

Dynamics of Highly Excited Electrons in 3D and 2D Semiconductors: Theory and Experiments.

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The rapid development of the computational methods based on density functional theory, on the one hand, and of the time- energy- and momentum- resolved spectroscopy, on the other hand, allows today an unprecedentedly detailed insight into the processes governing hot electron relaxation dynamics, and, in particular, into the role of the electron-phonon coupling [1]. Recently, we have developed a computational method, based on density functional theory and on interpolation of the electron-phonon matrix elements in Wannier space, for the calculation of the electron-phonon coupling in polar materials [2]. 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 experiments. 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 [3]. Interestingly, the energy relaxation times become faster at lower energies [4].

In this work, we will present our new results, both experimental and theoretical, on hot electron relaxation in silicon. Numerous additional experiments were performed with respect to the work of [5], and a new interpretation of the measured relaxation times is provided, based on our *ab initio* calculations and on the concept of hot electron ensembles proposed recently in [3].

Moreover, we will present our recent results, both experimental and theoretical, on the hot electron relaxation and cooling in InSe. InSe is a quasi-2D material which was shown recently to have potential interest for optoelectronics [6]. In this work, we will discuss our new results on the relaxation and cooling dynamics in doped InSe.

References

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