ABSTRACT

In typical applications of Frequency Selective Surfaces (FSS) at RF frequencies, loss effects in dielectric substrates can be significant, but losses in the metallic elements of the FSS themselves are generally negligible. However, recent attempts to construct bandpass filters from metallic FSS for use at near-infrared frequencies have shown that the dominant loss mechanism in this frequency range is ohmic loss in the metal. Common FSS analysis techniques can include the effects of loss in bandstop filters comprised of electrically conductive wire elements in a dielectric substrate, but calculating the loss in FSS composed of slots in a lossy ground plane can be much more challenging.

This work details the loss in slot FSS at near-infrared wavelengths calculated by a perturbation of the lossless case. The theoretical basis and numerical implementation of this procedure are described. Results for a number of geometries are presented, and a detailed study of two fundamental building blocks, the straight and bent slots, is made. Because it is paramount in understanding the mechanisms for losses and what can be done to minimize them, the current distributions across the FSS are examined in detail for the various geometries. Parametric studies of the array geometries are presented, and the effects of dielectric substrates on the loss properties of the different geometries are studied. Finally, the criteria for designing a low loss bandpass filter are discussed along with an outline for future work.