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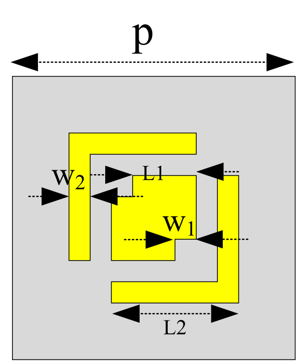

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Comment on "Design and Characterization of an Ultrabroadband Metamaterial Microwave Absorber"

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Abstract: The authors have proposed an Ultrabroadband Metamaterial Microwave Absorber. The authors have claimed that the proposed structure is metamaterial absorber. We have recognized that the designed structure is not a metamaterial absorber because of ignorance of cross-polarized reflection coefficient. The designed structure is polarization convertor because the proposed unit cell has an-isotropic geometry.

Index Terms: Polar polarization conversion, metasurface.

1. Introduction

The designed structure in [1] has been simulated in CST microwave studio using cell boundary conditions where for excitation of unit cell floquet port is used. The authors have calculated the absorption using $A = 1 - R(w) - T(w)$ equation. Due to ignorance of cross-polarization reflection coefficient the designed structure, provide a very strong absorption rate over a frequency band of 20.59 GHz to 43.73 GHZ as the authors claimed in [1].

We have simulate the designed unit cell as shown in Fig. 1. The simulated co- and co- and cross-polarized reflection coefficient (R_{xx} & R_{yx}) is shown in Fig. 2. From Fig. 2, it can be seen that the magnitude of the cross-polarized reflection (R_{yx}) is increases in the resonating band. Because of high cross-polarized reflection coefficient the absorption of the metasurface will decreases, the metasurface will behaves as a polarization converting metasurface.

The efficiency of polarization conversion can be obtain from the polarization conversion ratio (PCR) given as follow;

$$PCR \frac{|R_{yx}|^2}{|R_{yx}|^2 + |R_{xx}|^2}$$

The magnitude of PCR is plotted verses resonant frequency as shown in Fig. 3. It can be noticed that the designed unit cell has PCR > 0.9 within resonating frequency band, therefore, the designed structure can be used as a broadband polarization converter [2].

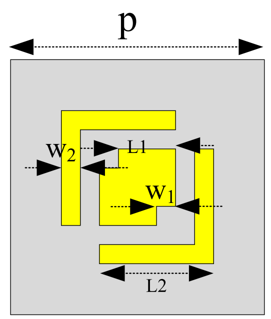


Fig. 1. Schematic view of the designed unit cell [1].

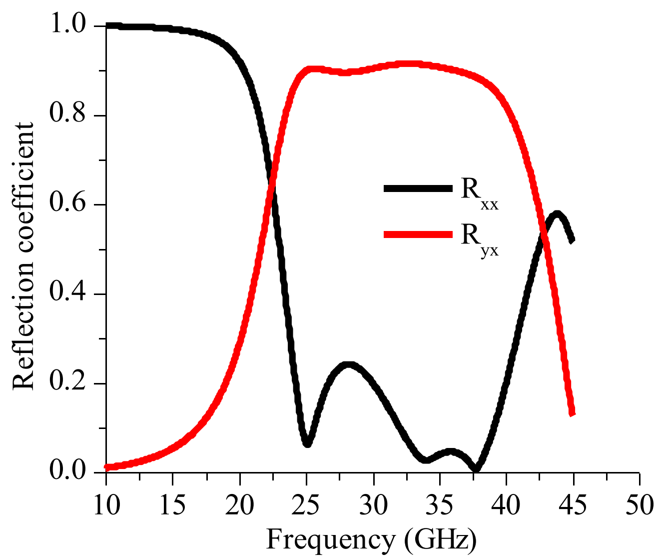


Fig. 2. Simulated Co- and cross-polarized reflection coefficient

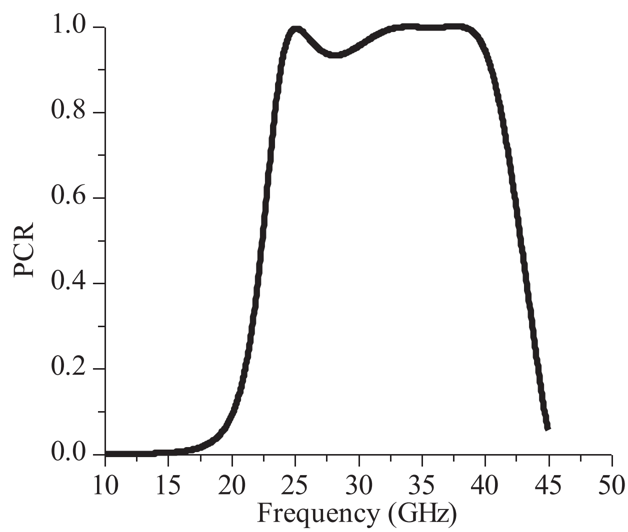
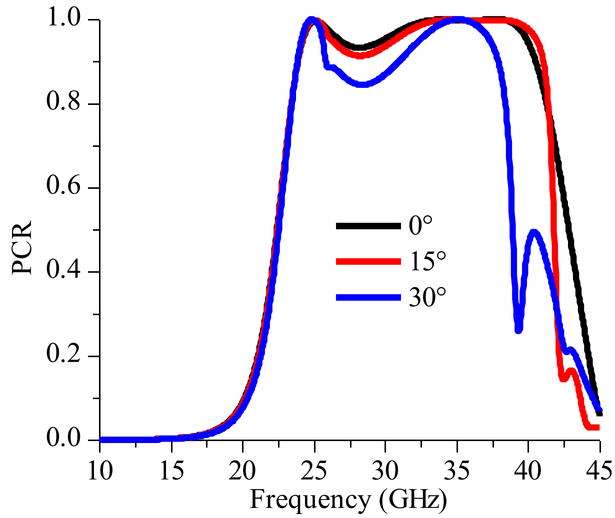
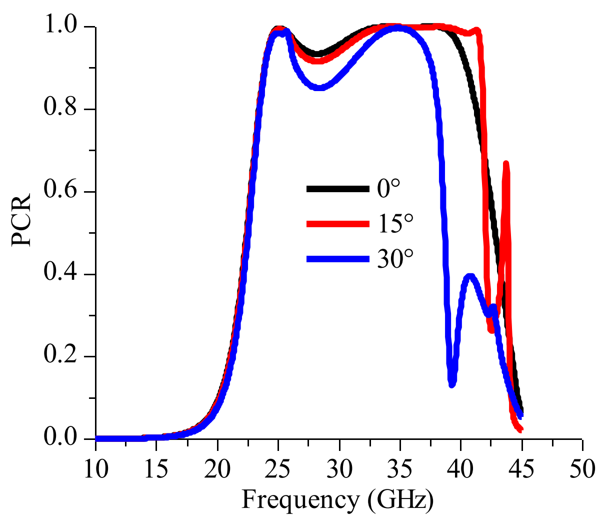


Fig. 3. The simulated polarization conversion ratio (PCR) of the reflected wave.



(a)



(b)

Fig. 4. The simulated polarization conversion ratio (PCR) of the reflected wave in (a) TE mode and (b) TM mode.

Further, to verify the stability of polarization conversion in both TE and TM modes, for oblique angle from 0° to 30°, the PCR is plotted in Fig. 4. It can be seen that from Fig. 4(a) and (b), that the PCR is greater than 0.85 in the broadband.

Another reason is that proposed structure is not isotropic in nature. The cross-polarization reflection is increases because the proposed design is an-isotropic in nature [2]–[4].

2. Summary

From the above discussion, it concluded that isotropic geometry is important for metamaterial absorber. However if the isotropy is break, then the meta-structure will behaves as polarization converter. For anisotropic metasurface, the cross polarization reflection should be consider in the calculation of absorptivity.

References

[1] W. Xin, Z. Binzhen, W. Wanjun, W. Junlin, and D. Junping, “Design and characterization of an ultrabroadband metamaterial microwave absorber,” *IEEE Photon. J.*, vol. 9, no. 3, pp. 1–13, Jun. 2017.
[2] M. I. Khan, Z. Khalid, and F. A. Tahir, “Linear and circular-polarization conversion in X-band using anisotropic metasurface,” *Sci. Rep.*, vol. 9, pp. 1–11, 2019.
[3] N. Yu and F. Capasso, “Flat optics with designer metasurfaces,” *Nat. Mater.*, vol. 13, pp. 139–150, 2014.
[4] S. S. Bukhari, J. Y. Vardaxoglou, and W. Whittow, “Applied sciences a metasurfaces review: Definitions and applications,” *Appl. Sci.*, vol. 9, pp. 1–14, 2019.