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**Near-field spectroscopy of graphene during ultrafast photoexcitation** MARTIN WAGNER, ZHE FEI, ALEXANDER MCLEOD, ALEKSANDR RODIN, University of California San Diego, WENZHONG BAO, University of California Riverside, LINGFENG ZHANG, Boston University, ZENG ZHAO, University of California Riverside, ERIC IWINSKI, MARK THIEMENS, MICHAEL FOGLER, University of California San Diego, ANTONIO CASTRO-NETO, National University of Singapore, CHUNNING LAU, University of California Riverside, FRITZ KEILMANN, Max Planck Institute of Quantum Optics, DIMITRI BASOV, University of California San Diego — Recently, impressive progress in nanoplasmonics of graphene using near-field spectroscopy and imaging has been reported [Z. Fei et al., Nano Lett. 11, 4701 (2011); Z. Fei et al., Nature 487, 82 (2012)]. However, these studies of the interaction of the graphene plasmon with the SiO2 substrate surface phonon were time-independent. Here we combine imaging and material characterization on the nano scale with ultrafast sub-picosecond time resolution and present optical pump broadband mid-infrared probe spectroscopy of graphene. We discuss the optical pump induced changes of the coupled plasmon-phonon modes with respect to carrier density and time-dependence. The difference between ultrafast photoexcitation and conventional electrostatic doping via the field effect is analyzed and compared with modeling.

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