17p-C1-9

パッシブ型 THz 近接場顕微鏡における探針サイズ依存性

Tip size dependence of passive THz near-field microscopy

東大生研 [1]，東大総合文化 [2] ○林 冠廷 [1]，梶原 優介 [1]，小宮山 進 [2]

Univ. Tokyo[1, 2], ○Kuan-Ting Lin[1], Yusuke Kajihara[1], and Susumu Komiyama[2]

E-mail: kuanting@iis.u-tokyo.ac.jp

We have recently developed a scattering-type scanning near-field optical microscope (s-SNOM) equipped with an ultrahighly sensitive THz detector, CSIP (charge-sensitive infrared phototransistor; λ: 14.5±0.7 μm) [1]. The diagram of the s-SNOM is shown in Fig. 1(a). A tungsten tip is used to locally scatter thermal evanescent waves without external illumination, and collect THz wave with a set of germanium lens to the CSIP detector. The spatial resolution of near-field signal reaches 60 nm (λ/250) [2].

However, to study interesting objects like biomolecules or nano-particles, the spatial resolution less than 20 nm is strongly required. Besides, it is also unclear about the tip size dependence of passive near-field signals. With improved AC electrochemical etching procedure, the current through a tungsten probe is monitored in real-time, and a sharper tip can be fabricated when the process is stopped at most suitable current. Four different radii of tips are used and signal characteristics are evaluated. (Fig. (b)-(e)). The best spatial resolution of near-field signal reaches 20 nm (λ/725) as shown in Fig. 1(f) with a tip with ~15 nm apex radius judging from the step edge between Au and SiO_2. The spatial resolutions all consist with the tip size as shown in Fig. 1(f)-(i). The decay length of the evanescent wave is ~40 nm and independent of the tip size. This is exactly what the theories predict [3]. Besides, we studied the characteristic of standing wave due to background radiation with different tip radii. In this presentation, we will show and discuss those results.

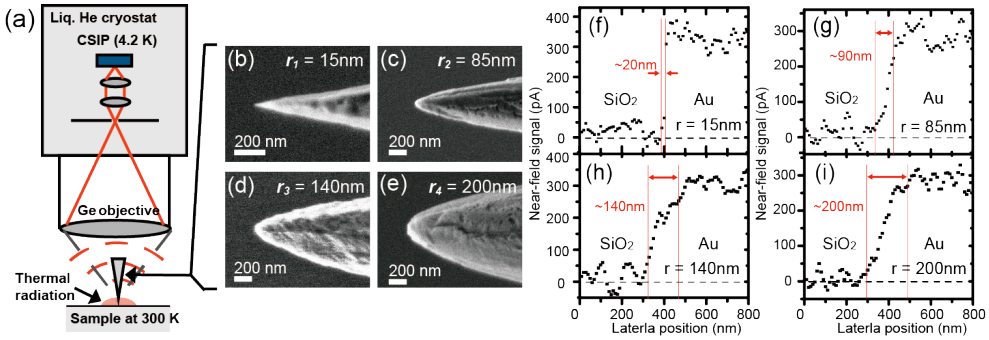

Fig. 1 (a) Schematic diagram of the passive s-SNOM equipped with a sharp tungsten probe. SEM images of tip with (b) 15 nm (c) 85 nm (d) 140 nm (f) 200 nm radius. (e)–(f) The lateral spatial resolution of the near-field signal individually taken by four different tip sizes.

Reference:

[1] T. Ueda, et al., J. Appl. Phys., 103, (2008) 093109

[2] Y. Kajihara, et al., Opt. Express, 19, (2011) 7695

[3] K. Joulain et al., Surface Science Reports, **57,** 59–112 (2005)