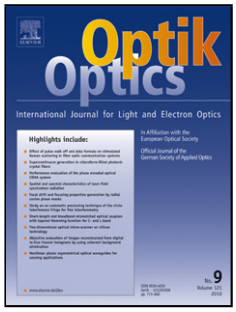

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Design of a broadband infrared metamaterial absorber

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Abstract: A broadband infrared metamaterial absorber based on the combination of four different resonators is presented and numerically examined. There are two resonant layers with different dielectrics in the absorber. The simulated absorptivity is beyond 90% for 8 to 12 μm wavelength and the absorber is polarization independent. We studied the absorbent mechanism by the distribution of magnetic fields and energy dissipation in the absorber. The absorptivity stays quasi constant for the incident angle up to 25°. Further simulation shows that we can change the absorption band through the optimization of the geometrical parameters.

Key words: Metamaterial absorber, Infrared, Broadband absorption, Resonance

1.Introduction

Metamaterial is a kind of artificial material with special electromagnetic properties unavailable in nature[1-3]. Band-pass, band-stop, filter [4], phase modulation and absorption are often achieved through changes of geometric configuration. Since the first metamaterial absorber with the near unity absorption of 99% at the frequency of 11.48 GHz is theoretically and experimentally demonstrated by Landy et al[5], metamaterial absorber has attracted growing interests. While widely applied in microwave applications such as wireless communication, stealth material and electromagnetic compatibility [6-7], metamaterial absorber is less used in infrared and visible region due to the fabrication technology. However, with the development of micro/nano fabrication technologies, it is possible to fabricate infrared, visible band [8-11] and ultraviolet [12] metamaterial absorber. Infrared metamaterial absorber may find practical applications in selective thermal emitters, infrared detectors, infrared stealth and solar energy harvesting [13-15]. Liu et al. [16] designed and fabricated a mid-infrared metamaterial absorber that achieved an experimental absorption of 97% at 6.0 μm and demonstrated a dual-band absorber with two absorption bands [17]. Jeremy John et al. demonstrated a simple design of an ultra-thin, wide-angle plasmonic absorber exhibiting spectrally selective near-unity absorption [18], and the spectral position of the absorption peak as high as 95% can be controlled. Govind [19] designed a polarization independent absorber at mid-infrared consisted of array of circular metallic patches. Wu et al. [20] investigated a TE polarization spectrum selective absorber exhibiting near 100% absorption for infrared frequencies. Bai et al. [21] designed a wide-angle, polarization independent and dual band infrared absorber based on L-shaped metamaterial. A new architecture that used a multifunctional metamaterial absorber to absorb far-infrared incident wave with a narrowband (560 nm FWHM) is demonstrated by Suen et al.[22].

Since the absorption of the metamaterial absorber is based on the electromagnetic resonance in the structure, the absorption bandwidth is often narrow. The metamaterial absorbers in **[**8-11**], can only achieve high absorption at a certain wavelength. M. A. Baqir and P. K. Choudhury investigated a** hyperbolic metamaterial (HMM)-based absorber which has a nearly perfect absorption in the entire ultraviolet [12]. In infrared narrow band absorber can be used for infrared

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