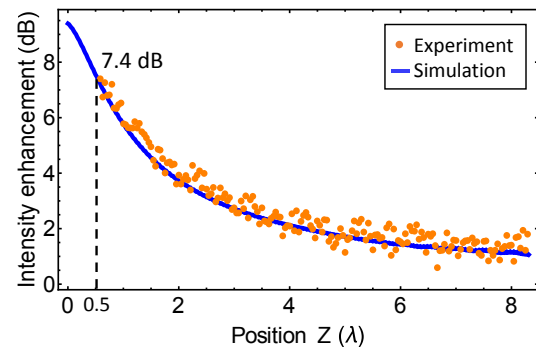


Fig.2 Intensity enhancement along Z-axis.

distance of 0.5λ from the cuboid. The generation of the terajet with a subwavelength focusing performance by a 3D dielectric cuboid at 125 GHz was experimentally confirmed and characterized for the first time. In the future, the performance of the terajet when changing the THz frequency and illumination angle of the THz beam will be experimentally studied.

Acknowledgements:

This work was supported in part by MEXT KAKENHI (15K13383); and Mendeleev Scientific Fund of Tomsk State University (8.2.48.2015).

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[2] S. Hisatake et al., Optica 1, pp. 365-371, 2014.