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Electrical transport in suspended graphene

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Many quantum limit transport phenomena in graphene remain yet to be observed due to the omnipresence of carrier scattering. We report a sample preparation method that yields high quality graphene specimens and demonstrates that much of the scattering in traditional graphene-on-silica devices is not intrinsic but rather results from the interaction with the substrate underlying the graphene. We fabricate devices where electrically contacted and electrostatically gated graphene flakes are suspended over a substrate and use current-induced heating to remove the remaining impurities. The measured mobilities are found to exceed 200,000 cm^2/Vs in such devices, an order of magnitude improvement over the best values reported in the literature. The very high mobility of our specimens allows us to probe previously inaccessible transport regimes in graphene. At low temperatures transport is near-ballistic in a device of $\sim 2\mu$m dimension. At large carrier density, we observe linear increase of resistivity with temperature, consistent with scattering off acoustic phonons. At near-room temperature we observe the mobility is $\sim$120,000 cm^2/Vs, higher than in any known semiconductor.