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Mid Infrared Near Field Study of Monolayer Graphene Z. FEI, G.O. ANDREEV, University of California - San Diego, W. BAO, University of California - Riverside, L.M. ZHANG, Boston University, Z. ZHAO, University of California - Riverside, G. DOMINGUEZ, M. THIEMENS, M.M. FOGLER, University of California - San Diego, C.N. LAU, University of California - Riverside, F. KEILMANN, Max-Planck-Institute of Quantum Optics, D.N. BASOV, University of California - San Diego — We have performed near-field spectroscopic studies of both monolayer suspended graphene (SG) and graphene on SiO_2/Si substrate (GOS) using scattering-type scanning near-field optical microscope (s-SNOM). Our data show that SG produces reliable near-field signal in mid-infrared frequencies. Images taken with high spatial resolution ($\sim$20nm) show nanoscopic features such as ripples and electronic inhomogeneities. The SiO_2/Si substrate contributes a phonon resonance in the near-field signal around 1130 cm^{-1}. This resonance is remarkably strengthened and broadened by just a single layer of graphene in the case of GOS. By probing the resonance spectrum we find over 400% contrast in near field signal between GOS and the bare substrate. The detailed analysis of the contrast suggests that GOS is slightly doped. This study therefore provides much needed insight into the thickness resolution of the s-SNOM technique, proving it can be sensitive to just a single layer of atoms, and advances the fundamental understanding of graphene-light interactions by probing in the near-field regime.

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