

Orientation Effects and Homogenization Volumes for SRR Metamaterials

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Split ring resonators have been used for developing negative refractive index materials that exhibit negative permeability in narrow frequency bands when the magnetic field is perpendicular to the rings. In this paper we present experimental data for periodic spaced but regularly and randomly oriented SRRs using a focused plane wave free space measurement setup. The effect of the number of scatterers in the homogenization volume is studied. Three samples, namely SRR1 (gap $\perp$ to E), SRR2 (random gaps) and SRR3 (gap $\parallel$ to E) were fabricated and studied. The SRRs were arranged with magnetic field at variable angles with respect to the plane of the rings. We present the experimental data that verifies the non-symmetric behavior of SRR1 and symmetric behavior of SRR2 and SRR3. The number of the scatterers in the homogenization volume does not affect the retrieved material parameters. The intensity of the resonant peaks vary with the number of the scatterers in the homogenization volume, magnetic resonances were observed for different orientations of SRR1 when measured with the standard number of scatterers and also with varied number of scatterers in the illuminated volume. The agreement of the experimental data with the numerical simulation data (using HFSS) is discussed.