Low-temperature quantum transport in CVD-grown single crystal graphene

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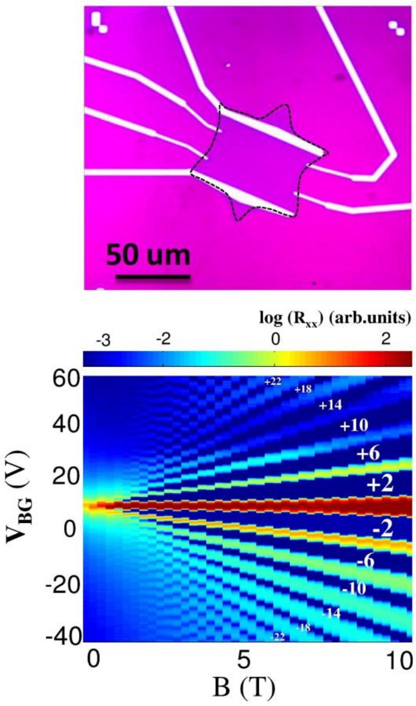
Chemical vapor deposition (CVD) has been proposed for large-scale graphene synthesis for practical applications. However, the inferior electronic properties of CVD graphene are one of the key problems to be solved. Several protocols were reported to improve the electrical characteristics of CVD-graphene, including a dry transfer technique and the use of flakes of hexagonal boron nitride (h-BN) as substrates. Dry transfer can reduce the transfer-related contamination thus minimizing the extrinsic doping of CVD graphene. Furthermore, h-BN substrates can provide atomically-smooth surfaces and small lattice mismatch, which leads to reduced substrate-induced scattering. Unfortunately, owing to the small size of h-BN flakes, this method requires a cumbersome aligned-transfer of graphene, and device dimensions are limited. In this study, we present a detailed study on the electronic properties of high-quality single crystal monolayer graphene. The graphene is grown by CVD on copper using a cold-wall reactor and then transferred to Si/SiO_2. Our low-temperature magneto-transport data demonstrate that the characteristics of the measured single-crystal CVD graphene samples are superior to those of polycrystalline graphene and have a quality which is comparable to that of exfoliated graphene on Si/SiO_2. The Dirac point in our best samples is located at back gate voltages of less than 10 V, and their mobility can reach 11000 cm^2/Vs. More than 12 flat and discernible half-integer quantum Hall plateaus have been observed in high magnetic field on both the electron and hole side of the Dirac point (shown in the figure). At low magnetic field, the magnetoresistance shows a clear weak localization peak. Using the theory of McCann *et al.* [1], we find that the inelastic scattering length is larger than 1 μm in these samples even at the charge neutrality point, much larger than the results reported in previous studies on CVD graphene.



Top: Optical microscopy image of CVD-graphene device. Bottom: Landau fan diagram of longitudinal resistance as a function of back gate voltage and magnetic field. There are more than 12 Landau levels clearly observed.

[1] E. McCann, K. Kechedzhi, V. I. Fal'ko, H. Suzuura, T. Ando, and B. L. Altshuler, *Phys. Rev. Lett.* **97**, 146805 (2006).