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Direct Observation of the Strength of Plasmon-Longitudinal Optical Phonon Interaction in n-type GaAs HAKAN ALTAN, XUYING XIN, DAVID MATTEN, ROBERT ALFANO, City College of New York — The screening of longitudinal optical phonons by plasmons is investigated by time-resolved visible pump-mid infrared probe transmission measurements in a series of light to highly doped n-type GaAs wafers. The reduced relaxation of photogenerated carriers is strongly correlated to the coupling between longitudinal optical phonons and background plasmons as suggested by the variation of the phonon strength over the doping range. Our results show that at low photogeneration ($< 10^{16}\text{cm}^{-3}$) the critical doping density at which the strength of the coupling between LO phonons and plasmons decreases significantly is on the order of $N_c \sim 1\text{x}10^{18}\text{cm}^{-3}$. The lack of LO phonons that participate in relaxation of carriers due to the hybridization of the longitudinal modes above this doping level, can either result in adverse effects in the spectrum of diode lasers and semiconductor electronic devices or enhance photonic device performance due to longer minority carrier recombination times.

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