CoRiGraph ANR project

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A major technological challenge is the finding of a new material for the post-silicon CMOS era. Graphene exhibits the excellent properties of carbon nanotubes (CNT), while not suffering from placing and scalability problems. Pristine CNTs are known to be ballistic conductors even at room temperature and to withstand high current densities. Graphene nanoribbons are predicted to have similar properties and are thus interesting for all-graphene circuitry. However most strategies involve the growth of extended graphene 2D sheets and subsequent graphene nano-patterning that degrades considerably the electronic mobility of nanopatterned graphene.

The CoRiGraph project focuses on graphene nanostructures produced by nonlithographic techniques on sidewall of pre-etched SiC steps silicon carbide. This technique takes full advantage of the single crystalline SiC substrate. It is scalable as already demonstrated by the fabrication of 10,000 transistors on a single chip. Nanoscopic ribbons have been shown to have remarkable properties. A gap is observed on the graphene ribbon edge and ballistic transport is demonstrated. This suggests smooth edges since disordered-related effects (localization, transport gap) are not observed. These ribbons may be the needed breakthrough in graphene electronics, opening the way for electronics based on ballistic transport and coherent effects, which cannot be realized with conventional semiconductors.

The primary goal of the CoRiGraph project is to study the atomic and electronic structure of graphene nanoribbons grown on SiC sidewalls, and compare them with lithographically etched ribbons. Metal contacts on graphene, a key issue to any device fabrication will be also studied. These questions will be addressed by a complementary set of experimental techniques (ARPES, STM/STS, STEM) and theoretical studies (quantum transport) put together in the consortium.

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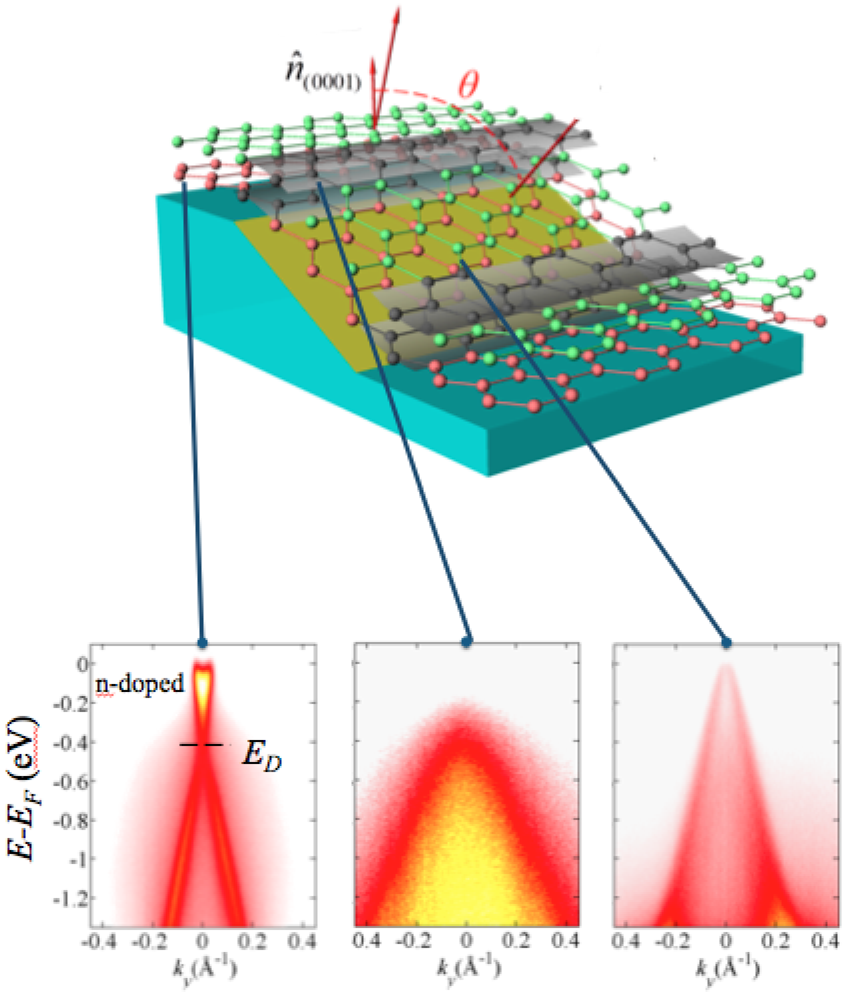
Highlight: **a metal-semiconducting-metal all graphene nanostructure on graphene sidewall ribbons**



Preliminary results on these ribbons are very promising. Photoemission has allowed us to observe that at the edge of these graphene strips, a semiconductor, is bonded to metallic graphene. This semiconductor is only a few nanometers wide (a few graphene lattice constants), a level of precision beyond modern lithographic limits.

To learn more:

« A wide band gap metal-semiconductor-metal nanostructure made entirely from graphene ».
J. Hicks, A. Tejeda, A. Taleb-Ibrahimi, M.S. Nevius, F. Wang, K. Shepperd, J. Palmer, F. Bertran, P. Le Fèvre, J. Kunc, W.A. de Heer, C. Berger, et E.H. Conrad.
Nature Physics 9, 49 (2012). Link to article.

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