Metasurfaces Made of Transmission Lines: A Way to Spatial Filtering

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Since decades ago, many researchers have been involved in the design of Frequency Selective Surfaces (FSS). A comprehensive review of the theory was collected by the well-known author B. A. Munk (B. A. Munk, *Frequency Selective Surfaces: Theory and Design*, 2000.). In more recent years, FSS based on particles previously used in metamaterials are being investigated. These are commonly called metasurfaces and share the good property of having a unit cell much smaller than the wavelength. One example of is given in Fig. 1(a). This metasurface is based on the use of the Split Ring Resonator (SRR). It was demonstrated by F. Falcone and co-workers that it behaves as a band-pass filter (F. Falcone et al., Phys. Rev. Lett., vol. 93, p. 197401, 2004). It has been also reported that this behaviour remains stable under oblique incidence (M. Beruete et al., Electromagnetics, vol. 26, p. 247, 2006.).

The aim of this paper is to investigate the effects of connecting these resonators forming 1D chains as shown in Fig. 1(b), and compare its behaviour with that of the sample with unconnected particles. We found that the new structure (Fig. 1(b)) provide angle-dependent tunability, being possible to significantly shift the central frequency while keeping the bandwidth constant. In other words, this kind of metasurfaces has the capability of spatial filtering. Figure 2 shows the simulated transmission coefficients for metasurfaces made with unconnected (dotted lines) and interconnected SRRs (solid lines). Geometrical and physical parameters for these two samples were similar to those used by M. Beruete in the paper cited above. The difference between these two samples is very clear: when the incidence angle is modified, the central frequency moves for the sample with interconnected SRRs while it stays invariant for the case of unconnected SRRs. A model of surface waves based on a transmission line model has been proposed to study these structures. The expected tuning was finally checked by numerical simulations and measurements. Model and measurements will be shown during the conference days.

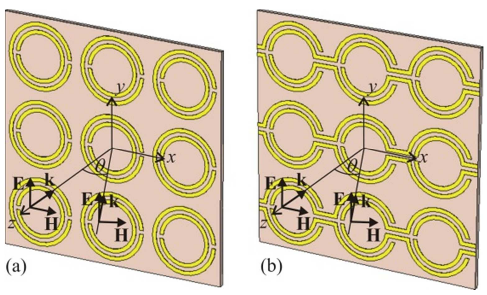

Fig. 1 Metasurfaces made of unconnected SRRs (a) or interconnected SRRs (b). Yellow represents cupper while grey is the dielectric substrate.

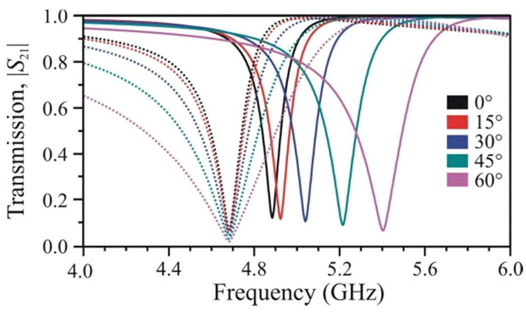

Fig. 2 Simulated transmission coefficients for metasurfaces of unconnected SRRs (dotted lines) and interconnected SRRs (solid lines).