Disordered Fermi Liquid in Epitaxial Graphene from Quantum Transport Measurements

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Epitaxial graphene synthesized on the Si-terminated face of silicon carbide (SiC/G) has demonstrated the ability to supersede conventional semiconductors as the system of choice for fast analogue transistors, quantum metrology, and is also emerging as a suitable platform for such disruptive technologies as spintronics.

In SiC/G, the two dimensional system is formed by a conducting graphene layer situated on top of a non-conducting buffer carbon layer, covalently bonded to SiC. The interplay between these two layers, unavailable in graphene flakes, graphene on the C face of SiC or conventional semiconductor-based 2D gases, makes SiC/G a system full of rich new physics. A detailed understanding of electron scattering and localization in this material is therefore important.

We quantify the charge scattering in SiC/G by analyzing quantum corrections to conductivity from magnetotransport measurements at low temperatures and decoupling the two quantum transport phenomena contributing to effect: the Aronov-Altshuler electron-electron interaction (AA) and weak-localization (WL). The analysis of the AA correction has confirmed that electrons in SiC/G display all the attributes of a disordered Fermi liquid and that the electron-electron interaction is responsible for dephasing in this system; from the analysis of WL has extract the characteristic times of symmetry-breaking disorder and intervalley scattering, finding a characteristic phase relaxation time of electrons of about 50 ps, which we attribute to the presence of local magnetic moments of defects in or under graphene. Based on this, we conclude that spin memory of electrons in a field effect transistor based on epitaxial graphene with n~1011 cm2 can exceed a micrometer scale, which proves the suitability of this system for applications in spintronics

References

[1] S. Lara-Avila, A. Tzalenchuk, S. Kubatkin, R. Yakimova, T. J. B. M. Janssen, K. Cedergren, T. Bergsten, and V. Fal'ko, Phys. Rev. Lett. **107**, (2011), 166602.

Figures

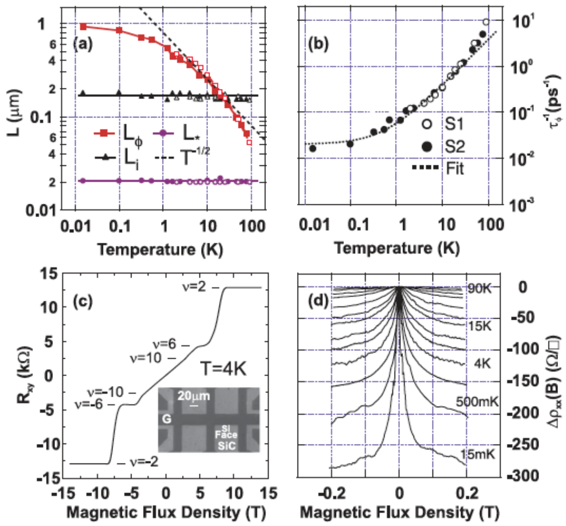

Figure caption

FIG. 1. Magnetotransport measurements in monolayer SiC/G. (a) Temperature dependence of the characteristic scattering lengths and (b) decoherence rate for samples **S**1 (open markers) and **S**2 (solid markers). (c) Half-integer QHE proving the monolayer nature of SiC/G. Inset: Micrograph of one of the devices. (d) Weak localization peak at different temperatures.