ELECTRONIC TRANSPORT IN NANOSTRUCTURED GRAPHENE

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Summary :

Graphene is a remarkable two-dimensional material.[1] While it is chemically inert, its electrical properties are very sensitive to adsorbed molecules. We propose to study how it is possible to alter the transport properties of graphene thanks to molecular layers, in the prospect of using the intrinsic properties of the molecules to controllably modulate the electrical transport properties of graphene. Two approaches are considered. The first is to create nanostructured graphene layers, offering maximum carbon atoms electronically unsaturated, and therefore more reactive. These structured, if properly patterned, can be seen as a network of conductive Coulomb islands, which very high if it enters into specific cotunneling transport regime (see our publications in Small [2] and Advanced Materials [3] in 2012). The other approach is to self-assemble ordered layers of molecules on the graphene surface, giving rise to a double-layer capable of providing new electrical transport properties (see for example reference [4]). If the molecules have a controllable switchable state, it should be possible to directly modify the graphene property while switching the molecular state.

This thesis will suit to a candidate interested in experimental work – nanofabrication in cleanroom environment[Cr], electrical and magnetic measurements - and having a good knowledge of solid state physics., The student will work in an international team, and will interact with several researcher and PhD students. This work is funded by 1 international grant.

[1] K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, Y. Zhang, S. V. Dubonos, I. V. Grigorieva, A. A. Firsov, Electric Field Effect in Atomically Thin Carbon Films, *Science*, **306**, 666 (2004).

[2] Pauly, M., Dayen, J.-F., Golubev, D., Beaufrand, J.-B., Pichon, B. P., Doudin, B. and Bégin-Colin, S., Co-tunneling Enhancement of the Electrical Response of Nanoparticle Networks. *Small*, **8,** 108–115 (2012).

[3] Dayen, J.-F., Devid, E., Kamalakar, M. V., Golubev, D., Guédon, C., Faramarzi, V., Doudin, B. and van der Molen, S. J. (2012), Enhancing the Molecular Signature in Molecule-Nanoparticle Networks Via Inelastic Cotunneling. *Advanced Materials*, doi: 10.1002/adma.20120155 (2012).

[4] Lucie Routaboul, Pierre Braunstein, Jie Xiao, Zhengzheng Zhang, Peter A. Dowben, Guillaume Dalmas, Victor Da Costa, Olivier Félix, Gero Decher, Luis G. Rosa, and Bernard Doudin, Altering the Static Dipole on Surfaces through Chemistry: Molecular Films of Zwitterionic Quinonoids, *JACS***, 134,** 8494 (2012).

[5] **S**alle blanche de Cronenbourg (cf : http://www-ipcms.u-strasbg.fr/spip.php?rubrique176).