2D MATERIALS FOR NANOELECTRONICS AND SINGLE-ELECTRON ELECTRONICS

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With graphene as a flagship, and more recently with discovery of semiconductor of few atoms thickness (such as MoS2, MoSe2), two dimensional ('2D') materials revealed as remarkable materials which may lead to electronics and spintronics revolution. This Master intership is motivated by two recent results obtained in our group.

IPCMS recently unveils [1] a surprising growth & oxidation mechanism responsible for the formation of self-ordered Al clusters *with similar sizes* (~6nm) embedded into alumina matrix over graphene ([fig.1.a]). While implementing this 2D-0D hybrid material as bottom electrode into large μm^2 tunnel junctions, we observed robust, reproducible and well-defined Coulomb blockade oscillations ([fig.1.b]), with high charging energy in the 100meV range. These CB signatures are preserved even for record junction area up to 100 μm^2 (with potentially up to 10^6 NC contacted) while they are usually observed on device limited to 100 nm^2 area! These new raise fundamental questions and open challenging prospects for the realization of single-electron devices. Moreover, IPCMS recently developed a new photodetector architecture allowing boosting by 7 orders of magnitude the photoresponse of nanocrystals.[2] We are interested in exploring this geometry for 2d semiconducting material.

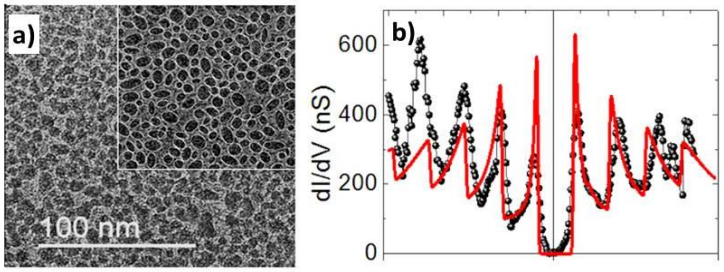

FIGURE 1.A) TEM IMAGE OF 2D-0D HYBRID DEVELOPPED AT IPCMS. B) COULOMB BLOCKADE OSCILLATIONS MEASURED ON LARGE AREA TUNNEL JUNCTION BASED ON 2D-0D HYBRIDS.

The candidate will work on the continuity of these discoveries, within the Nanodevice group of IPCMS. He will explore further the fabrication routes, and will explore novel devices concepts based on these materials. The student will develop skills in nanofabrication, nanoelectronics and low temperature magneto-transport measurements.

This Master 2 internship will suit to a candidate interested in experimental work, with a pronounced interest for nanofabrication in cleanroom environment [3], electrical and magnetic measurements, combined with a good knowledge of solid state physics. The student will work in an international team, and will interact with several researchers and PhD students.

Bibliography :

[1] Godel et al., submitted.
[2] Lhuillier et al., Nano Lett. 15, 1736 (2015).
[3] Salle blanche de Cronenbourg : http://www.ipcms.unistra.fr/?page_id=2317