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Wide Band Microwave Absorber using Flexible Broadside Coupled Split Ring Resonator Metamaterial Structure

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Abstract – **This paper proposes a wide band microwave absorber in a bulk form realized using a Broad Side Coupled Split Ring Resonator (BCSRR) metamaterial structural units fabricated in a novel way which possesses structural flexibility and wide band frequency tunability. Instead of using a conventional structure, the two conducting rings of the structure are prepared separately by photochemical etching using thin copper sheets glued on polypropylene film. The resonant property studies of the BCSRR show a noticeable tunability in resonant frequency with spacing variation, a result not observed using other conventional SRR structures. A spacing variation of 1 mm of a typical BCSRR unit shows around 3 GHz resonant tunability which makes it suitable for materializing various sensor applications. The resonant properties of BCSRR in a bulk form made with specific structural dimensions arranged in periodic manner with progressively varying spacing using layers of cotton fabric, show wide band resonant absorption. By suitably modifying the structural parameters of BCSRR rings, the range of the frequency absorption band can be specifically designed. The result of the study predicts a possibility of using this proposed BCSRR designs in various types of wide band absorbers.**

I. Introduction

There is vibrant research carried out by different groups in order to explore the potential possibilities and manifold applications of different types of Split Ring Resonators (SRRs) [1]. Broad Side Coupled Split Ring Resonator (BCSRR), one of the important candidates for negative permeability metamaterial resonating units, is widely used in different sensors, miniaturized antennas, frequency selective surfaces etc [2]. Conventionally BCSRRs are constructed by etching the rings of the structure on two sides of a single substrate and there by will have a fixed resonating frequency due to the thickness of the substrate used for selected structural parameters. By designing BCSRR in a novel way by fabricating the two rings on separate substrate of the same material, the spacing variation between the rings leading to wide band frequency tunability was easily achieved [3]. Instead of using rigid substrates for fabricating the rings, we have incorporated flexible, lossless microfilms as the substrate unit which will provide the added advantage of flexibility [4]. In this paper, such specially designed BCSRR units are periodically structured to materialize a bulk medium to achieve a noticeable wide band frequency absorption which is not possible with conventional structures.

II. Fabrication and Measurements

The rings of BCSRR are fabricated on thin copper sheets of thickness 20 μm. The substrate used is a polypropylene film of thickness 18 μm which is glued to the copper sheets. By using photochemical etching method the required BCSRR rings of specific dimensions are fabricated. Three sets of rings with inner radius r = 5.4 mm, 4.7 mm, 3.0 mm and width w= 2.7 mm, 1.8 mm, 2 mm and slit width d = 0.2 mm are precisely made. Cotton fabric strips of thickness of 0.1 mm are used for achieving the required spacing between the rings of the BCSRR. Planar array of BCSRR rings with periodicity 12 mm having five columns with varying spacing using different

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