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Ultrafast Optical Response of Graphene/$LaAlO_3/SrTiO_3$ Heterostructure[1] LU CHEN, ERIN SUTTON, JIANAN LI, QING GUO, University of Pittsburgh, MENGCHEN HUANG, University of California, Santa Barbara, JEN-FENG HSU, BRIAN D'URSO, University of Pittsburgh, JUNG-WOO LEE, HYUNGWOO LEE, CHANG-BEOM EOM, University of WisconsinMadison, PATRICK IRVIN, JEREMY LEVY, University of Pittsburgh — Graphene is a promising tunable plasmonic material in the terahertz regime. Plasmons can be induced in graphene by femtosecond laser excitation, and their resonance frequency can be gate-tuned over a broad terahertz range[2]. Another 2D electron system, the complex-oxide heterostructure $LaAlO_3/SrTiO_3$, has been shown to exhibit great promise for control and detection of broadband THz emission at extreme nanoscale dimensions[3]. Recently, we have successfully integrated these two platforms: we have created graphene/$LaAlO_3/SrTiO_3$ structures with high mobility in the graphene channel and oxide nanostructures directly underneath the graphene layer. Here we describe new experiments that probe graphene plasmonic behavior using this nanoscale THz spectrometer. This unprecedented control of THz radiation at 10 nm length scales creates a pathway toward hybrid THz functionality in graphene/$LaAlO_3/SrTiO_3$ heterostructures.

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[2]L. Ju, *et al.*, Nature Nanotech. **6**, 630 (2011)
[3]Y. Ma, *et al.*, Nano Lett. **13**, 2884 (2013)

Lu Chen
University of Pittsburgh

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