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Biography

Kazuhiko Hirakawa received the B.E., M.E., and Ph.D. degrees in electronic engineering in 1982, 1984, and 1987, respectively, from University of Tokyo. He is currently a professor at Institute of Industrial Science, University of Tokyo. He was a visiting researcher at Princeton University for 1991-1993, a visiting professor at Laboratoire Pierre Aigrain, Ecole Normale Superieure in 2006, and a visiting scholar at University of Paris 6 in 2012. His research interests include ultrafast terahertz (THz) carrier dynamics in quantum nanostructures, novel THz detection devices, cooling phenomena in semiconductor heterostructures, and fabrication of ultrasmall transistors (single molecules, etc.) and their physics.

Abstract - Room-temperature, fast and sensitive terahertz detection using MEMS resonators

We have developed a terahertz (THz) bolometer that utilizes a novel thermomechanical transduction scheme using a doubly clamped microelectromechanical system (MEMS) beam resonator and performed the frequency-modulation (FM) operation for fast and sensitive THz detection at 300 K. In the FM detection, the MEMS resonator is driven in a self-sustained oscillation mode by a phase-locked loop, which tracks the shift in the resonance frequency induced by THz heating. The detection speed has been dramatically improved in the FM detection mode, which allows fast operation of the MEMS bolometer up to several kHz. The frequency noise in the FM detection can be suppressed by a large-amplitude operation of the beam resonator, achieving a noise equivalent power (NEP) as low as ~70 pW/√Hz, which is close to the fundamental limit by the thermal fluctuation noise. Furthermore, the dynamic range of the present MEMS bolometer is greater than 10^7. The present MEMS bolometers are fabricated by the standard semiconductor fabrication process and are well suited for making detector arrays for fast THz imaging.