**Recent advances in THz parametric generation
and detection techniques**

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The injection-seeded terahertz wave parametric generator (is-TPG) technology presented in this report shows significant promise for measurements through thick packaging materials, owing to its extensive dynamic range. This is further enhanced by terahertz parametric detection methods that convert the terahertz wave into a near-infrared beam. This study details the recent advancements in is-TPG technology, addressing both generation and detection aspects. On the generation front, recent advancements have enabled the simultaneous generation of multi-wavelengths and high-speed wavelength tuning. When coupled with parametric detection, this allows for the real-time separation and detection of each wavelength component, facilitating real-time spectroscopy. Moreover, integrating machine learning enables real-time identification, which significantly speeds up tag reading and spectral identification imaging. On the detection side, sensitivity has been markedly improved through the use of multiple parametric detection stages. Combined with is-TPG, this approach achieves a dynamic range of up to 125 dB. This system now makes it feasible to conduct spectroscopic imaging through shields with 100 dB attenuation, a task that was previously challenging. This report will also cover related topics in addition to these advancements.

**Short Bio:**

**Kosuke Murate** received B.S., M.S. and Ph.D. degrees from Nagoya University, Japan in 2013, 2015, and 2018, respectively. Now he is working as an assistant professor in the Department of Electronics, Graduate school of Engineering, Nagoya University since 2018. He received Ikushi prize from Japan Society for the Promotion of Science in 2018.