Accepted Manuscript

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PII: S0925-8388(16)31866-7

DOI: 10.1016/j.jallcom.2016.06.143

Reference: JALCOM 38012

To appear in: *Journal of Alloys and Compounds*

Received Date: 4 May 2016

Revised Date: 12 June 2016

Accepted Date: 14 June 2016

Please cite this article as: M.P. Ustunsoy, C. Sabah, Dual-band high-frequency metamaterial absorber based on patch resonator for solar cell applications and its enhancement with graphene layers, *Journal of Alloys and Compounds* (2016), doi: 10.1016/j.jallcom.2016.06.143.

Dual-Band High-Frequency Metamaterial Absorber based on Patch Resonator for Solar Cell Applications and its Enhancement with Graphene Layers

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Abstract

In this paper, a dual-band high-frequency metamaterial absorber based on patch resonator is designed and analyzed for solar cells. In order to obtain a metamaterial absorber, metal-semiconductor-metal layers are combined. The results of the designed structure are shown in the infrared and visible ranges of solar spectrum. Structural parameters and dimensions of the device have a significant importance on the performance of the designed absorber. The simulations are carried out with full-wave electromagnetic (EM) solver based on the finite integration technique. In the first simulation, the constitutive parameters of the structure are selected as constant in which the metamaterial absorber has 99.99% absorption at 558.75THz and 99% absorption at 216.75THz. When the structure parameters are designed again according to Drude model, the second simulation results show that the metamaterial absorber has 99.96% absorption at 514.5THz and 99.63% absorption at 197.25THz. Moreover, the second simulation results show that the proposed design is also polarization and incident angle insensitive. Furthermore, the structure is enhanced by the integration of the graphene layer(s). In addition, the fractional bandwidths (FBW) for the resonances are also calculated to show the quality of the absorber. As a result, the proposed metamaterial absorber based on patch resonator and its enhancement with graphene present high absorption in the infrared and visible ranges and can be used in many metamaterial and solar applications.

Keywords: Metamaterial; absorber; Drude model; solar cells; graphene

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1. Introduction