A Broadband THz Cutline Metamaterial Absorber

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Abstract

We demonstrate a broadband metamaterial (MM) absorber for THz frequencies. Modelling of the MM was done by finite element method using the RF Module of COMSOL Multiphysics software followed by fabrication on a quartz substrate using E-beam lithography. The MM was characterized in the spectral region of 0.3 - 3 THz with THz Time domain spectroscopy (TDS) using 1 mm ZnTe crystal for Electro-optic detection. The MM is a periodically repeating structure of cut lines in two dimensions along the plane of the substrate, each cut line being 67.5 μm long and 2 μm wide. The periodicity of each unit cell was optimized to be 50 μm. Gold is sputtered on the patterned cut lines with its height being 150 nm.
A strong broadband resonance is observed, centered around 1.8 THz when the cut lines are aligned along the polarization of the THz electric field (0 degree). The resonance is observed due to the interaction of cut lines with the incident THz field. Tuning of the central resonant frequency is possible by changing the length of the cut line which effectively changes its inductance and capacitance if the MM is studied using LC circuit theory. The Full width at half maximum (FWHM) of the resonance is ~ 1 THz. No such resonance is observed when the cut lines are aligned perpendicular to the THz electric field (90 degree).

Reference

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3. Chin, Jessie Y., Mingzhi Lu, and Tie Jun Cui. "Metamaterial polarizers by electric-field-coupled resonators." Applied Physics Letters 93.25 (2008): 251903.
4. Lam, Vu Dinh, Nguyen Thanh Tung, and Young Pak Lee. "Metamaterials: Detailed parametric studies on cut-wire pair and combined structure." Journal of Physics: Conference Series. Vol. 187. No. 1. IOP Publishing, 2009.

Figures used in the abstract

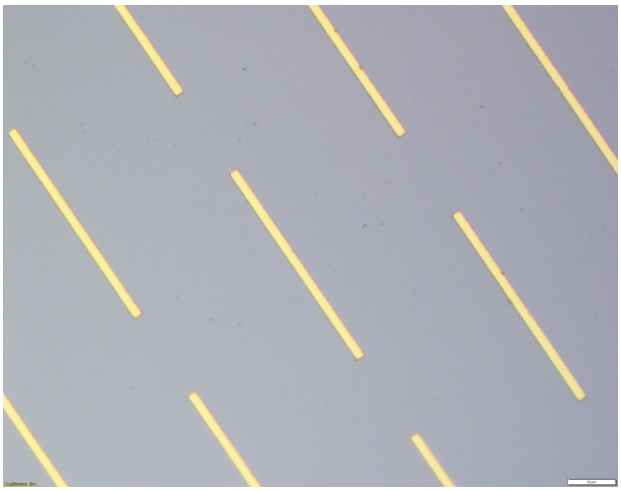

Figure 1: Microscopic Image of Fabricated Metamaterial Structure.

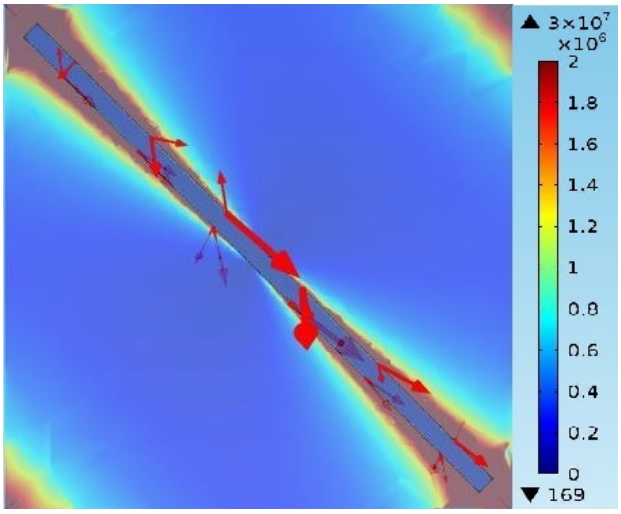

Figure 2: Electric Current Density and Electric Field Norm at Resonance.

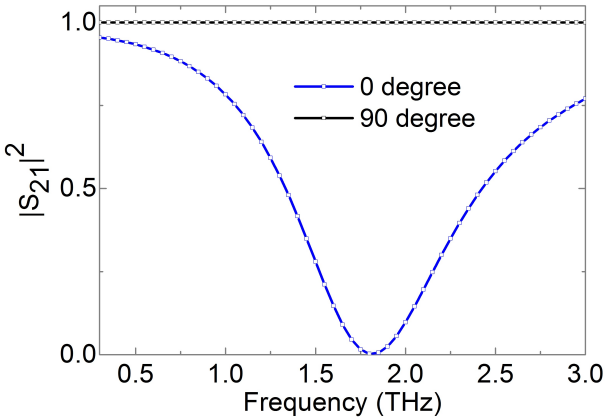

Figure 3: Simulated Values of Absorption as a Function of Frequency.