Planar chiral metamaterials and their application to optoelectronics devices

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Recent experimental results on planar chiral metamaterials have shown that such structures are capable of manipulating the polarization states of light [1, 2]. Metallic chiral structures of opposite handedness were found to exhibit opposite effects on the rotation and elliptization of linearly polarized plane waves that were diffracted from regular arrays of gammadions. We have now extended this work to include structures of different geometries, such as fractals, and different material compositions including supported dielectric films and free-standing metallic membranes. The polarization dependent properties of these structures also show a strong dependence on the handedness and magnitude of the geometric chirality of the design but with significant differences for different material structures, such as different magnitudes of ellipticity and azimuth rotation. Intriguingly, similar effects have now been observed in the relative amplitude of diffracted beams for chiral structures of opposite handedness, suggesting that enantiomeric structures could exhibit different reflection and transmission coefficients for a given input polarization state. As a result, we will show how such structures could form the basis of a new range of polarization sensitive optoelectronic detectors.

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[2] A. Papakostas et al., Phys.Rev. Lett. 90, 107404 (2003).

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