A Novel EBG Resonator for Dielectric Measurements

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The applications of EBG for power plane resonance suppression have been explored since 2002. It was reported (S. Rogers, Trans. MTT, vol.53, no.8, 2495-2505, 2005.) that in the parallel plate waveguide structure, the band width is strongly dependent of the superstrate dielectric that the EBG patch is embedded, i.e., the starting frequency and the upper limit frequency of the stop band is strongly dependent of the supperstrate dielectric properties. This characteristic of the EBG structure has a potential for dielectric material characterization, if the tested specimen is to be used as a superstrate perturbation of the similar EBG structure.

Cavity resonators have been widely used for dielectric measurements. The addition of a dielectric specimen under test in a designed cavity resonator can result in a small shift of the resonance. In this paper we design a PMC (perfect magnetic conductor) wall backed cavity resonator for dielectric measurements by using an embedded EBG structure deposited on the bottom of the cavity. A theoretical calculation shows that with a small perturbation of the dielectric specimen added on the top of the EBG, the stop band will be shifted lower due to the increase of the capacitance, as depicted in Figure 1. Considering the first stop band of the base line (ε_r=1.0, stop band=3.7 GHz-7.4GHz), a small increase of dielectric constant (ε_r from 1.0 to 1.05) can result in a shift of 100 MHz of the lower limit of the stop band, and a shift of 150 MHz of the upper limit. The greater the dielectric variation is, the larger the frequency shift is observed on the stop band lower and upper limits.

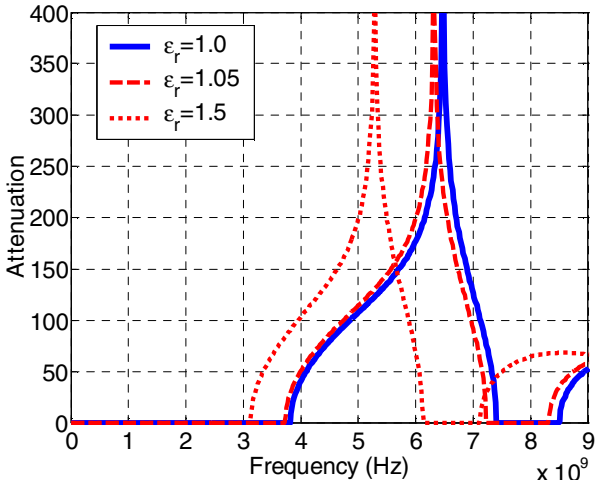

Figure 1. The stop band shift due to the superstrate dielectric variation.