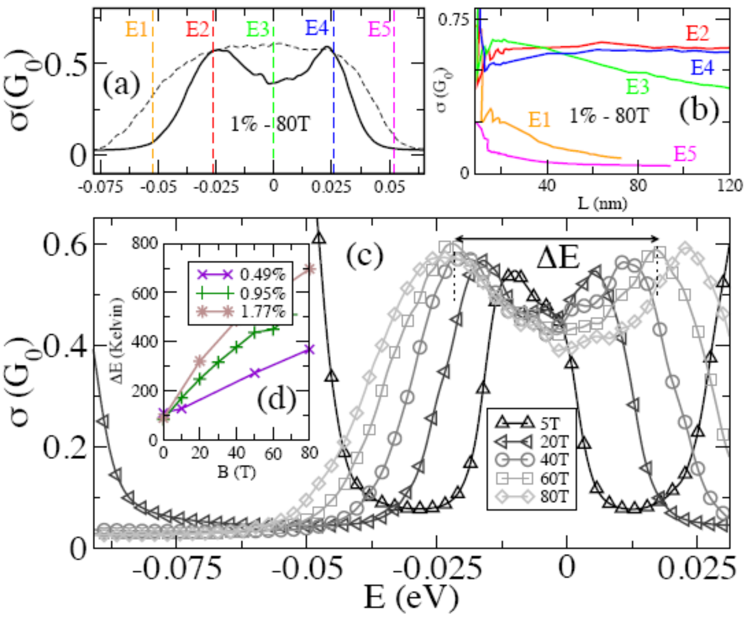
Quantum transport in chemically functionalized graphene at high magnetic field: Defect-Induced Critical States and Breakdown of Electron-Hole Symmetry

Nicolas Leconte,
Frank Ortmann,
Alessandro Cresti, Jean-Christophe Charlier and Stephan Roche

nicolas.leconte@icn.cat

ICN2 - Institut Catala de Nanociencia i Nanotecnologia, Campus UAB,
08193 Bellaterra (Barcelona) Spain

Unconventional magneto-transport fingerprints in the quantum Hall regime (with applied magnetic field rom one to several tens of Tesla) in chemically functionalized graphene are reported [1]. The scattering otential induced by the impurities is modeled by tight-binding parameters extracted from *ab initio* alculations [2], which, in turn, are used inside an efficient real space order *N* method [3] to calculate the issipative conductivity [4] under high field. Upon chemical adsorption of monoatomic oxygen (from 0.5% to few percents), the electron-hole symmetry of Landau levels is broken, while a double-peaked onductivity develops at low-energy, resulting from the formation of critical states conveyed by the andom network of defects-induced impurity states. Scaling analysis suggests an additional zero-energy uantized Hall conductance plateau, which is here not connected to degeneracy lifting of Landau levels y sublattice symmetry breakage. This singularly contrasts with usual interpretation, and unveils a new layground for tailoring the fundamental characteristics of the quantum Hall effect.



References

[1] N. Leconte, F. Ortmann, A. Cresti, J.-C. Charlier, and S. Roche, accepted in 2D Materials (2014)

[2] N. Leconte; A. Lherbier, F. Varchon, P. Ordejon, S. Roche, and J.-C. Charlier, Phys. Rev. B 84 2011) 235420; N. Leconte, J. Moser, P. Ordejon, H.H. Tao, A. Lherbier, A. Bachtold, F. Alsina, C.M.S. Torres, J.-C. Charlier, and S. Roche, ACS Nano 4 (2010) 4033

[3] H. Ishii, F. Triozon, N. Koboyashi, K. Hirose, and S. Roche, C.-R. Physique 10 (2009) 283

[4] D. Soriano, N. Leconte, P. Ordejon, J.-C. Charlier, J.J. Palacios, and S. Roche Phys. Rev. Lett. 107 (2011) 016602; N. Leconte, D. Soriano, S. Roche, P. Ordejon, J.-C. Charlier, and J.J. Palacios, ACS Nano 5 (2011) 3987