FOCUSING PROPERTIES SIMULATION OF COMPACT DIFFRACTIVE ELEMENT COMBINED WITH META-MATERIALS

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Nowadays Terahertz (THz) radiation is actively used for imaging applications medical diagnostics, security inspection [1] or food and pharmaceutical industry [2]. Components of optical system should be compact and high efficiency. Diffractive components such as a metal zone plates and phase zone plates reduce the size of the optical systems [3] while meta-materials increase the efficiency of individual components and allow to control the parameters of the radiation.

The main goal of this work was to define the best meta-material design for focusing the 0.6 THz radiation. Dependency of focus efficiency and phase quantization level was also determined. Simulations were done using CST microwave studio program.

To achieve the focusing functionality, the split ring metasurface with various opening angles θ ware used. We have created two different designs (see Fig. 1) to identify the maximum transmission coefficient at 0.6 THz.

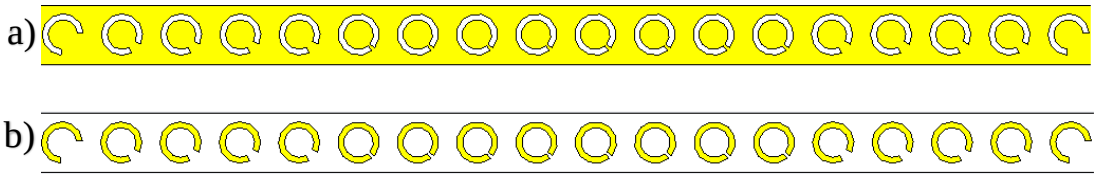

Fig. 1. 100-nm thick gold film on a silicon wafer with cutouts (a) and 100-nm split ring gold film matasurface on a silicon wafer (b).

Different opening angles θ were used in order to achieve the phase shift covering 2π range and nearly constant transmission amplitude simultaneously. The required phase distribution at the appropriate place in diffractive elements was obtained by cylindrical lens formula. Both designs of the diffractive element let to focus 0.6 THz radiation in the focal point of 4 mm is shown in Fig. 2.

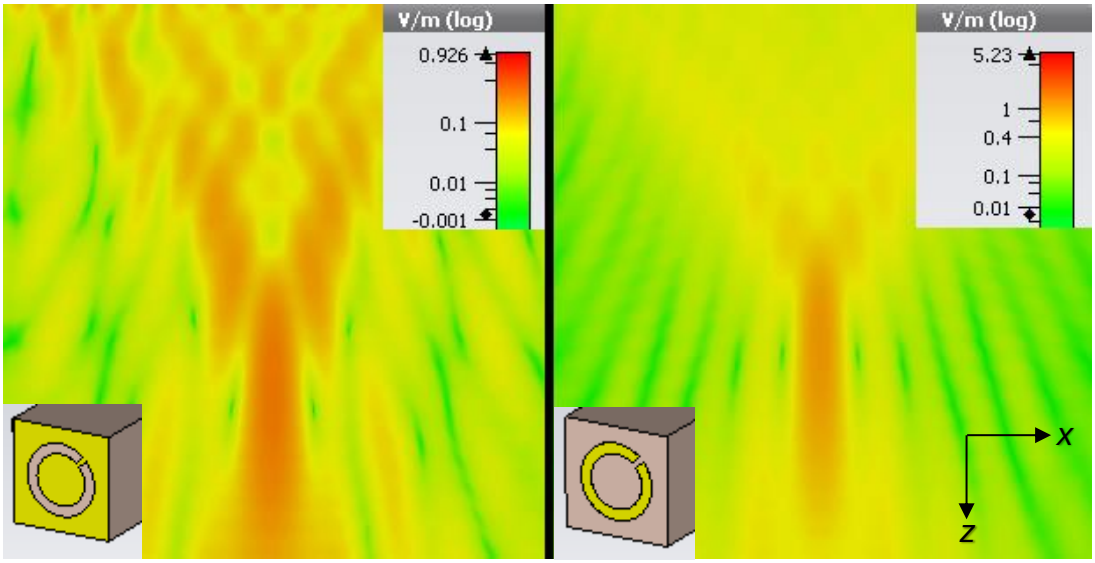

Fig. 2. Simulation result of different diffractive elements combined with split ring meta-materials.

To conclude, the focusing characteristics of the diffractive element consisting of ring-shaped metamaterials were theoretically evaluated and optimized design was estimated.

[1] V. Tamošiūnas, S. Indrišiūnas, M.Tamošiūnaitė ir kt., Focusing of Terahertz Radiation with Laser-Ablated Antireflective Structures, IEEE Transactions on Terahertz Science and Technology **8**(5), 541-548 (2018)
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[3] L. Minkevičius, K. Madeikis, B, Voisiat ir kt., Focusing Performance of Terahertz Zone Plates with Plates with Integrated Cross-Shape Apertures, Journal of infrared, millimeter and terahertz waves **35**(9), 699-702 (2014).