Design of Tunable Metamaterial Operating Near 90 GHz

K. Tarnowski[1], Wlodzimierz Salejda[1]

[1]Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland

Abstract

Currently there is much interest in electromagnetic metamaterials [1-9]. In our work we have focused on design of tunable metamaterial which can be made within available technology. In proposed design we use metallic split-ring resonators and thin-wires (Figure 1). Moreover we have decided to introduce nematic liquid crystal layer in design to obtain tunability (Figure 2). One can control propagation of electromagnetic waves by changing orientation of liquid crystal molecules. We have used COMSOL Multiphysics to validate our design with electromagnetic simulations where scattering parameters (elements of scattering matrix) have been computed. Afterwards we have retrieved effective refractive index, permittivity and permeability. Obtained results allow us to state that proposed metamaterial can be applied in construction of phase-shifter operating near 90 GHz. We have confirmed high tunability of proposed design. Relative change of real part of effective refractive index was about 67%, and relative shift of minimum of real part of refractive index was about 1.8%. We have recommended final structure to practical realization. We believe that our work could be used to further optimization of electromagnetic devices (phase-shifters, filters etc.).

Reference

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Figures used in the abstract

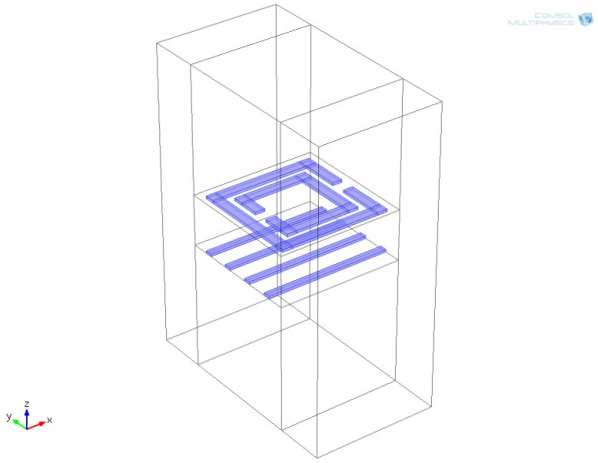

Figure 1: Metallic elements of presented design of metamaterial cell.

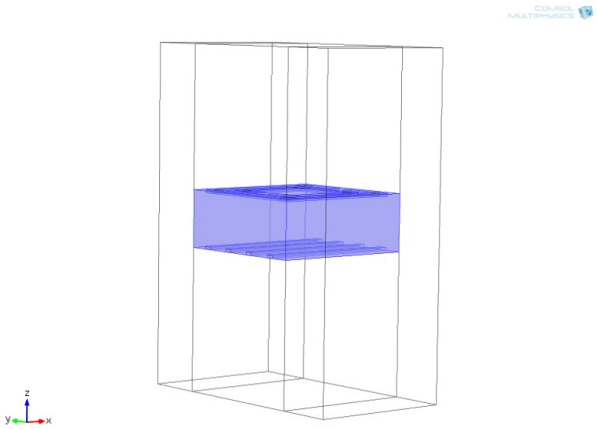

Figure 2: Liquid crystal layer introduced to presented design to obtain tunability.