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A Novel Metamaterial Absorber Design in Microwave Frequency

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ABSTRACT— Microwave absorbers are used in military applications to reduce the radar cross-section (RCS) of a conducting object and the electromagnetic interference among microwave components. One of approaches for the design of EM absorber structures was based on the use of metamaterial. In this paper, the design of novel, broadband metamaterial absorbers that operate in the microwave frequency, is presented. Furthermore, the new structures are polarization-independent, due to the symmetry of its unit cell. By exploiting the scalability property of metamaterials, the operational bandwidth of our design can be drastically improved by placing unit cells with properly scaled resonators adjacent to each other. Furthermore, the absorption band of the design is effectively extended by simply stacking several such structural layers with different geometrical dimensions.

KEYWORDS: Radar cross section**;** microwave absorbers (MA); metamaterials.

I. INTRODUCTION

Metamaterials have undergone rapid development during the last decade due to their engineered electromagnetic (EM) responses not usually found in nature materials. Based on these exotic properties, many novel materials/devices have been reported, such as invisibility cloaks [1–2], superlens [3, 4] and perfect absorbers [5–6].

The absorbers based on the metamaterial are very different from the conventional ones. Because the absorption frequency of conventional absorbers is described by the internal complex permittivity and permeability of the bulk material, it is difficult to find the appropriate perfect absorber for specific electromagnetic band applications. The metamaterial-based absorbers are very helpful to overcome the difficulty. Their absorption frequencies can be tailored by changing the geometry of metamaterial units. Up to now, perfect absorber over wide range of frequencies, including microwaves, THz, IR, and optical have been investigated. Many characteristic absorbers, for example, polarization insensitive absorption, wide angle bsorption or broadband absorption have achieved with various structures. It is worth paying more attention on broadband absorber because of its potentially wide application areas. These broadband absorbers are designed with different geometrical dimensions.

The expression of the absorptivity is $A(\omega)=1-R(\omega)-T(\omega)$, where A(ω), $R(\omega)=|S_{11}|^2$, and $T(\omega)=|S_{12}|^2$ are the absorptivity, the reflectance, and the transmission as functions of frequency ω