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Τίτλος

« Fabrication of Metallic Photonic Structures by Two – Photon Polymerization»

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Abstract

During the last few decades there has been an increasing interest for investigation of structures and devices that can control and manipulate light. Such a category of structures are the so-called photonic crystals, i.e. periodic dielectric or metallo-dielectric systems where the diffraction of light can lead to formation of allowed and forbidden spectral regimes for light propagation, known respectively as bands and gaps (or stop-bands).

In this work, we studied the fabrication procedure of a specific category of photonic crystals, named woodpile, using a direct laser writing approach. The main goal was to achieve good quality metallo-dielectric woodpile structures with the smallest possible period (of nm scale). In order to achieve this goal, we fabricated dielectric woodpile structures, (made of a hard polymer that was created in the lab), using a technique called two-photon polymerization (2PP). 2PP is a direct laser writing technique that allows the construction of 3D structures with sub-micron resolution. After fabrication, the dielectric samples were metalized via electroless plating process leading thus to metallic woodpile structures.

Following the aforementioned process we managed to show that our experimental technique is suitable for the fabrication of metallo-dielectric woodpile structures of nanometer scale and quite good structure quality. Specifically, characterizing the morphology of the structures (resolution, average thickness, metal disposition etc.) by varying different fabrication parameters, we showed that resolution below 100 nm can be achieved for 600 nm periodicity structures, and we examined and identified the optimal fabrication conditions as to achieve the highest possible resolution. The electromagnetic characterization of these structures, using

transmission measurements, showed the creation of a photonic gap cantered at 450 THz approximately, which was in good agreement with corresponding theoretical results.

Based on metallic woodpile structures like the ones obtained in our work, one can fabricating devices that can reflect light waves over a desired frequency range, allow or forbid light to propagate in certain directions (acting as a waveguide) or confine it in a focal volume (photon localization), which can have huge technological impact.

Ο Πρόεδρος του Τμήματος

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