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Optimization design of artificial electromagnetic metamaterial with perfect wave absorption

Kepeng Qiu, Shuqi Feng, Fuli Zhang, Weihong Zhang, Zijun Liu

Northwestern Polytechnical University, Xi'an, People's Republic of China,
qiukp@nwpu.edu.cn

Abstract

In order to obtain highly efficient microwave properties, various methods have been developed to achieve microwave absorbers with multi-band, wide bandwidth and tunable direction [1, 2], such as assembling different types of absorbents, adding optimized absorbent and designing multi-layer structures. Now, the research into artificial metamaterial absorber has shown the trend such as the multi-gap SRRs structure, ultrathin double-layer structures, integrating non-planar metamaterial and so on [3, 4]. In this work, we used the optimization technique to design the novel metamaterial configuration with the perfect wave absorption. The whole absorbing structure composes of the designed layer, dielectric substrate and metal backplane. Firstly, based on the intuition and empirical testing, an intelligent CAD approach is used to determine that the design domain is rotationally symmetrical and the design variables are related correspondingly. Therefore, the optimal structure has the polarization insensitivity. In the optimization problem, the objective function is to maximize the absorption index which is described by the reflection and transmission with the frequency range of 8-12GHz. The genetic algorithm (GA) is employed according to versatility and applicability for designing the functional metamaterial. The optimal results show that this metamaterial absorber has the wide oblique incident angle range for the transverse electric and magnetic wave. And the absorbing frequencies are steady which are determined by the metamaterial sizes and the thickness of dielectric substrate. Therefore the special absorption frequencies are obtained by the size design. Moreover, the frequency band can be broadened by the multilayer structural design.

Keywords: Optimization design, artificial electromagnetic metamaterial, Wave absorption, Genetic algorithm

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