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Dynamics of highly excited electrons photoinjected into GaAs: formation and decay of hot-electron ensembles.[1]

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Electron scattering by phonons is one of the major processes that determine the transport characteristics and relaxation dynamics in semiconductor-based devices.
Although density functional theory (DFT) -based computational methods for the calculation of the electron-phonon coupling matrix elements in metals exist since the late nineties, DFT-based calculations of the electron-phonon coupling in semiconductors started much later [1,2]. Very recently, we have developed a computational method for the calculation of the electron-phonon coupling in polar semiconductors, based on the interpolation of the electron-phonon matrix elements in Wannier representation [3]. This method allowed us to successfully interpret the dynamics of hot electron relaxation in bulk GaAs, in excellent agreement with time- and angle- resolved photoemission experiment by the group of K. Tanimura (University of Osaka, Japan). The measured, and calculated, electron-phonon scattering times turned out to be surprisingly fast, of the order of a few tens of femtoseconds. Moreover, we have demonstrated, for the relaxation of hot carriers in GaAs, the existence of two distinct relaxation regimes, one related with the momentum, and the other with energy relaxation. Both regimes are shown to be almost entirely ruled by the electron-phonon interaction [4].

1. J. Sjakste, N. Vast, V. Tyuterev, Phys. Rev. Lett. 99, 236405 (2007)
2. Annual Reviews of Heat Transfer, Vol. 17, Begell House Inc, Danbury, CT, USA, J. Sjakste, I. Timrov, P. Gava, N. Mingo, and N. Vast (2014).
3. J. Sjakste, N. Vast, M. Calandra, F. Mauri, Phys. Rev. B 92, 054307 (2015).
4. H. Tanimura, J. Kanasaki, K. Tanimura, J. Sjakste, N. Vast, M. Calandra, F. Mauri, Phys. Rev. B 93, 161203 (R) (2016).

[1]This work was done in collaboration with N. Vast, M. Calandra, F. Mauri and the group of K. Tanimura.