高感度検出器を利用した低温 THz 近接場顕微鏡の開発

Development of low-temperature near-field microscopy with a highly sensitive THz detector

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In the past several years, a highly sensitive THz detector, called charge-sensitive infrared phototransistor (CSIP) [1], has been developed. Compared to conventional detectors in the long-wavelength infrared region, the CSIP represents a highly promising candidate for passive THz microscopy, where external illuminations are not needed. Recently the CSIP has been used for passive scattering-type scanning near-field microscope (s-SNOM) [2], and evanescent waves can be imaged both in thermal-equilibrium state [3] and nonequilibrium state [4]. The samples, however, can only place at room temperature. To expand the capability of the passive THz microscopy to cryogenic temperatures, we have developed a low-temperature (LT) THz microscope containing a chamber, providing 4.2 K environment for both CSIP and sample stage, as shown in Fig. 1(a). The radiations from the sample are collected by a Ge objective (single-lens; N.A.: 0.34) to the CSIP. In this report, we prepared a NiCr narrow wire as a heater to heat up a Au/SiO_2 sample, as shown in Fig. 1(b). In Fig. 1(c), the far-field signals of Au and SiO_2 are clearly distinguished due to the difference in emissivity. The spatial resolution of the microscope is about 110 μm. In the future, we can expect a LT s-SNOM will be developed based on this LT THz microscope, which can study nanoscale charge kinetics of nano-devices in a non-equilibrium condition.

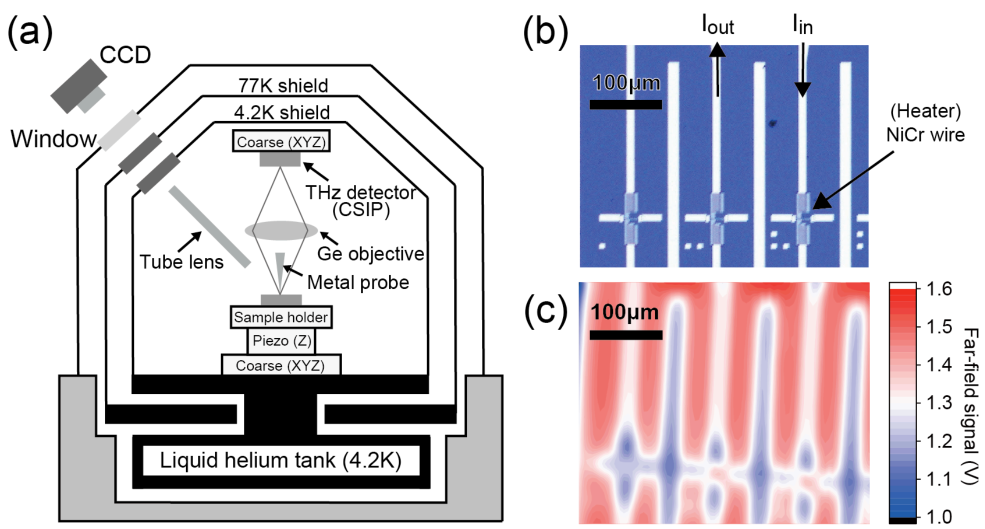

Fig. 1 (a) Schematic view of the low temperature passive THz microscope. (b) Microscope image of a heater device with NiCr narrow wire. (c) Passive THz microscope image taken with $I = 2.55$ mA.

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