Vasili Perebeinos
Davoud Adinehloo, Cheng Tan, James Hone
Department of Electrical Engineering, University at Buffalo, Buffalo, New York 14260, USA
Department of Mechanical Engineering, Columbia University, New York, 10027 New York, USA
vasilipe@buffalo.edu

Phonon limited mobility in h-BN encapsulated AB-stacked bilayer graphene

We report the electrical transport in h-BN encapsulated AB-stacked bilayer graphene theoretically and experimentally. Using the perturbation theory within the tight-binding model approach, we identify the dominant role of the shear phonon mode scattering on the carrier mobility in AB-stacked graphene bilayer at room temperature. The shear phonon mode is absent in free-standing monolayer graphene, which explains high mobilities in monolayer devices fabricated under similar conditions resulting in minimal Coulomb impurity scattering. At temperatures above 200K, the surface polar phonon scattering from boron-nitride (BN) substrate contributes significantly to the experimental mobilities of 15,000 -20,000 cm^2/Vs at room temperature, and carrier concentration $n \sim 10^{12}$ cm^2 reported here. A screened SPP potential for a dual encapsulated bilayer and transferable tight-binding model allows us to predict mobility scaling with temperature and bandgap for both electrons and holes in agreement with the experiment.

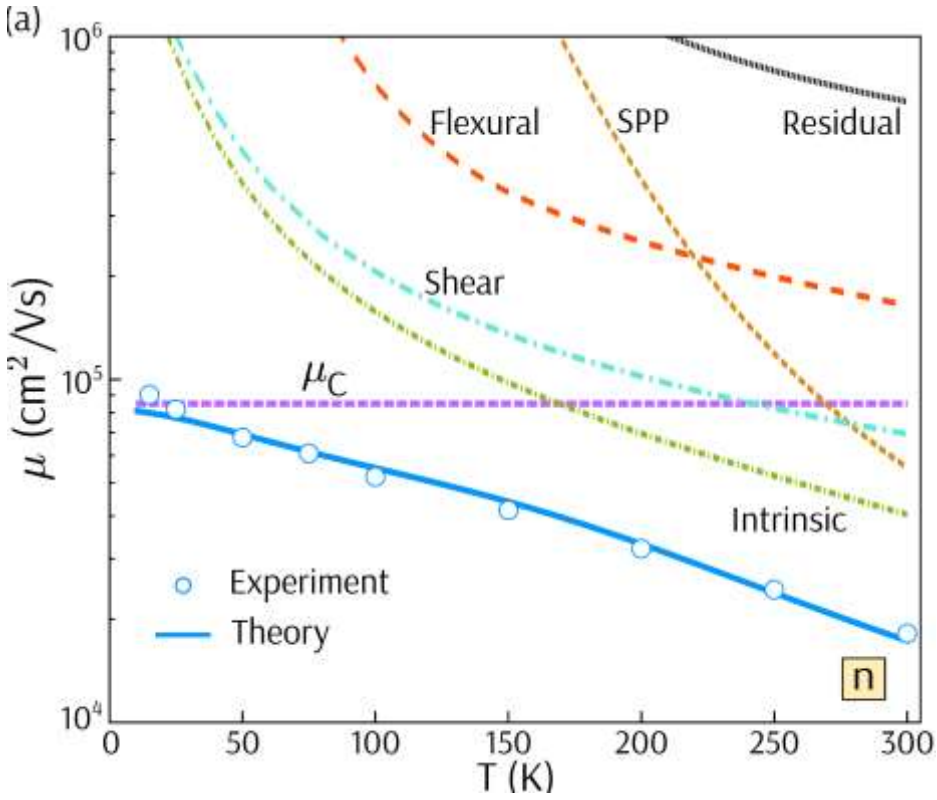

Figure 1: Overall experimentally measured and theoretically calculated electron mobilities as a function of temperature blue circles and blue curve, respectively, at electron carrier density 0.9 x 10^{12} cm^{-2}. The theoretical intrinsic, SPP, shear, flexural, and residual phonon-limited mobilities are shown by the dashed curves (from bottom to top at room temperature, respectively).