Sub-THz domain hybrid phase coding for large aperture lenses.

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For many THz application large aperture of the lens is necessary. The light weight diffractive optics can provide low loss and better transparency than refractive one. The use of kinoform [1] phase coding is typically highly effective. However when large aperture lens are created with small focal length very strong shadow effect [2,3] appears on its edges. This effect can be significantly reduced by phase encoding with gradient index or in sub-wave technique. However, this methods requires very large resolution or advanced technology. We propose coding the area that is vulnerable for shadow effect with binary phase. It will lower the shadow effect and increase the efficiency. With the simplicity of production it is a reasonable compromise

In this article is presented hybrid diffractive structure consisting of phase encoded as a kinoform in the center and binary phase on the edges (fig.1.b). With this combination, for the lens aperture greater than the focal length, it is possible to considerably improve the performance in comparison to the structure coded entirely as a kinoform. All the modelling were provided for 288GHz frequency.

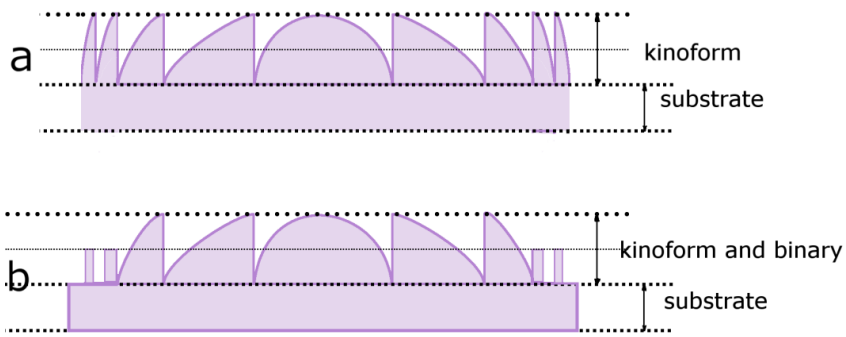

Fig.1 Illustration of the possibility of eliminating the negative impact of shadow effect concept: a) kinoform with fast alternating phase on the edges of, b) hybrid structure consisting lens coded as kinoform in the middle and as binary structure on the edges.

Computer modeling of designed structure efficiency and its comparison to other types of diffractive lenses for THz domain will be presented.

References

[1] J. A. Jordan, P. M. Hirsch, L. B. Lesem, and D. L. Van Rooy, "Kinoform Lenses," *Appl. Opt. 9*, 1883-1887 (1970)

[2] P. Lalanne, S. Astilean, P. Chavel, “Design and fabrication of blazed binary diffractive elements with sampling periods smaller than the structural cutoff,” J. Opt. Soc. Am. A 16, 1143-1155 (1999).

[3] J. Suszek, M. Sypek, M. Makowski, F. Garet, I. Ducin, K. Kakarenko, J. Bomba, and J.-L Coutaz, "Evaluation of the shadow effect in terahertz kinoform gratings," *Opt. Lett. 38*, 1464-1466 (2013)

[3] Philippe Lalanne, "Waveguiding in blazed-binary diffractive elements," *J. Opt. Soc. Am. A* 16, 2517-2520 (1999)