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Coherent LO phonon self-energy renormalization under high photoexcited carrier densities in Si ANCA-MONIA CONSTANTINESCU, University of Pittsburgh, MUNEAKI HASE[1], University of Tsukuba, MASAHIRO KITAJIMA[2], National Institute for Material Science, HRVOJE PETEK, University of Pittsburgh — The study of hot carrier-phonon interaction dynamics is motivated by their influence on optical and electrical properties of semiconductors. Following high-density (10^{19}–10^{20} carriers/cm^3) photoexcitation of Si(001) with 10 fs duration 400 nm laser pulses, the complex self-energy (i.e. frequency and decay rate) of coherent LO phonon ($\boldsymbol{k}\approx 0$) renormalize due to deformation potential interaction with the photogenerated non-equilibrium plasma. We evaluate the time dependent LO phonon frequency and dephasing time by analyzing the transient electro-optic reflectivity of variously doped Si(100). We measure the coherent LO phonon mode oscillations in the transient reflectivity over a delay time of 6 ps between pump and probe pulses. Varying the pump power from 50 to 5 mW, we observe that the electronic softening of the lattice (i.e. LO phonon frequency change) and the quasi-exponential dephasing time of the phonon depend on the initial photoexcited carrier density.

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