*URSI GASS 2021, Rome, Italy, 28 August - 4 September 2021*

# A Dielectric-Free Wideband Bandpass Frequency-Selective Surface and Its Frequency Response for Normal and Oblique Incidence

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Frequency selective surfaces (FSSs) allow an intended passband frequency spectrum while rejecting the out-of-band interfering signals [1]. The demand for high-speed connectivity from a wideband system coupled with the requirement of reducing cost or complexity needs technological evolution in FSS designs. Majority of the conventional FSS designs are based on the strategy where specific patterns are printed in metal layers supported by dielectric substrates. Such FSSs have been actively researched over the past several decades for the range of applications such as reflectors, RF absorber, EM shielding, antenna radomes, and polarizers [2–4]. These designs have some technical limitations due to usages of thick bulky dielectric materials or having 3D complex structures which may limit their practical applications. This paper addresses limitations by developing a new class of planar dielectric-free FSS (DF-FSS), which does not use dielectric substrate, thus substantially reducing the production cost and complexity of the FSSs. The new FSS structure is a 2D array of identical dielectric-free cells where each cell has three thin conductive sheets with a square slot and four identical stubs at the center of the sheet, as shown in Figure 1 (a). Parametric analysis was carried out using CST Microwave Studio to determine optimal values for the unit-cell. The periodicity (S) of the unit-cell is fixed to 10.8 mm. The separation between adjacent metal sheets (H) is set to 6 mm, the width (R) of the outer metallic ring is 1 mm, and the length (L) and width (W) of four stubs are 3 mm and 1.5 mm, respectively. The combined effect of the high-pass slot, resonating stubs and three layers contributes three transmission poles resulting in a $3^{rd}$-order wideband bandpass FSS. The predicted 3-dB fractional bandwidth of the FSS is 35.2%, which can easily be tuned only by varying the unit cell's two design parameters.

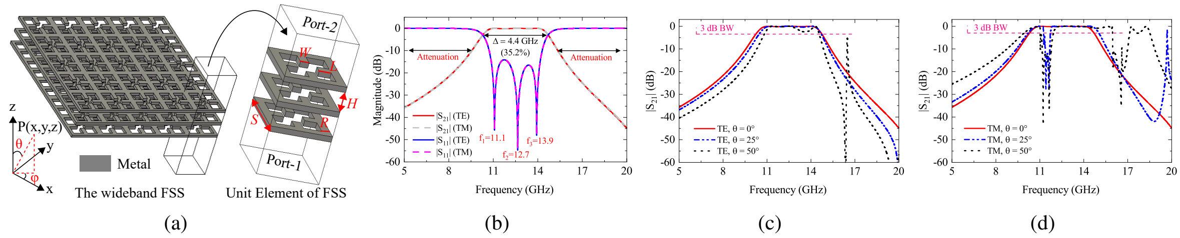


**Figure 1.** (a) Wideband DF-FSS; Frequency response of DF-FSS at (b) normal and (c-d) oblique incidence.

The frequency response of the DF-FSS was predicted for different incident fields and polarization modes. Figure 1 (b), (c) and (d) show the performance of DF-FSS while it is normally and obliquely excited by plane waves. With TE incident, the transmission passband bandwidth are extremely stable even for a large oblique incidence angle of 50°. On the contrary, the DF-FSS is sensitive around the 1st transmission pole to the incidence angle with TM polarization. Even then, the DF-FSS has more than 23% 3-dB bandwidth with stable passband response for TM mode. However, the simple design aspects, light-weight, and high transmission in the passband are striking features that make the proposed FSS a suitable candidate for many emerging cost-efficient applications. Moreover, the elimination of dielectric also enhanced its application spectrum to high-power and space-borne applications.

## References

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