Researchers develop novel terahertz phase modulator based on NGO single crystals

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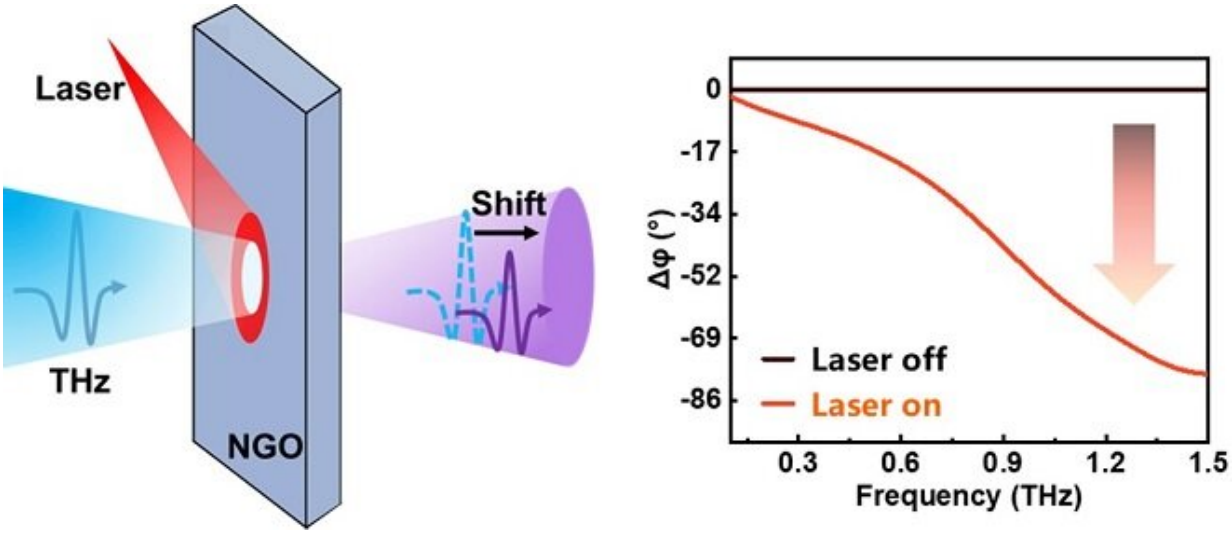

Schematic diagram of terahertz modulation experiment and phase shift as a function of terahertz frequency and light switch. Credit: Xu Jinyi

According to a study published in *ACS Applied Electronic Materials*, a collaborative research group from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences has developed an active terahertz phase modulator based on $NdGaO_3$ (NGO) single crystals, which are suitable candidates for terahertz phase modulators.

Finding appropriate materials to shape terahertz waves is not only highly desirable, but also a challenge that limits the technical application of

terahertz technology.

In this study, scientists found that NGO crystals exhibited distinct terahertz phase shifts. When the temperature of NGO single crystals was increased from 100 to 400 K, the terahertz phase shift would reach ?94°.

In addition, the terahertz phase shift of the NGO crystal was sensitive to the crystal orientation. The phase shifts for each crystal orientation showed a linear proportional relationship.

Using optical control, the researchers achieved active modulation of the terahertz phase: laser illumination could efficiently induce a noticeable terahertz shift. With a light fluence of 20 J/cm^2, a terahertz shift of ?78° could be achieved with good manipulation stability. By changing the light fluence, the multi-state terahertz phase shift can be achieved.

The sensitivity and stability of the NGO crystals are expected to have a major technological impact and offer prospects for the applications in terahertz optics, according to the researchers.

More information: Jinyi Xu et al, Terahertz Phase Shift and Its Modulation in NdGaO3 Single Crystals, *ACS Applied Electronic Materials* (2022). DOI: 10.1021/acsaelm.2c01370

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