Design and Experimental Verification of Three-Dimensional FSS Elements with Wide Frequency Responses

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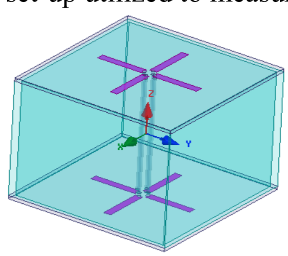
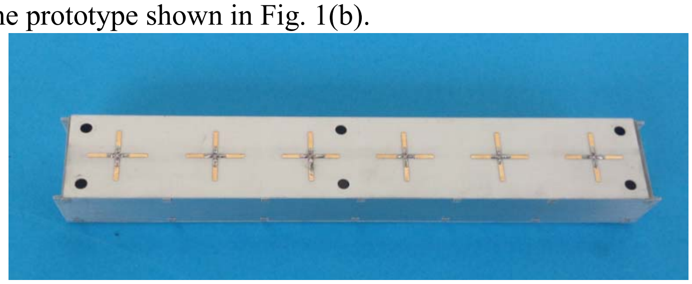
In designing frequency selective surfaces (FSS), one of the desirable design goals is to achieve a wide bandwidth, as well as a sharp transition from pass- to stop-band. There are several techniques used to control the FSS bandwidth, which include: (*i*) choosing suitable lattice spacing; (*ii*) using element shapes that provide a sharp frequency transition, e.g., screens with thick apertures; and (*iii*) cascading multiple layers of FSS screens and dielectrics.

We present a 3D FSS element comprising of a metallic waveguide filled with foam, with $\varepsilon_r = 1.03$ and $\sigma = 0.001$ S/m. Two RO4003 dielectric substrates of thickness $d = 0.508$ mm sandwich the waveguide. Cross dipoles are printed over the top and bottom substrates and are connected via metallic cylinders. Fig. 1 shows the simulated model in (a), and the fabricated structure in (b). The cell size of the periodic structure is: $D_x = D_y = 24.3$ mm. We design the element to achieve a relatively flat bandpass response, with a cut-off frequency around 4.5 GHz, which coincides with the cut-off frequency of the waveguide structure. The -3dB frequency bandwidth (BW/f_0) the structure is able to provide is around 70% and the simulated results agree well with the experimental ones, as may be seen from Fig. 2. The presentation will also discuss some aspects relative to the set-up utilized to measure the prototype shown in Fig. 1(b).

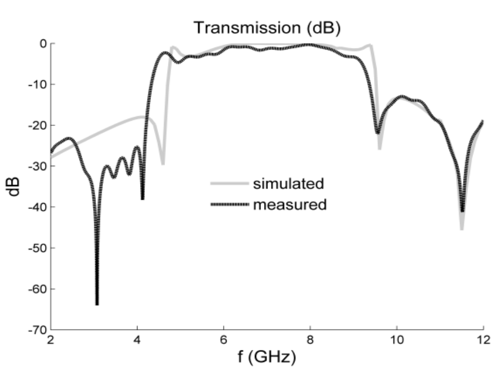


(a)

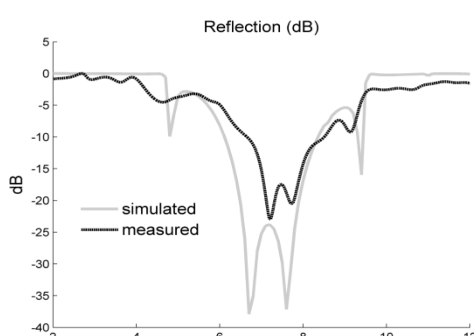


(b)

Fig. 1 Geometry of the (a) simulated unit cell and (b) fabricated FSS structure.



(a)



(b)

Fig. 2 Simulated and measured results for (a) Transmission and (b) Reflection coefficients.