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Frank Isakson Prize for Optical Effects in Solids Lecture: Infrared nano-spectroscopy and nano-imaging of Dirac plasmons in graphene

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We have applied antenna-based infrared (IR) nano-spectroscopy and nano-imaging to investigate Dirac plasmons in monolayer graphene. This experimental technique enables IR imaging with nano-scale spatial resolution, and also allows one to investigate electromagnetic phenomena at wave-vectors on the order of the Fermi wave-vector in gated graphene. Nano-spectroscopy and nano-imaging experiments have uncovered rich optical effects associated with the Dirac plasmons of graphene [*Fei et al. Nano Letters 2011*]. We were able to directly image Dirac plasmons propagating over sub-micron distances and reflecting from the edges of graphene flakes, all with a spatial resolution far exceeding the plasmon wavelength. Furthermore, we employed new IR nano-optics capabilities to demonstrate the gate-tunable plasmonic properties of graphene and to investigate the coupling between Dirac plasmons and the phonon modes of polar substrates.