P26

Thick objects imaging using compact phase shifting elements designed for 0.6 THz

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Reducing the dimensions of terahertz (THz) imaging systems is a key-factor for increasing applicability in mobile unattended package inspection systems used at airports or public places [1]. From practical view of point, it is of particular importance to design THz imaging system so that it would be compact, reliable and provides the ability to scan thick objects, mostly independent by the distance to the focusing element.

Fig. 1 The photo of thin silicon-based phase shifting element for the 0.6 THz

In this work, we demonstrate design, operation and high-resolution imaging of silicon-based Fibonacci [2] and Bessel zone plates [3] for 0.6 THz frequency. These focusing elements can improve THz imaging system by simultaneous two plane imaging or by long focal depth for thick object inspection. Focusing elements were fabricated on silicon wafer of 0.5 mm thickness with resistance 0.01–1 MΩ·cm and refractive index of 3.46 using laser direct writing technology [4], which was also employed to produce multilevel phase Fresnel lens described in [5]. The focusing performance was investigated theoretically and experimentally by measuring spatial profiles, distance between the foci and focal depth at sub-THz range. The ability to perform simultaneous imaging with the wavelength resolution of two planes separated by 7 mm distance was experimentally revealed. The multifocal imaging results were compared with the performance of the multilevel phase Fresnel lens [5]. A novel approach of THz imaging using Bessel zone plate providing a 2×λ resolution at λ=0.5 mm and weak result dependence on object position will be demonstrated as well.

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REFERNCES

[1] R. Li, C. Li, H. Li, S. Wu, and G. Fang;*IEEE Trans. Terahertz Sci. Technol.*, **9**(2) (2019) pp. 165–176.
[2] D. Jokubauskis, L. Minkevičius, M. Karaliūnas, S. Indrišiūnas, I. Kašalynas, G. Račiukaitis, and G. Valušis; *Opt. Lett.*, **43**(12) (2018) pp. 2795–2798.
[3] L. Minkevičius, D. Jokubauskis, I. Kašalynas, S. Orlovas, A. Urbas, and G. Valušis in *International Conference on Infrared, Millimeter, and Terahertz Waves, IRMMW-THz*, (2019) pp. 2.
[4] B. Voisiat, S. Indrišiūnas, R. Šniaukas, L. Minkevičius, I. Kašalynas, and G. Račiukaitis, *Proc. SPIE* **10091**(10) (2017) pp. 100910F.
[5] L. Minkevičius, S. Indrišiūnas, R. Šniaukas, B. Voisiat, V. Janonis, V. Tamošiūnas, I. Kašalynas, G. Račiukaitis, and G. Valušis, *Opt. Lett.* **42**(10) (2017) pp. 1875–1878.