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Microwave metamaterial Absorber based on Jerusalem Cross with meandered load for bandwidth enhancement

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ABSTRACT

Microwave absorber is important devices that have been noticed in various applications such as microwave imagining and reflect array antenna. In this paper, we have developed a novel form of the JC metamaterial absorber for microwave application with dual band application at Ku band. We have shown that with meandered load, we have obtained wider bandwidth. The current distribution and capacitances are described that how the load is made a new resonance and made wider bandwidth. The symmetrical form of prototype structure is made polarization independence and for this absorber is checked for 0° to 60° incident wave angle. The Prototype MA is simulated with CST by time domain method with periodic boundary condition and it is fabricated on a FR-4 low cost substrate for dual band application and test in the chamber room. The loads are placed in symmetrical formation and made a uniform current distribution which is important for polarization independent. The parametric studies are noticed for each element and reveals that how the capacitance between load and JC are made and controlled the absorption.

1. Introduction

Nowadays, artificial electromagnetic structures called metamaterials (MTMs) have received a great deal of research attention due to their various potential applications such as cloaking [1], antenna [2], microwave application [3] and optical devices [4,5] base on the left hand characteristic. These materials are composed of metals and dielectric which made from arrays of subwavelength.

In particular, several studies have been investigated in realizing metamaterial absorber based on their various applications such as radar with Split Ring resonator (SRR) at C band [6], multi ring for wide bandwidth 10–28 GHz [7] and optical sensor for imaging in areas such as biology based on plasmonic absorber [8]. The concept of a perfect absorber with near-unity absorption can be achieved through adjusting the reflection and impedance of MTMs [9] which is useful for optical solar cell [10]. Enormous efforts have focused on the search for dual band and multi band metamaterial absorber for THz application [11]. Quite recently, the design, fabrication and characterization of multi band MA have been investigated from microwave [12] to THz frequencies with graphene for tunable application [13]. Several efforts have been examined in MA to achieve multi-band based on various shapes such as isotropic ring resonator [14], Jerusalem cross with Ring [15] L-

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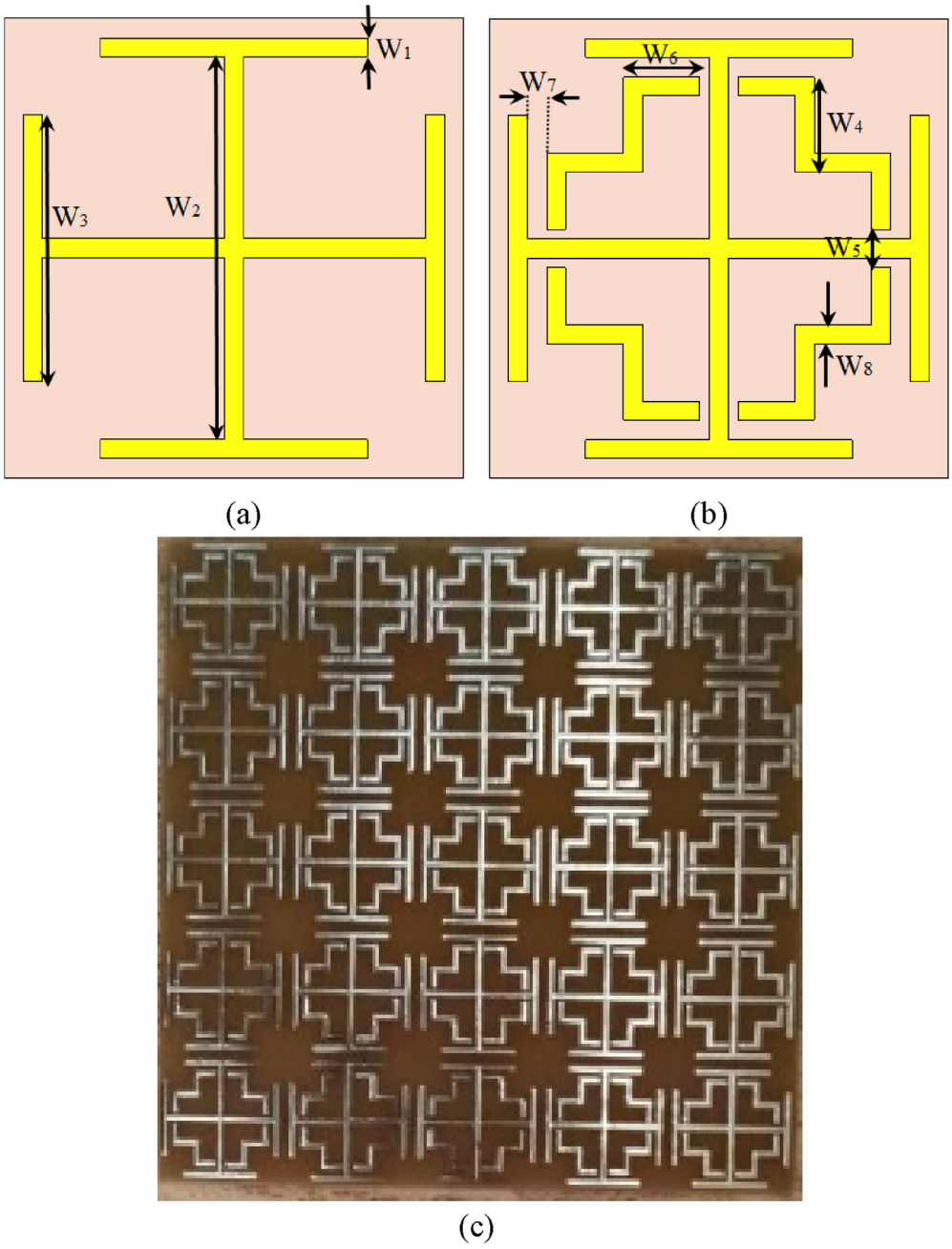

Fig. 1. (a) the geometry of the Jerusalem cross (b) the geometry of the Jerusalem cross with meander load (c) the fabricated absorber.

shaped coupled metamaterial [16] and broken cross [17]. Wen et al. proposed a dual-band metamaterial absorber in the terahertz region, which has two distinct absorptions of 80.8% and 63.4% near 0.45 and 0.92 THz [18]. The results exhibit that the absorber is an excellent electromagnetic wave collector, which traps the input EM wave into specific locations of the devices and then strongly absorbs it for Triple band application in THz and microwave. Huang et al. investigated a Triple-band metamaterial absorber based on spiral which can perform absorption peaks at three resonant frequencies 9.86 GHz, 12.24 GHz, and 15.34 GHz with the absorption of 99.4%, 96.7%, and 99.1%, respectively [19]. Shen et al. presented Triple-band terahertz metamaterial absorber using three concentric closed rings to form a compact single particle which has three distinctive absorption peaks at 0.5, 1.03, and 1.71 THz with absorption rates of 96.4%, 96.3%, and 96.7%, respectively [20]. Various formations of the cross-shaped structures have been investigated for dual-band and multi-band applications. Aslan et al. proposed a dual-resonant Jerusalem cross-shaped nanoaperture antenna foe infrared detection application [21]. The single and multi-band perfect metamaterial absorber (MA) in the THz region base on the Jerusalem cross (JC)