Dipole Loaded Complementary Frequency Selective Surfaces

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Complementary Frequency Selective Surfaces (CFSS) are compact structures which are highly stable with respect to the angle of incidence. CFSS is formed by combining a layer of band pass filters (aperture layer) and an array of band stop spatial filters (for example, dipole). The concept is inspired from Babinet's principle and by placing these two complementary structures on either side of a thin dielectric, a strong interaction between these layers occurs. This interaction leads to a decrease in the pass band resonant frequency of the CFSS. In this work, this pass-band resonant frequency is further lowered by adding an additional layer of dipole on the other side of the CFSS aperture layer. The new configuration is dipole-dielectric-slot-dielectric-dipole layer and we name this structure as dipole loaded CFSS.

A CFSS with a 70µm thick dielectric layer with permittivity 3 and loss tangent 0.025 was simulated in CST Microwave Studio. The lengths of individual elements of the dipoles layer and apertures layer are 3.5mm. This CFSS has a pass band resonant frequency at 14.3GHz. By loading this CFSS with a dipole layer on the other side of the apertures layer, the pass band resonant frequency of this structure was reduced to 11.01GHz. The insertion loss was simulated to be 3dB; however the insertion loss can be decreased by using a substrate of a lower loss tangent. The same 70µm thick dielectric was placed between the apertures layer and the added dipole layer.

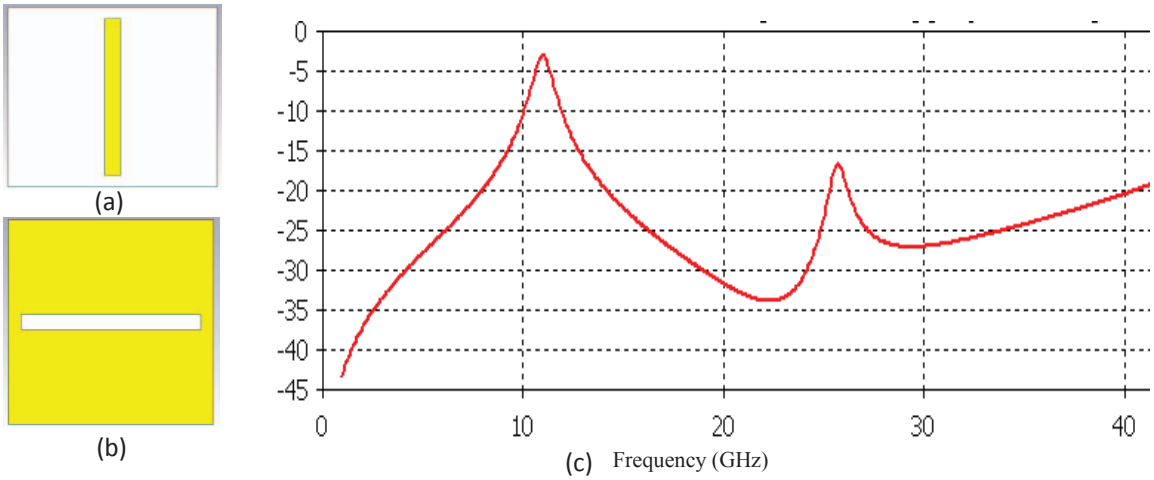

Fig. 1: (a) Top and bottom dipole layer (b) Middle layer of apertures (c) S21

When the length of the individual element of this loaded dipole layer was decreased, the pass band frequency of this structure was also increased. The simulation results indicate that decreasing the length of this element from 1.75mm to 0.25mm with a decrement of 0.75mm caused the frequency to increase from 11.01GHz to 12.32GHz and 13.67GHz respectively.