The researchers said that the low-density structures in their database are of particular interest because they expect them to have large rings and large pores, and expressed the hope that their work will spur attempts at their synthesis. The researchers also said that they are collaborating with other research groups in order to explore the adsorption and diffusion of small molecules in a subset of their zeolite database as well as how their predicted zeolites can be used for carbon sequestration.

The researchers said that their approach "may serve as a guide for construction of analogous databases for other materials such as metal-organic frameworks or crystal hydrates. Diversity in structures and possible functionality among these classes of materials could reveal themselves through such efforts."

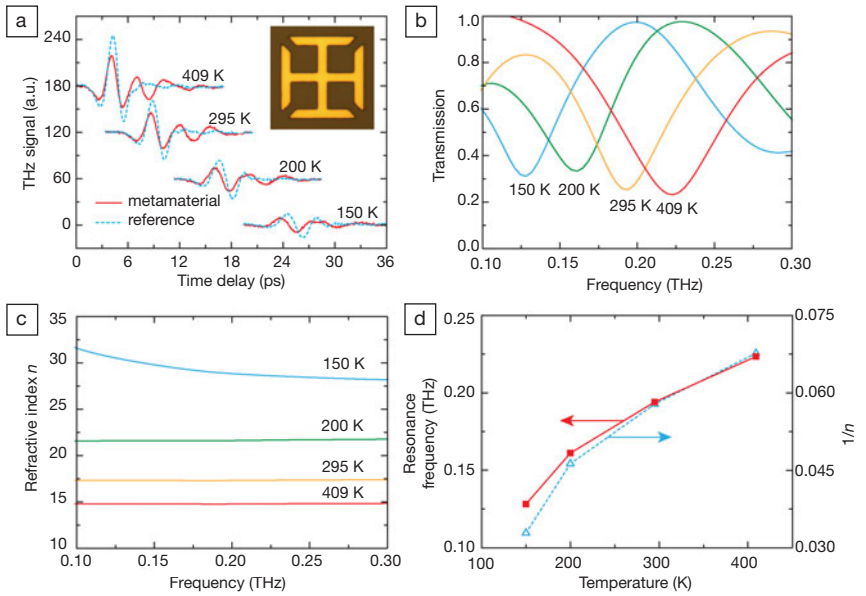
Steven Trohalaki

Nano Focus

Thermal tunability in terahertz metamaterial achieved on strontium titanate single crystals

Although split-ring resonator (SRR) based metamaterials are attractive for use in devices with novel functionalities over a large electromagnetic spectral domain, devices incorporating SRRs fall short on performance due to lack of dynamic control over their resonances. R. Singh, H.-T. Chen, and co-researchers at the Center for Integrated Nanotechnologies at the Los Alamos National Laboratory, hypothesized that in most cases the frequency tuning of metamaterial resonance is accompanied with a large variation in resonance strength, which is undesirable and caused by the damping from the materials integrated in metamaterials.

As reported in the April 7th issue of *Optics Letters* (DOI: 10.1364/OL.36.001230; p. 1230), the researchers fabricated a planar square array of subwavelength 200-nm-thick gold electric SRRs on a 533-μm-thick single crystal (100) oriented strontium titanate (STO) substrate. They measured the resonant behavior in the THz frequency range of the metamaterial as a function of temperature using a time-domain spectroscopy (TDS) system incorporated with a continuous flow liquid helium cryostat. The researchers observed a 43% shift in resonance frequency after cooling the metamaterial from 409 K to 150 K with less disparity in resonance strength. They attributed this behavior to the temperature-dependant dielectric constant of strontium titanate.



At various temperatures, (a) THz pulse in the time-domain after transmission through the metamaterial and a bare strontium titanate (STO) substrate, (b) normalized THz transmission amplitude spectra through the metamaterial, (c) refractive index of the STO substrate as a function of THz frequency, and (d) a comparison of resonance frequency and inverse of STO refractive index. Inset to (a) is the microscopy image of a metamaterial unit cell. Reproduced with permission from *Opt. Lett.* **36** (7) (2011) DOI: 10.1364/OL.36.001230; p. 1230. © 2011 Optical Society of America.

The experiment opens up avenues for designing tunable terahertz devices by exploiting the temperature-sensitive characteristics of high dielectric constant substrates and complex metal oxide materials. Such thermal tuning of metamaterial resonance using STO and ferroelectric materials will enable the integration of metamaterials with other complex metal oxides and resonance tuning approaches to realize multifunctional THz metamaterial devices.

Jean L. Njoroge

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