Magnetic Edges Current and Disorder in Graphene Nano-Ribbons

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The control of the current flow in graphene nanoribbons (GNRs) constitutes a fascinating challenge for the future of carbon-based electronic devices. However, non-perfect edges, bulk vacancies, charge trapped in the oxide or structural deformations are potential sources of backscattering. Their respective contribution remains debated and seems to be sample dependent.

This work presents compelling evidences of the 1D transport character in the first generation of chemically derived GNRs with smooth edges and the possibility of tuning backscattering effects by means of an external magnetic field [1]. Bandstructure calculations allow some assignment of the measured gate-dependent conductance modulations to the underlying van Hove singularities, and hence some estimation of the likely ribbon edge symmetry. The application of perpendicular high magnetic field on narrow ribbons, in the range of 11-30nm, further induces a marked enhancement of the conductance, irrespective of the applied gate voltage and in large contrast to the magneto-fingerprints of graphene flakes. Close to the charge neutrality point, the measured large positive magnetoconductance is attributed to the formation of the first Landau state, responsible for the closing of the energy gap and of a marked reduction of backscattering processes. Landauer-Buttiker conductance simulations convincingly support the scenario of an entangled interplay between the magnetic bands formation and a disorder-induced interband scattering suppression. Both smooth edge disorder and long range Coulomb scatters yield similar conclusions.

Finally, a comparative magneto-transport study between chemically derived GNRs and patterned GNR by oxygen plasma reactive ion etching will be addressed.

References

[1] J-M Poumirol et al., arXiv:1002.4571