

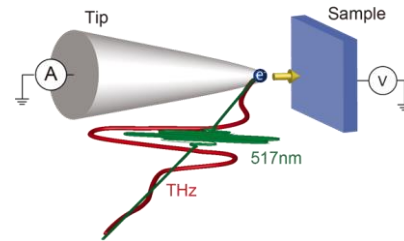
# Direct characterization of terahertz near field waveform around metal nanotip by multiphoton photoemission

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Recently, THz-STM has emerged as a novel technique to probe ultrafast dynamics at the atomic scale. In THz-STM, The STM tunneling junction is irradiated by phase stable monocycle THz pulses. Through an antenna like coupling of THz pulse with nanotip, enhanced THz near field is formed around a nanotip, which drives ultrafast tunneling current. Through the field enhancement, THz near field waveform is known to be deformed, however the characterization technique of near field waveform has not yet been established.

In this study, we have developed the direct method to probe THz near field waveform around nanotip using photoelectron emission. In this method, multiphoton photoemission is induced at a nanotip apex by intense visible pulse (517nm), and simultaneously impinged THz pulse modulate photoelectron emission. Near field THz waveform is characterized by measuring THz induced change of photoelectron current as a function of delay time between visible pulse and THz pulse.



**Fig** Schematic illustration of measurement