SIMULATION OF SILICON-BASED BESSEL ZONE PLATES FOCUSING PERFORMANCE AT SUBTERAHERTZ RANGE

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Food, medicine and other industries require imaging systems so that they could ensure the best quality products available [1], [2]. Compact imaging systems are becoming high in demand and terahertz systems are a great example of them. These systems contain small diffractive elements that perform the same as the bulky optical lenses or mirrors [3]. Besides being compact they should have a high focusing efficiency, should be reliable, have enough focal depth to penetrate (scan) thick objects with great accuracy.

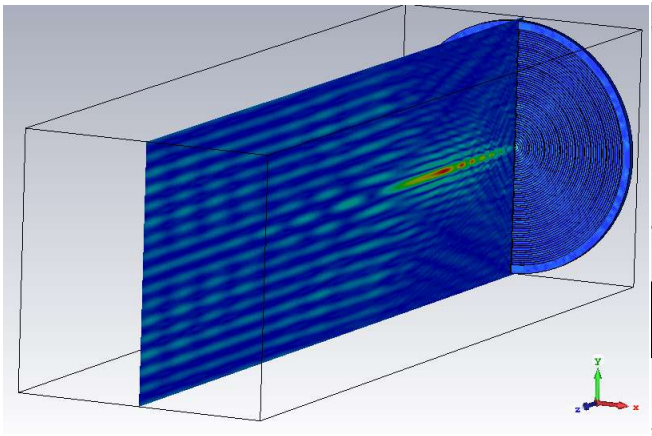

Fig. 1 Quasi- Bessel beam created by BZP with number of zones Z=7 and quantization level N=8.

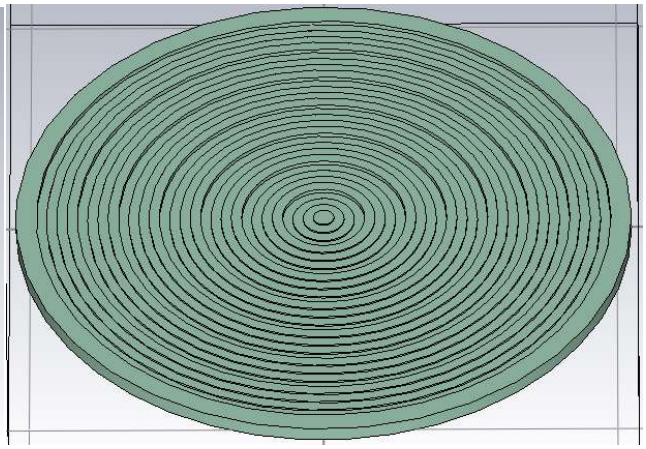

Fig. 2. BZP with a quantization level of N=4 and number of zones Z=7.

In this work, we demonstrate the design and theoretical calculations of the performance of a regular axicon and Bessel zone plate (Fig. 2) which was designed for 0.6 THz frequency. „CST STUDIO SUITE“ was used for modeling of the optical elements. The axicon with a diameter of 25 mm and Bessel zone plates were designed as ideal silicon- based which had a dielectric permeability of 11.9. Using „CST STUDIO SUITE“ Time domain solver simulation option after the program made calculations we looked at the focusing performance of the axicon depending on its base angle (8°15°). With regards to the Bessel zone plate, its focusing efficiency was measured while altering two factors: number of zones, number of quantization levels. As a second task, the importance of the orientation of two separated BZP by a distance of double the focal length on the electric field distribution was calculated as well. The latter theoretical calculations ware used to see if two Bessel zone plates could in theory act as a part of a compact imaging system.

[1] G. Ok, H. J. Shin, M.-C. Lim, and S.-W. Choi, “Large-scan-area sub-terahertz imaging system for nondestructive food quality inspection,” *Food Control*, vol. 96, pp. 383–389, Feb. 2019.

[2] K. Ahi, “A method and system for enhancing the resolution of terahertz imaging,” *Measurement*, vol. 138, pp. 614–619, May 2019.

[3] L. Minkevičius *et al.*, “Terahertz multilevel phase Fresnel lenses fabricated by laser patterning of silicon,” *Opt. Lett.*, vol. 42, no. 10, p. 1875, May 2017.