機械式冷凍機を用いたパッシブ型 THz 近接場顕微鏡の開発

A passive THz near-field microscope with a helium-free cryostat

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Passive THz s-SNOMs (scattering-type scanning near-field optical microscopes) provide a unique tool for nanoscale study of weak spontaneous radiation on material surface without any external light [1]. It has been demonstrated for studying thermal evanescent waves from metal and dielectic (e.g. Au, GaAs, SiO_2, or SiC) at room temperature [2]. In our passive s-SNOM, an extremely sensitive CSIP (charge-sensitive infrared phototransistor [3]) detector is necessary to be operated in a 4K cryostat. To cool down the CSIP more conveniently, we introduced a helium-free cryostat equipped on the passive s-SNOM as depicted in Fig. 1(a). One issue, however, we should overcome is the vibration from the compressor, or the tip is difficult to approach the sample surface. Mechanical and He gas dampers are used to attenuate the vibration. Besides, we also introduced a movable pinhole (inset of Fig. 1(a)), which can make focusing onto the CSIP detector much easier in the cryostat. Fig. 1(b) shows that we have successfully measured topography across the Au/GaAs grating (upper panel) with 5 μm pitches and observed the near-field signal (lower panel) in the meantime. The spatial resolution now is derived to be better than 100 nm. In this talk, we will show the development and the evaluation of this new passive s-SNOM.

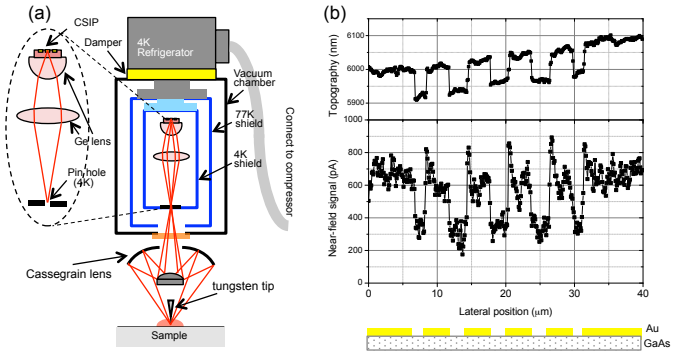

Fig. 1 (a) Schematic diagram of the passive s-SNOM equipped with helium-free cryostat. (b) An AFM topography profile (upper panel) and an intensity profile of the near-field signal across the Au grating deposited on a GaAs substrate (lower panel).

Reference:

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