New phonon-based and magneto-tunable monochromatic terahertz source

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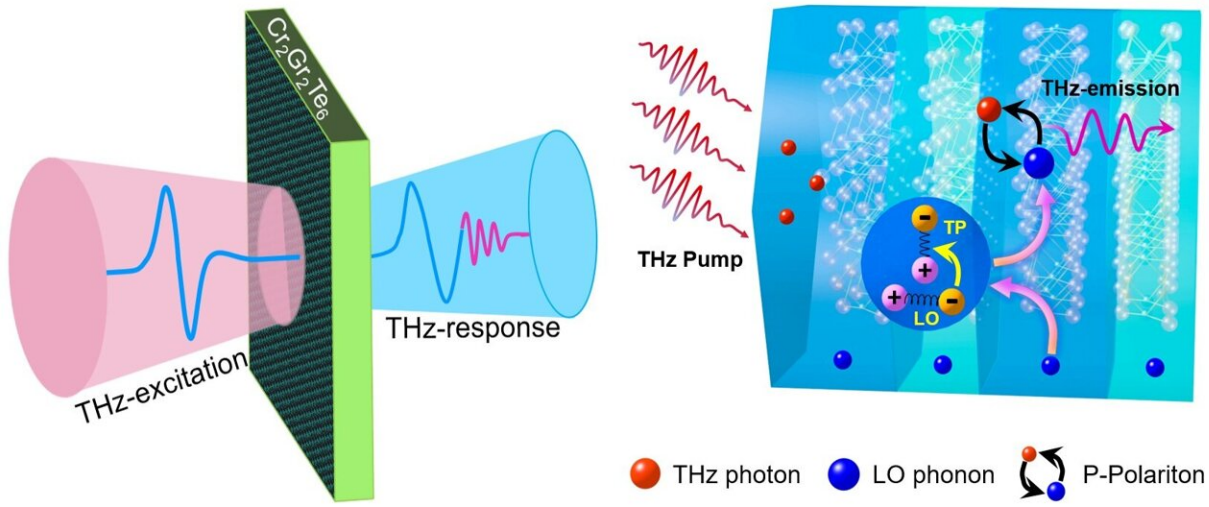

Schematic of the van der Waals phonon-polariton based monochromatic THz radiation. Credit: CHENG Long

Terahertz (THz, 1,011~1,013 Hz) related technology, with its superior spectral performance, has wide application potential in fields like communication, security, sensing, etc.

Using a 2D ferromagnetic $Cr_2Ge_2Te_6$ crystal, researchers from the Hefei Institutes of physical science (HFIPS) and University of Science and Technology of the Chinese Academy of Sciences developed a highly efficient magneto-tunable and phonon-based monochromatic THz generator with a frequency of ~0.9 THz.

"Benefiting from the bosonic nature of the radiation mechanism, this new THz source has advantages of "zero threshold," high quality factor and radiation efficiency," said Prof. Sheng Zhigao from the Hight Magnetic Field Laboratory of HFIPS. Results were published in *Advanced Science*.

Combining theoretical and experimental approaches, the team selected a two-dimensional (2D) van der Waals magnetic semiconductor $Cr_2Ge_2Te_6$ crystal and innovatively exploited the excellent properties of its van der Waals interlayered breathing phonon mode (boson) with THz-TDS (time domain spectroscopy) magneto-optic system.

They found the breathing mode could effectively couple with incident co-frequency THz pulse and form a new quasi-bosonic particle, namely phonon-polariton. This quasi-bosonic particle could then generate far-field electro-magnetic radiation with monochromatic frequency comparable to the phonon mode.

With the strong spin lattice coupling existing in this 2D material, the researchers tried to regulate the radiation via the spin-phonon interaction channel. They found that the phonon-related THz radiation could also be effectively modulated by external magnetic fields.

The development of this phonon-related monochromatic THz source not only offers better understanding about phonon-polaritons in 2D magnetic materials, but also provides a novel strategy for the realization of new THz sources.

More information: Long Cheng et al, Phonon-Related Monochromatic THz Radiation and its Magneto-Modulation in 2D Ferromagnetic $Cr_2Ge_2Te_6$, *Advanced Science* (2021). DOI: 10.1002/advs.202103229

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