Design of Perfect Absorber Based on Spiral Architecture Metamaterial for Near-Infrared Spectral Range

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Recently, perfect absorbers utilizing single-turn metallic helix electromagnetic metamaterial were designed and realized for radio-frequency range[1,2]. Here, we report optimization of this design to tune perfect absorber frequency into near-infrared (NIR) spectral range using numerical simulations that take into account lattice downscaling, and dielectric dispersion of metal. Figure 1(a) shows design of an architecture consisting of left- and right-handed gold helices, and its main structural parameters. Spectra of optical reflectance, transmittance, and absorbance of this structure for normal incidence, obtained using finite-element electromagnetic simulations are shown in Fig. 1(b). Nearly perfect absorbance with peak value of 98% occurs at the resonance wavelength of $\lambda = 2.25$ μm, independent of polarization. Thus, ultrathin single-layer absorber can be realized for NIR spectral range. In future such structure can be realized using a dielectric template fabricated in photoresist by direct laser write lithography, and subsequently metallized by gold, silver, or other metal.

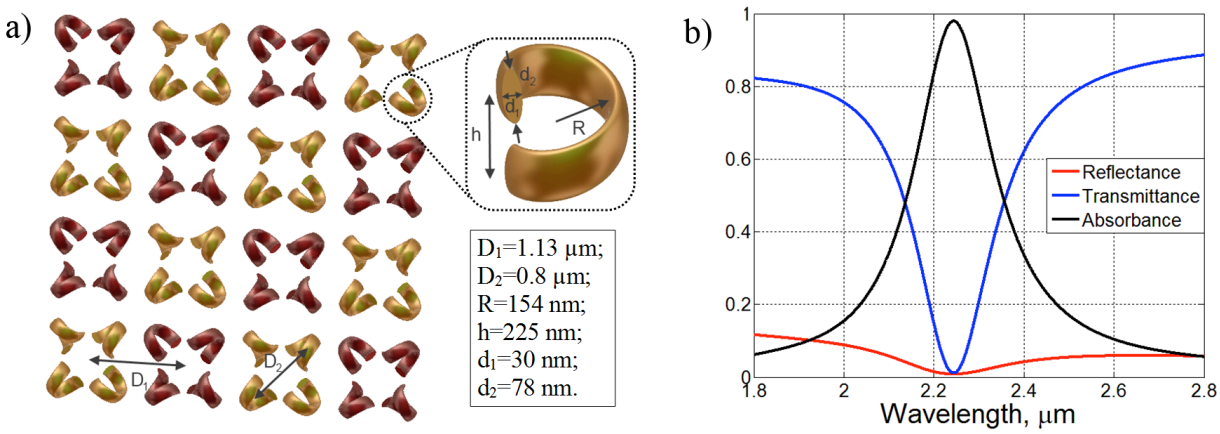

Fig. 1 (color) a) The spiral architecture; b) Reflectance, transmittance and absorbance at normal incidence.

[1] V.S. Asadchy, I.A. Faniayeu, Y. Ra'di, I.V. Semchenko, and S.A. Khakhomov, 7th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics, (2013) 244-246.

[2] I.A. Faniayeu, V.S. Asadchy, T.A. Dzerzhauskaya, I.V. Semchenko, and S.A. Khakhomov, 8th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics, (2014) arXiv:1404.1816.

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