ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

ΠΑΡΟΥΣΙΑΣΗ ΜΕΤΑΠΤΥΧΙΑΚΟΥ ΔΙΠΛΩΜΑΤΟΣ ΕΙΔΙΚΕΥΣΗΣ

Τίτλος

« Three-dimensional photonic structures fabricated by direct laser writing»

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Abstract

The study illustrates the theory, fabrication and characterization of two photonic meta-devices. The structures are fabricated in order to manipulate the light when passing through them. Therefore, the structures exhibit a periodic well-defined structuring. We diverse our study in the fabrication of 3D silver Split Cube Resonators (SCR's) and gold/silver Helix structures.

SCR's:

A three-dimensional (3D) infra-red conductive metamaterial proposed for 90 degrees one way polarization converter and asymmetric transmitter meta-device for linearly polarize light is demonstrated. The metamaterial structure, which comprises of Spit Cube Resonator (SCR) pairs rotated by 90 degrees with respect to each other along the wave propagation axis, was fabricated by direct laser writing and selective electroless silver coating, a straightforward, novel technique producing mechanically and chemically stable 3D photonic structures. The asymmetric transmission (A.T.) response of the structure results from asymmetric interplay of electric and magnetic resonant responses of the SCRs, and equips the structure with almost total opaqueness along one propagation direction versus satisfying transparency along the opposite one, for linearly polarized incident way of a specific polarization. This asymmetric transmission response was also indirectly demonstrated experimentally through reflection measurements, in excellent agreement with the corresponding simulations. Additional simulations demonstrate that the 30% transmission asymmetry results from asymmetric polarization conversion, as is expected for reciprocal media, and it is associated with total opaqueness of the structure along the one propagation direction and with one-way 90^{o} polarization conversion. These features, along with the possibility to modify the

structure impedance adjusting properly the electric and magnetic responses make the structure an excellent candidate component for polarization conversion and isolation systems.

Helix:

Spiral structures that offer polarization capabilities such as beam splitting effects, circular polarization and strong circular dichroism have been extensively studied by many research groups in the last years. In order to fabricate a polarizer which leads to broadband response concerning the separation of Right handed Circular Polarization light (RCP) and the Left-handed one (LCP), we fabricate a spiral structure. The results indicate the blocking of LCP for more than 35 THz. The deviations of the two different polarizations is extremely high and recommends the structure for applications such as broadband circular polarizer, also we are able to create both gold and silver structure with selective electroless plating.

The fabrication success for both structures was verified by the Scanning Electron Microscopy (SEM) and Electron Dispersion X-rays (EDX) characterization techniques. In advance, we have the ability to characterize electromagnetically (FT-IR) the structures with both circular and linearly polarized waves.