【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Interdisciplinary science and engineering)

Title of Project： Highly sensitive terahertz heterodyne CT and spectroscopic imaging

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Research Area： Terahertz Engineering

Keyword： Terahertz wave, Nonlinear optics, Terahertz parametric generation, Imaging

【Purpose and Background of the Research】

Frequency conversion in a nonlinear optical material is an effective method of achieving coherent terahertz-wave radiation and detection due to a large figure of merit of $LiNbO_3$ crystal. By converting terahertz-wave to near-IR, we can achieve more sensitive terahertz-wave detection than a direct measurement using thermal terahertz detectors. We will demonstrate a highly sensitive terahertz heterodyne CT and spectroscopic imaging system introducing an injection seeded terahertz-wave parametric generator and detector (is-TPG) using $LiNbO_3$ crystals.

【Research Methods】

Figure 1 shows our experimental setup. The terahertz-wave source is is-TPG. The terahertz wave emitted from the is-TPG was focused onto a $LiNbO_3$ crystal to be detected. The incident angle between the terahertz wave and the pump beam satisfy the phase-matching conditions in the $LiNbO_3$ crystal. This involves mixing terahertz-wave radiation with an intense pump beam to generate the idler beam at a difference frequency. The idler is also parametrically amplified inside the $LiNbO_3$ for highly sensitive detection. The idler output power is proportional to that of the incident terahertz-wave. The idler separated from the pumping beam was then detected using a InGaAs *p-i-n* photodiode. We obtained the considerably higher sensitivity than a liquid-He-cooled Si bolometer and the outstanding dynamic range of more than 100 dB.

【Expected Research Achievements and Scientific Significance】

In this research, we will demonstrate a highly sensitive terahertz heterodyne CT and spectroscopic imaging system for the purpose of detection of illicit drugs hidden in envelopes, etc. Realization of such room temperature operated systems may open the door to novel terahertz-wave applications.

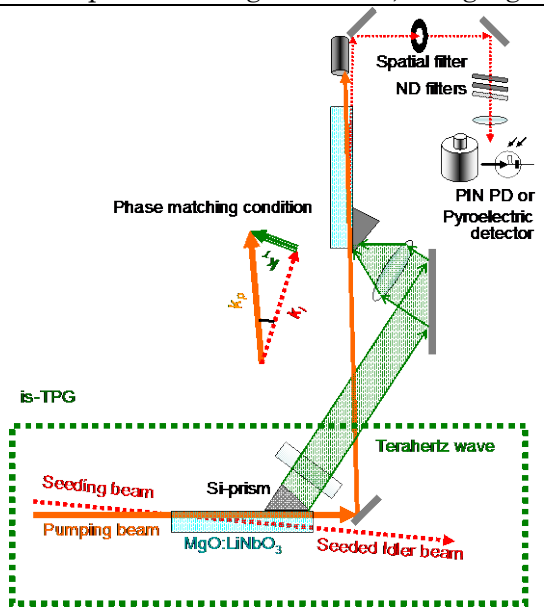

Figure 1. Injection seeded terahertz-wave parametric generator and detector

【Publications Relevant to the Project】

- K. Kawase, J. Shikata, K. Imai, H. Ito, “Transform limited narrow linewidth terahertz-wave parametric generator,” Applied Physics Letters, Vol. 78, No. 19, pp. 2819-2821 (2001).
- S. Hayashi, H. Minamide, T. Ikari, Y. Ogawa, J. Shikata, H. Ito, C. Otani, K. Kawase, “Tunability enhancement of a terahertz wave parametric generator pumped by a microchip Nd:YAG Laser,” Applied Optics, Vol. 48, No. 15, pp.2899-2902 (2009).
- S. Hayashi, K. Nawata, H. Sakai, T. Taira, H. Minamide, and K. Kawase, "High-power, single longitudinal mode terahertz-wave generation pumped by a microchip Nd:YAG laser," Optics Express, Vol. 20, No. 3, pp. 2881-2886 (2012).

【Term of Project】 FY2013-2017

【Budget Allocation】 163,500 Thousand Yen

【Homepage Address and Other Contact Information】

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