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Ultrafast coupled plasmon-phonon mode dynamics in GaAs, a combined experimental and theoretical approach[1] EVAN THATCHER, CHRISTOPHER STANTON, Univ of Florida - Gainesville, KUNIE ISHIOKA, National Institute for Materials Science, Tsukuba, Japan, AMLAN BASAK, HRVOJE PETEK, Univ of Pittsburgh — We present results from a joint experimental and theoretical study exploring the excitation of coupled plasmon-phonon modes in GaAs. In contrast to previous coherent phonon studies in GaAs where electrons were generated primarily in the Γ valley (E_0 gap), we use a pump-probe technique with a 10 fs pulse width and a shorter 400 nm laser wavelength to photoexcite electrons predominately in the L valley (E_1 gap). As a result: i) damping of the electron-hole plasma is faster and ii) diffusion of the carriers from the surface becomes important owing to the shorter absorption length. The probe pulses measure the time-dependent changes to the reflectivity due to the coupled plasmon-phonon modes created by the ultrafast photoexcitation and the subsequent depletion field screening. To model this, we solve for the time and density dependent coupled-mode frequencies allowing for ambipolar diffusion. Simulation of the coupled plasmon-phonon dynamics allows for comparison with, and a better understanding of experiments.

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Evan Thatcher
Univ of Florida - Gainesville

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