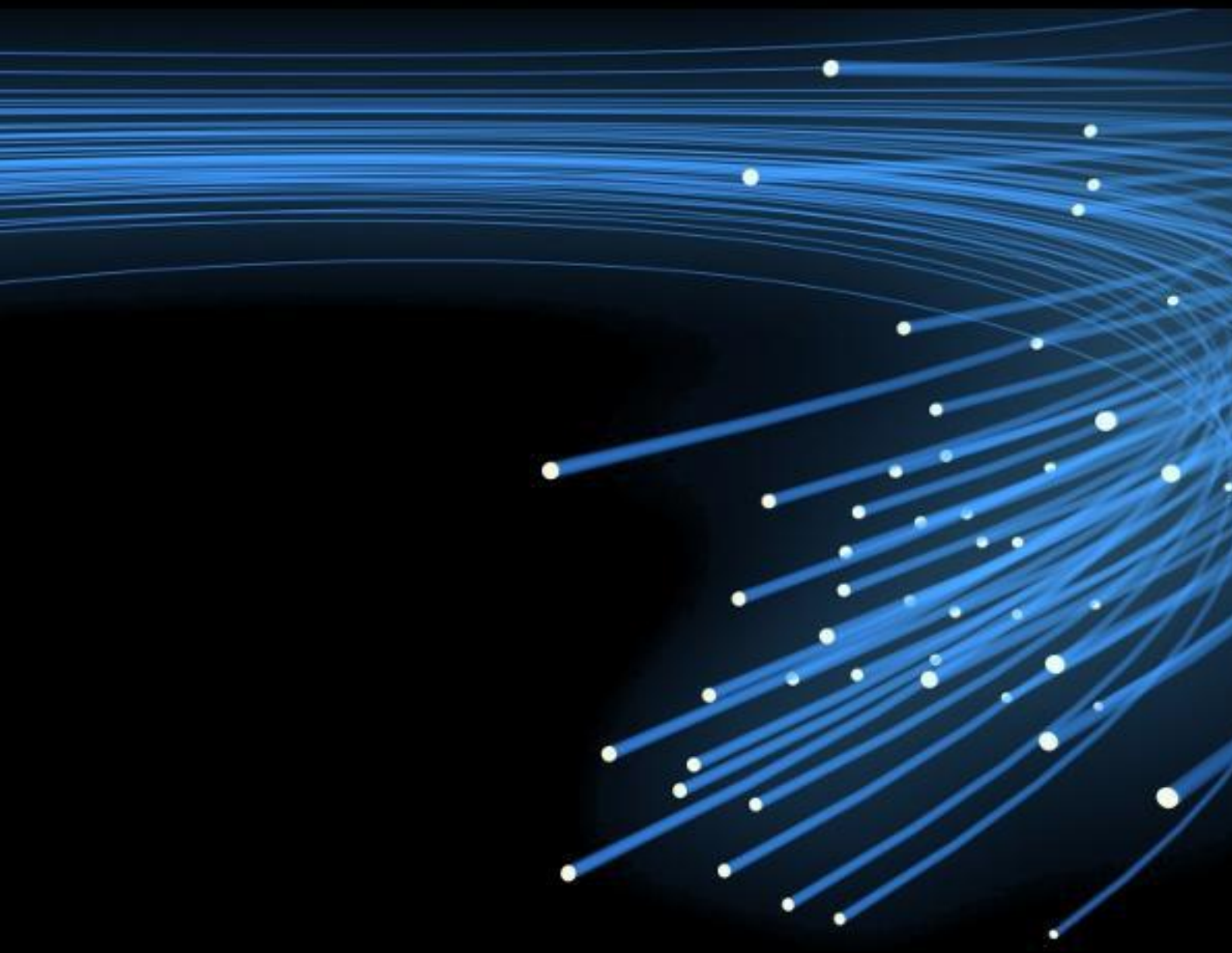
META'16 Malaga - Spain

The 7th International Conference on Metamaterials, Photonic Crystals and Plasmonics



Proceedings

ISSN 2429-1390

metaconferences.org

Chiral Metamaterial Structure With High Optical Activity Based On Conjugated Omega Particles

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Abstract- In this communication the authors present a novel chiral metamaterial structure formed by planar omega particles These omega particles, arranged in conjugated pairs, present high optical activity. Thanks to the high values of chirality, the structure provides negative refractive index with high figure of merit.

This communication presents a novel bilayered chiral metamaterial structure formed by planar omega particles. The pattern of one layer is the conjugated pattern of the other one. The structure is formed by combining alternately rows of horizontal conjugated omegas and vertical conjugated omegas (Fig 1a). In the proposed structure, the unit cell, with C_4 symmetry, (Fig. 1b), contains only half part of the conjugated omega structure. The full structure is completed with the neighbouring unit cells.

As chiral particles, the conjugated omega structures [1] insert cross-coupling between the electric and magnetic field. An incident E_y electric field produces a magnetic moment on the horizontal omega pairs while an incident H_x magnetic field induces an electric moment on the vertical conjugated omega structures.

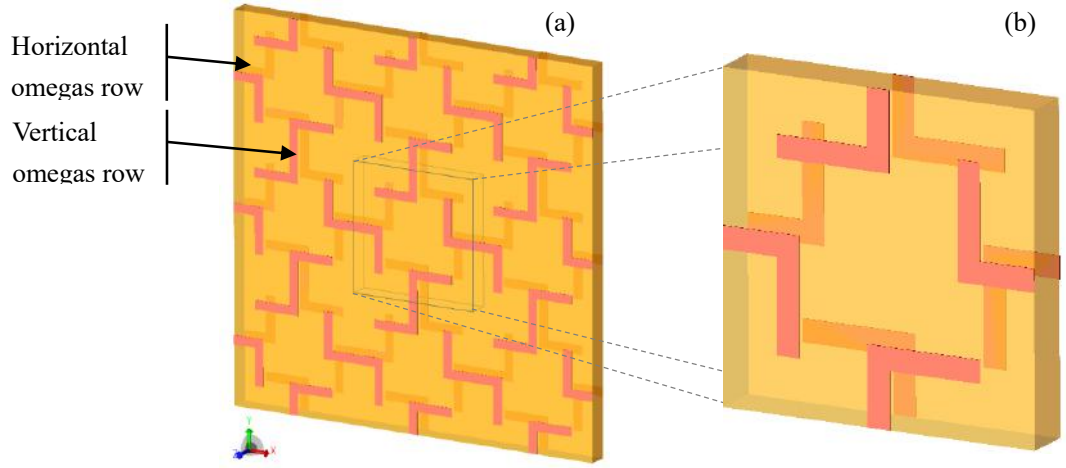

Figure 1. *(a) Conjugated omega structure, (b) unit cell*

The substrate, Rogers Duroid 3003, has a thickness of 60 mils, a dielectric constant $\varepsilon_r = 3$ a loss tangent *tan* $\delta = 0.0013$ and a copper cladding of 35 μm.The simulations were performed using the finite differences time domain engine of Keysight EMPro 3D electromagnetic simulation software. The characterization of the structure is done by means of the classical parameter retrieval algorithm proposed in [2] using the linear transmission and reflection coefficients.

The simulation results show high optical activity in the proposed chiral metamaterial structure. A linearly polarized incident field is transmitted through the structure with very low co-polar transmission coefficient but with a very high cross-polar transmission coefficient (Fig. 2a). As it is shown in Fig. 2b, the polarization plane rotates to about 90º (pure rotation).

The high optical activity is also reflected on the refractive index of the circularly polarized transmitted waves ($n_{\pm}$). Thanks to the high values of the chirality parameter, κ, (Fig. 1c) the real part of the refractive index n_+ or n_- presents negative values (Fig. 1d).

As in others planar chiral metamaterials, the imaginary part of the refractive index ($n''_{\pm}$) is high at the resonance frequencies. In these frequency regions the negative refraction is not useful due to the high losses. This structure presents a frequency region, next to the resonance frequency, where n'_- is still negative but n''_- is nearly zero. In this region the figure of merit (FOM = n'_-/n''_-) present high values.

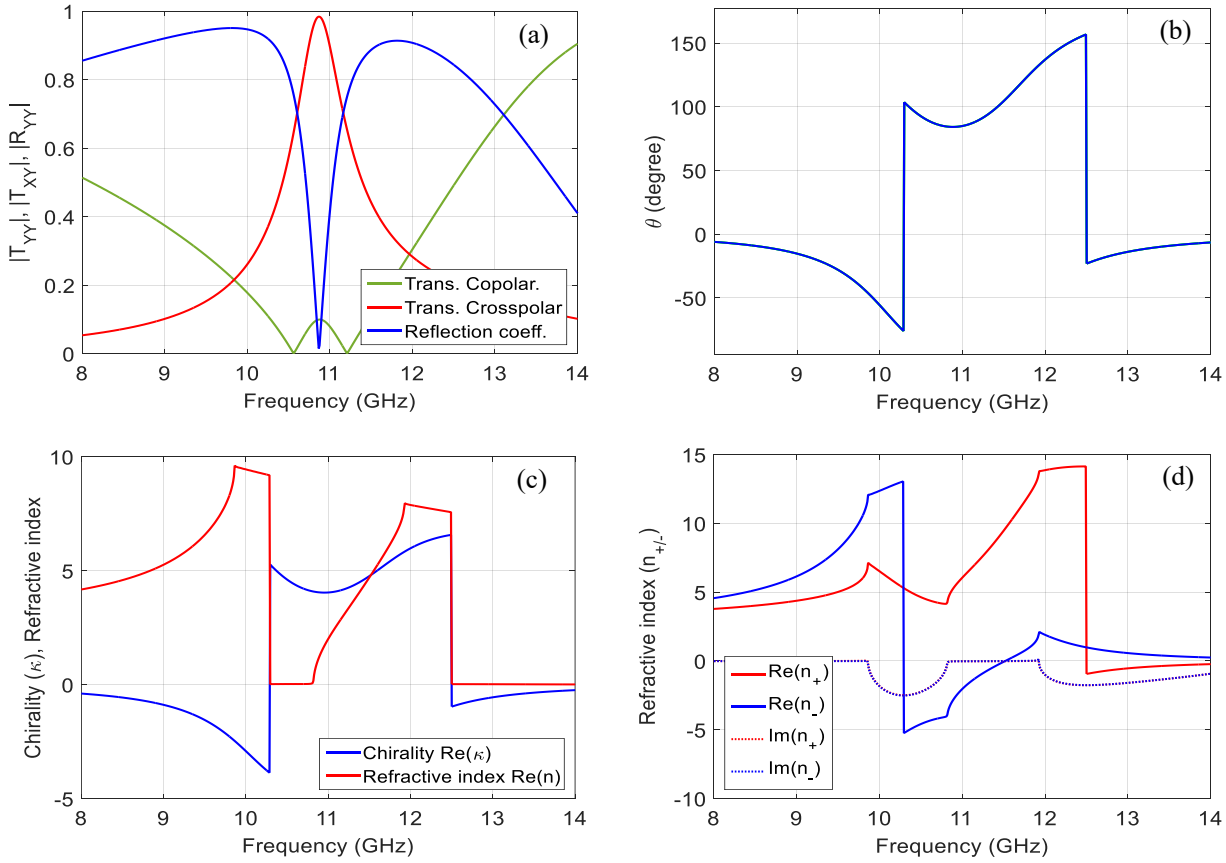

Figure 2. (a) Transmission and reflection coefficient, (b) Polarization plane rotation, (c) Chirality and refractive index (n), (d) Refractive index n_+ and n_-

Acknowledgements, this work has been supported by the Spanish Government MINECO through the Research Projects TEC2014-55463-C3-1-P, TEC2014-55463-C3-3-P and by the European Commission (ERDF).

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