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Temperature Dependence of Relative Permittivity: A Measurement Technique Using Split Ring Resonators

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Abstract : A compact method for measuring the relative permittivity of a dielectric material at different temperatures using a single circular Split Ring Resonator (SRR) metamaterial unit working as a test probe is presented in this paper. The dielectric constant of a material is dependent upon its temperature and the LC resonance of the SRR depends on its dielectric environment. Hence, the temperature of the dielectric material in contact with the resonator influences its resonant frequency. A single SRR placed between transmitting and receiving probes connected to a Vector Network Analyser (VNA) is used as a test probe. The dependence of temperature between 30 ^oC and 60 ^oC on resonant frequency of SRR is analysed. Relative permittivities ‘ε’ of test samples for different temperatures are extracted from a calibration graph drawn between the relative permittivity of samples of known dielectric constant and their corresponding resonant frequencies. This method is found to be an easy and efficient technique for analysing the temperature dependent permittivity of different materials.

Keywords : metamaterials, negative permeability, permittivity measurement techniques, split ring resonators, temperature dependent dielectric constant
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