Optically controllable THz chiral metamaterials

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Metamaterials are tailored man-made composite materials, made of sub-wavelength building structures, possessing different properties from those of their constituent materials. A very interesting and particularly useful category of metamaterials is the chiral metamaterials, as they offer great possibilities in the control of the light polarization, such as optical activity (i.e. polarization rotation of a linearly polarized wave) and circular dichroism (i.e. the absorption difference between left- and right-handed circularly polarized light).

Very few attempts to realize and demonstrate THz chiral metamaterials have been made up to now [1,2]. The majority of these designs are based on the bi-layer configuration, i.e. are composed of two layers of metallic structures that are not electrically connected but the chiral response comes from their electromagnetic coupling. Here we follow this approach, of the bi-layer conductor configuration, and numerically demonstrate very large tunable optical activity and switchable ellipticity response in different chiral metamaterial structures operating in the THz regime (1-12 THz), by properly inserting into the structures photoconducting silicon, which can be transformed from an insulating to a conducting state by photoexcitation [3].

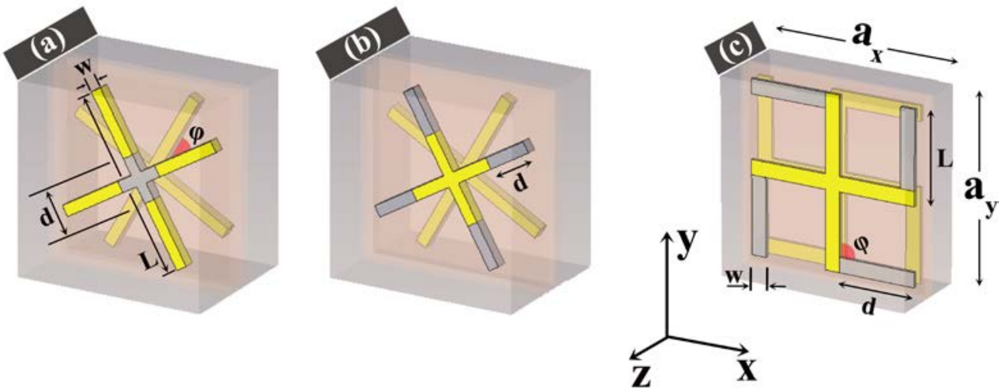

Figure 1: Schematic of the unit cell of the chiral metamaterials under consideration: (a), (b) cross-wires and (c) Z-type crosses with φ=90˚, respectively. Grey color corresponds to photoconductive silicon and yellow corresponds to metal (silver).

References

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