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INFLUENCE OF THE INTEGRATED ELEMENTS ON PERFECT ABSORPTION IN ULTRATHIN METAMATERIAL PERFECT ABSORBER

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In recent years, the exotic ability to perfectly absorb electromagnetic (EM) wave of the artificial structures (metamaterials) is promising candidates for many practical purposes, especially, in the rapid growth of telecommunication devices. By the association between perfectly-matched impedance and strong resonance phenomena, the incoming EM wave is completely absorbed inside a size far smaller than that of the traditional absorbers. Unfortunately, in the Bluetooth/WiFi bands, most recent metamaterial perfect absorbers (MPAs) are too thick, large and expensive to be easily integrated in real devices. Hence, many efforts have been proposed for creating the MPA structures with smaller unit cell [1-3]. In this work, an ultrathin MPA is simulated by using the CST Microwave Studio software to estimate perfect absorption property based on lumped elements. In this model, we improved common MPAs by integrating four embedded inductors with L = 200 nH or replacing four embedded capacitors with C = 200 pF in the same compact structure. The obtained results confirmed that the lumped capacitors-MPA can maintain an absorption rate over 90% at 110.5 MHz in a wide incident angle of EM wave up to 50° with an extreme thickness $t = \lambda/1350$, where λ is operating wavelength. Besides, by replacing these capacitors by inductors in the initial designed-MPA structure, we obtained an absorption peak over 90% at higher frequency (2.0 GHz) for an incident angle of 50° with an effective thickness of $t = \lambda/50$. Furthermore, we explained the absorption mechanism in terms of the induced surface currents, the magnetic-electric energy distributions and the impedance-matching effect (between MPA with the surrounding environment). Our work is further expected to realize a next generation of ultrathin-MPAs operating in the Bluetooth/WiFi bands.

Keywords: Metamaterials, Perfect absorption, Low frequency