A Dual Band-Reject FSS for WI-FI Application

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***Abstract* —** A dual band FSS based on array of double square ring shaped resonators has been proposed. The proposed structure represents a wide-angle perfect the WI-FI signals and screen room applications. Simulation results show polarization independency for both rejection bands.

***Index Terms* —** Dual band-rejection, wide-angle rejection, WI-FI signal blocker.

I. INTRODUCTION

A Frequency Selective Surface (FSS) is a two-dimensional frequency filter exhibiting reflection and transmission properties that are analogous to electronic frequency filters. FSS characteristics can be engineered to represent band-pass, band-stop, low-pass, or high-pass characteristics depending on design [1].

The advantage of the symmetry of the structural has been implemented to create the polarization independent resonant filter. Basically, to design a FSS, we have to maximize the rejection level at the desired frequency. It is equivalent to minimize the transmission (T) and maximizing the reflection (R) coefficients. In this paper, a planar FSS has been proposed. It rejects the electromagnetic waves at nearly 2.45 (GHz) and 5 (GHz) with rejection rate of 98% and 99%, respectively. It is observed that the structure represents Single Negative Metamaterial (SNG) behaviors at rejection resonant frequencies. FSS is polarization insensitive for both transverse electric (TE) and transvers magnetic (TM) waves. The simulation results represent good stability for different radiation angles and polarization. Many proposed FSS filters are designed for single frequency [2], and most of them do not have the simplicity in construction and rejection independent from frequency like proposed metamaterial absorbers [3].

II. DESIGN AND SIMULATION

The proposed FSS is an array of unit cell, which is considered as a double ring square shape Fig. 1.

The metallic structures on the top of the substrate are chosen as copper, the electrical conductivity and thickness are 5.8×10^7 (s/m) and 0.04 (mm), respectively. The substrate of absorber is FR4 ($\varepsilon_r = 4.38, \tan\delta = 0.025$) with 2 (mm) thickness.

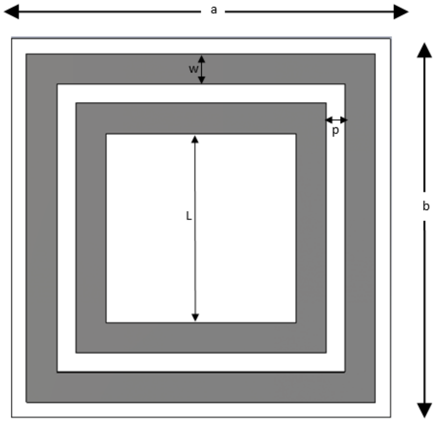

Fig. 1. Unit cell geometry and design parameters: a=b=25mm, L=12.25mm, w=2mm, and p=1mm.

The simulation is done by full wave commercial software CST [4] with periodic boundary conditions. The floquet boundary conditions perpendicular to the plane of the FSS are placed to simulate different incident angles Fig. 2.

The S_{21} and S_{11} parameters which represent the the transmission and reflection respectively are shown in Fig. 3.

The structure benefits from the symmetry so an independency of polarization and incident angle is expected. In order to investigate the influence of incident angle on the performance of the FSS, the absorption under different polarization incident wave for azimuth and elevation plane is presented in Fig. 4. The results show a good stability for different angle of incident and polarization.

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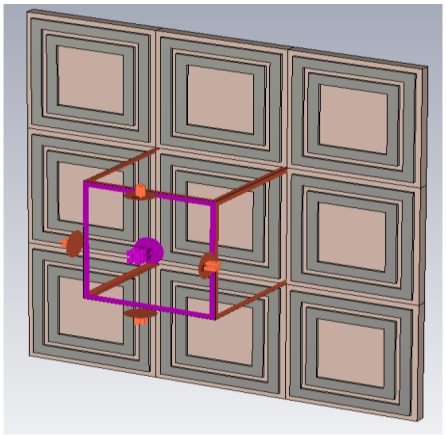


Fig. 2. The power reflection coefficient versus groove.

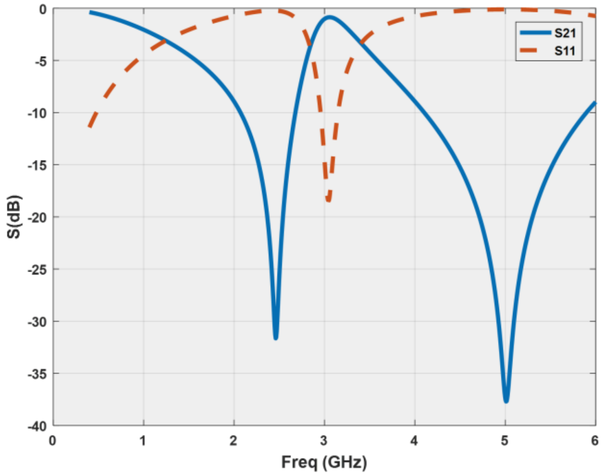
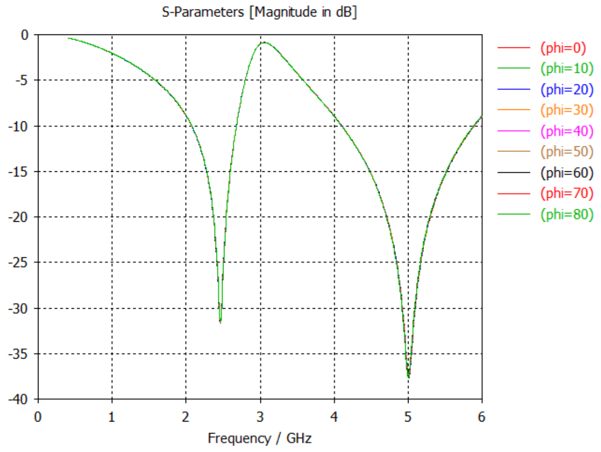
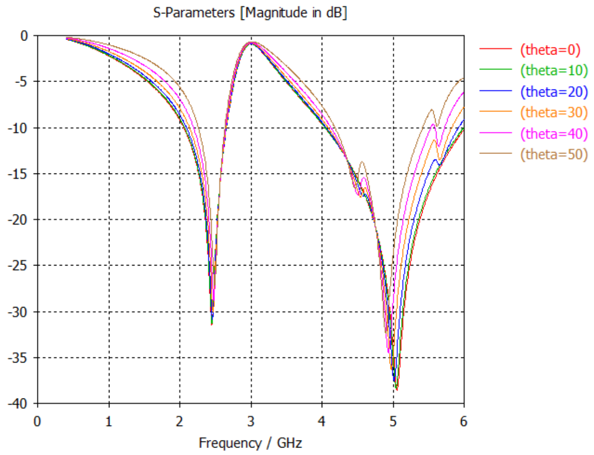


Fig. 3. Simulated reflection and transmission of the proposed metamaterial absorber



(a)



(b)

Fig. 4. Transmission at the different incident angles ranging from 0 to 80 Phi (a), and 0 for 50 Theta (b), with respect to FR4 plane.

III. THEORY

The structure shows maximum negative imaginary part of refractive index at resonant frequencies while the real part of refractive index is close to zero as shown in Fig. 5. Proposed FSS behaves like a SNG metamaterial at resonant frequencies and represents a high attenuation. Neglecting the losses, we see that when refractive index is purely imaginary at resonance frequencies the wave vector is also purely imaginary and the wave is strongly attenuated inside the slab [5]. This high attenuation constant results in a high mismatch and totally reflection of incident wave.

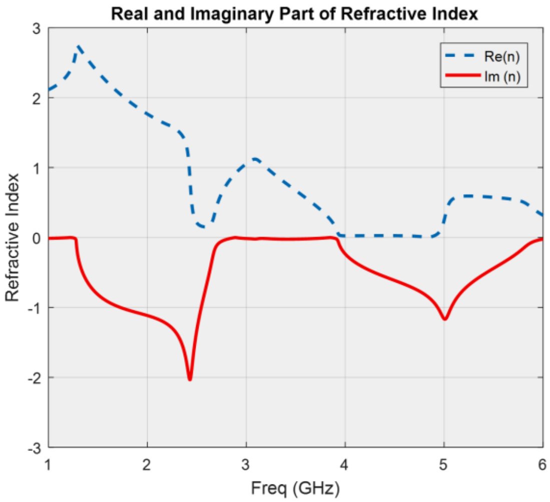


Fig. 5. Real and imaginary part of refractive index for normal incidence.

IV. CONCLUSION

The proposed symmetrical unit cell based on double square shapes represents a high level of rejection for dual WI-FI bands. Simulations demonstrated that due to the symmetry of structure the resonant frequency of rejection is independent of incident angles for a wide range both in azimuthal and elevation planes. In addition, FSS represents single negative metamaterial properties at resonance frequencies. The optimization of transmission bandwidth especially at five (GHz) can be a part of further research.

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