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Terahertz Beam Shaping with Diffractive Optics

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Diffractive optical elements (DOEs) provide compact and flexible solutions for beam shaping applications across different spectral ranges, including the terahertz (THz) domain [1]. In this study, an iterative holographic approach for designing THz diffractive structures dedicated to tailored beam shaping applications is presented. The proposed method is based on iterative wavefront propagation between the DOE plane and the target plane with enforced amplitude corresponding to a Gaussian THz source distribution and a predefined target intensity profile.

The designed structure operates at 267 GHz and transforms the incident beam into two separated focal line segments at a distance of 100 mm from the element. Numerical simulations were performed to evaluate different target intensity profiles and improve the uniformity of the generated line segments. Figure 1a presents the phase delay map of the designed diffractive structure, while Fig. 1b shows the simulated intensity distribution obtained at a propagation distance of 100 mm behind the DOE. The optimized DOE was fabricated via 3D printing using cyclic olefin copolymer, a material with low absorption in the THz radiation range [2]. Experimental measurements confirmed the formation of the designed two-segment intensity distribution, showing good qualitative agreement with numerical results.

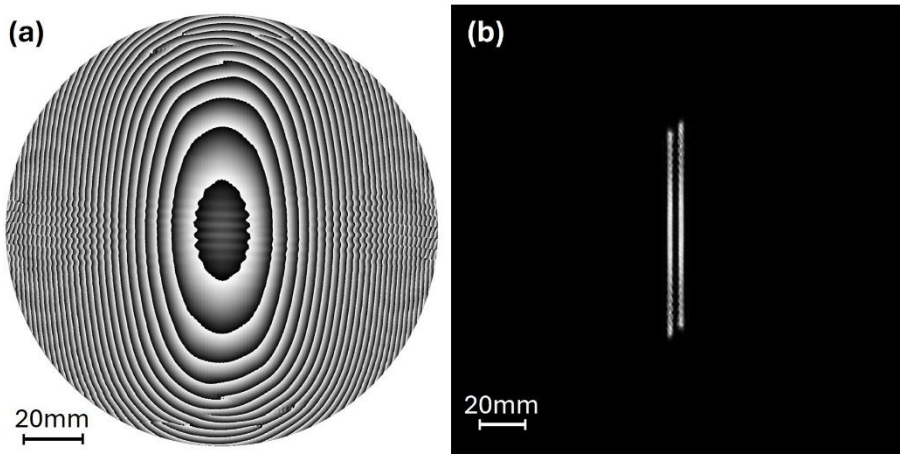

Fig. 1. (a) Phase delay map of the designed diffractive optical element and (b) simulated intensity distribution obtained at a propagation distance of 100 mm behind the structure.

These results demonstrate the potential of iterative holographic design combined with additive manufacturing for developing application-specific THz diffractive optics, particularly for beam shaping in scanning and imaging systems.

REFERENCES

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[2] M. Kaluza, M. Walczakowski, and A. Siemion; *Materials* **17** (2024) p. 5104.