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Terahertz-wave parametric wavelength conversion at room temperature

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Abstract

Over the past decade, there has been remarkable growth in the field of terahertz frequency science and engineering, which has become a vibrant, international, cross-disciplinary research activity. Wavelength conversion in nonlinear optical materials is an effective method for generating and detecting coherent terahertz waves owing to the high conversion efficiency, bandwidth, wide tunability, and room-temperature operation, and if the tuning range and the peak power can be enhanced, drastic developments in basic researches and industrial applications can be expected.

Here we demonstrate the generation of high-brightness terahertz waves using parametric wavelength conversion in a nonlinear MgO doped $LiNbO_3$ crystal. We revealed novel parametric wavelength conversion process using stimulated Raman scattering in MgO:$LiNbO_3$ without stimulated Brillouin scattering using recently-developed microchip Nd:YAG laser. We also demonstrated the coherent detection of generated terahertz waves using nonlinear up-conversion.

A number of applications require high brightness, that is, intense and narrowband, terahertz waves such as observing multi-photon absorption to specific excitation states. We speculate that the high-brightness terahertz wave and its visualization could be powerful tools not only for solving real world problems but also fundamental physics. We expect that these methods will open up new fields and tune up killer applications.

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