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A Simple Quarter-Wave Plate with Rectangular Periodic Openings in the THz Region

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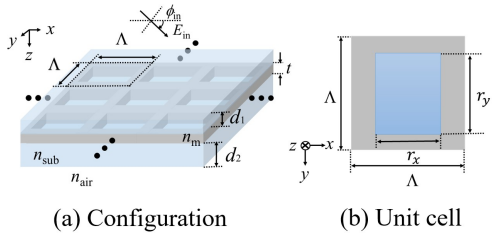
Polarization conversion using quarter-wave plates has been studied in a variety of configurations [1]. Although the plates using dielectric materials exist [2], their configurations tend to be large. On the other hand, the configurations can be reduced by using a metal plate. However, if wideband polarization conversion is to be achieved, the configuration may become more complex [3]. In this article, a wideband polarization conversion is achieved with a simple configuration.

We analyze a quarter-wave metal plate with rectangular periodic openings in the THz region, as shown in Fig. 1. The dielectric substrate is made of polyethylene and its refractive index is 1.5. The medium inside the rectangular aperture is also polyethylene. The metal plate is treated as a perfect electric conductor. The structural parameters are as follows: $t = 63\ \mu$m, $r_x = 75\ \mu$m, $r_y = 97.5\ \mu$m and $d_1 = 75\ \mu$m. The thickness of the lower dielectric layer d_2 is defined as semi-infinite. The period lengths Λ are fixed to be $112.5\ \mu$m. The FDTD method with the periodic boundary condition is used in the analysis.

Fig. 2 shows the ellipticity as a function of frequency. The dotted line indicates the 3 dB error range for obtaining circular polarization [4]. The gray range has a transmittance of more than 80% and meets the criteria for circular polarization. It is found that the linear polarization is converted to the circular one. A bandwidth of 14.2% is obtained, resulting in a wideband operation.



(a) Configuration (b) Unit cell

Figure 1. Quarter-wave plate

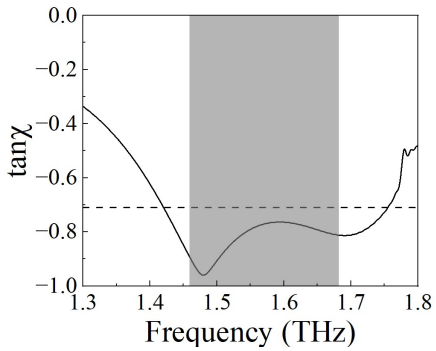


Figure 2. Ellipticity

References

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[3] X. You et al., "Broadband Terahertz Transmissive Quarter-Wave Metasurface," *APL Photon.*, vol. 5, no. 9, pp. 096108-1-9, Sept. 2020.

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