ESONN' European School On Nanosciences and Nanotechnologies

# Practicals

**N°69: Ionic sensing with graphene-based field effect transistors**

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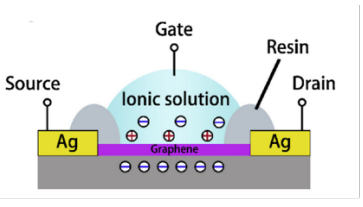
**Scientific objectives:**

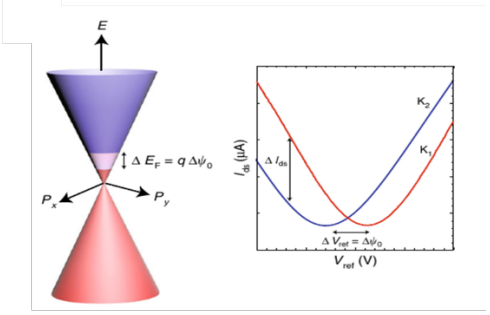
- Understand the operation of liquid-gated field effect transistors and the mechanisms involved during charge detection with graphene field-effect transistors (liquid-gated GFETs)
- Apply the liquid-gated GFETs to the detection of ionic and biological signals (neural cells, cardiomyocytes, proteins, DNAs, etc.).
- Training in GFET manufacturing techniques in a clean room (Access to clean rooms, SEM, fluorescence microscopy) and in bioelectronics.

**Course of the session**

- Microfabrication of graphene field effect transistors in clean room (laser lithography) and optical / SEM characterizations of monolayer graphene
- Measurement of the electronic properties of realized GFETs under a probe station. From the drain current-voltage $I_D$-$V_b$ and transfer curves $I_D$-$V_G$ and the Bode diagram Z(f), we will extract physical parameters of the GFETs such as resistivity, transductance, doping, double layer thickness electric etc.
- Application for ions detection: different solutions will be used (saline solution, DNAs, Proteins, pH)
- Discussion of the results, highlighting the different physical mechanisms involved at the graphene-fluid interface (formation and properties of a double electronic layer, adsorption/physisorption, electrostatic coupling, screening effect of surface dopants etc)
- Application to the detection of biological signals (neural, cardiac, EEG signals etc.)




Liquid-gated graphene field effect transistor




Change in surface potential leads to a direct shift in the graphene Fermi level and is translated to a shift in the GFET transfer curve.