Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Electron-Phonon Kinetics and Transport in 2D Structures of Reduced Electron Concentrations

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MICHAEL REIZER, VLADIMIR MITIN, SUNY at Buffalo — Usually, screening of the electron-phonon (e-ph) interaction is considered in linear approximation. In this case in 2D systems, the Debye screening radius $r_D$ is independent on the electron concentration, $n$. The linear approximation ignores the discreteness of the electron charge and it is not applicable for diluted systems. Here we show that the screening radius for e-ph interaction is in fact $\max(r_D, n^{-1/2})$. For this reason, e-ph interaction is drastically enhanced in the diluted systems. In particular, a value of the deformation potential is increased by a factor of $n^{1/2}/r_D \approx R_s/a_0 = r_s$. The suggested approach explains puzzling data [1], which demonstrate that the deformation potential between holes and phonons in dilute 2D GaAs is twenty times stronger than expected from the theory. Strong coupling increases all e-ph phenomena. Using the Keldysh diagrammatic technique, we calculate kinetic and transport characteristics for diluted 2D systems. [1] X.P.A. Gao et al, Phys. Rev Lett. 94, 086402 (2005).

The work was supported by the NYSTAR grant.