メタマテリアルを用いたコレステリック液晶テラヘルツイメージャー

Improvement of THz imager with hybridization system of metamaterial and cholesteric liquid crystal

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Terahertz (THz) wave is promising electromagnetic wave because of its high safety and wide applicability. Although the thermochromics liquid crystal has been applied to detect intense THz wave, the intensity of usual THz source is not enough to be detected by liquid crystal device [1]. In this study, we introduce an improved method to detect invisible THz wave more conveniently by adopting metamaterial and cholesteric liquid crystal (CLC) hybridization system. The CLC has a selective reflection band determined by the birefringence of the liquid crystal and pitch of the helical structure. Owing to the temperature dependence of the helical pitch, the CLC shows various colors depending on surrounding temperature [2]. To obtain more clarified temperature difference through the absorption of the THz waves, we utilize metamaterial substrates for the CLC. The electromagnetic fields are enhanced and absorbed at the meta-resonator, which is expected to improve the efficiency.

The metamaterial was fabricated by laser ablation process operated regeneratively amplified Ti:sapphire laser (800 nm center wavelength) on a 200 nm-thick Au thin film sputtered on a cyclo-olefin polymer substrate as shown in Fig 1. (a). The capsulized CLC were spin coated onto the metamaterial structure. Figure 1 (b) and (c) show the transmittance and reflectance spectra for y-polarization measured by FTIR (b) and simulated by the FDTD method (c) of the metamaterial, respectively. The resonance is observed at 5.5 THz where the improvement of the temperature increase upon the THz irradiation is expected.

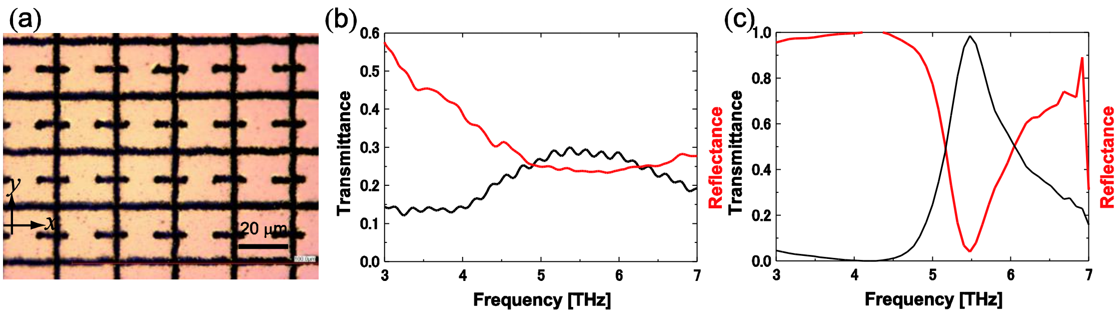

Fig. 1 (a) The microscope image of the metamaterial structure. Measured (b) and FDTD simulated (c) transmittance (black curve) and reflectance (red curve) spectra for the metamaterial, respectively.

[1] I. A. Chen, *et.al.*, Proc. of SPIE **8624,** 862415 (2012).

[2] K. Funamoto, *et.al.*, Jpn. J. Appl. Phys. **42**, 1523 (2003).