Ultrafast dynamics at surfaces probed by time resolved THz-STM

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Recently, THz-STM has attracted much attention as a novel technique to probe ultrafast dynamics of photo-induced phenomena with atomic scale spatial resolution. Carrier relaxation dynamics of single InAs quantum dot[1] and vibrational motion of single pentacene molecule[2] have been measured by the technique. In this study, we have developed time resolved THz-STM by combining low temperature UHV-STM with THz optics. In THz-STM, a THz pulse induced transient voltage across STM tunneling junction drives ultrafast tunneling current (I_{THz}). In this study, we excite a sample by IR pulse and probe the excited states by measuring I_{THz} as a function of delay time between them (fig.1). We found THz assisted hot electron tunneling appears in time resolved spectra on Bi_2Se_3. On the other hand, additional exponential delay appears in time resolved signal on 1T-TaS_2. The decay time constant is corresponding to the photo-induced phase transition between nearly commensurate CDW and in-commensurate CDW phase.

[1] T. L. Cocker, et al: Nature photonics, 7, 620–625 (2013)

[2] T. L. Cocker, et al: Nature, 539, 263–267 (2016)

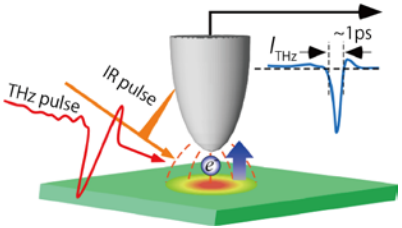

Figure. Schematic illustration of time resolved THz-STM