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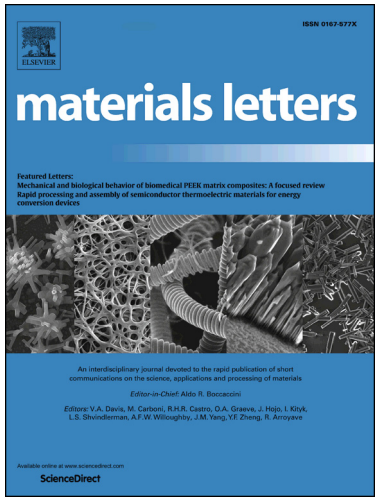

Broadband, ultrathin and polarization-insensitive metamaterial absorber based on a new mixing material in infrared and visible regions

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Broadband, ultrathin and polarization-insensitive metamaterial absorber based on a new mixing material in infrared and visible regions

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Abstract: In this paper, we proposed a broadband, ultrathin and polarization-insensitive metamaterial absorber which consists of three layers in the infrared and optical regions. Compared with the traditional three layers absorber, the most remarkable difference is that the metal Sn and InSb are used on the top layer at the same time. Numerical results reveal that a broadband absorption spectrum more than 90% can be achieved from the 97.0THz to 115THz. In addition, the perfect absorption character (484.4THz-603.6THz) also can be applied in the optical region by adjusting the structure parameters. The impedance matching theory and surface current distributions are investigated to explain the physical mechanism of the perfect absorption performance.

Key words: metamaterial, absorber, broadband, ultra-thin, sensor

1 Introduction

Metamaterial absorber (MA) has drawn increasing attention due to its ability to exhibit exceptional physical properties in many areas, such as biosensing, thermal emitters, solar-energy harvesting. A great many metamaterial absorbers can work in the microwave, THz, infrared even optical region [1-4]. However, the narrow absorption bandwidth of the Metamaterial (MM) absorbers limits their applications in solar harvesting, sensor, etc. To increase the absorption bandwidth, researchers have proposed several methods, such as stacking multilayer structure [5-7], using resistive film [8-9] and loading with lumped elements [10]. Nevertheless, all these methods are not still easy to implement. The thickness of the MM absorber is another factor which should be carefully considered. However, the total thickness of the absorber is about 2.5 μm, i.e., about λ /4 with respect to the center frequency of high absorption above 90% [11]. In other words, it is desired and necessary to reduce the total thickness of the absorber.

In this paper, we demonstrated a broadband, ultra-thin and polarization-insensitive MM absorber based on mixing materials on the top layer. Numerical results show that a broadband absorption spectrum above 90% can be achieved from 97THz to 115THz. The metamaterial absorber is ultra-thin, whether in the infrared or optical region, i.e., less than λ/10 with respect to the center frequency of the absorption band above 90%. Moreover, the other properties, such as perfect absorption, polarization-insensitive, oblique incidence and the mechanism of perfect absorption are also presented.

2 Design and Simulation