Solution-gated graphene field effect transistors (SGFET) platform for investigation of the liquid environment influence

Adrien Hugo[1,2]
Valeria Toffoli[1,2], Julien Renard[3], Pascal Mailley[1,2], Vincent Bouchiat[3], Thomas Alava[1,2]

[1] *Univ. Grenoble Alpes, F-38000 Grenoble, France*
[2] *CEA, LETI, Minatec Campus, F-38054 Grenoble, France*
[3] *Institut Néel, Université Grenoble Alpes – CNRS:UPR 2940, F-38042 Grenoble, France.*

Adrien.HUGO@cea.fr

The ongoing growing demand for flexible biological sensors [1] calls for materials exhibiting great mechanical and electrical performance in liquid media. The outstanding properties of graphene [2,3] make it promising to tackle this challenge. In particular, graphene solution-gated field-effect transistors (SGFET) show higher sensitivities than more conventional silicon-based SGFET [4]. We report the fabrication and successful characterization of a SGFET platform with state-of-the-art electrical performances that can be used for assessing the liquid environment influence (ionic strength and pH) on SGFET devices in an unequivocal manner.

Graphene was grown by a pulsed CVD process [5]. The monolayer sheet was then deposited onto the Si/SiO2 (290nm) substrate by a PMMA-assisted transfer method. The metallic contacts were insulated from the liquid medium in which the device was immersed thanks to a PDMS coating. A commonly used Ag/AgCl reference electrode was used to apply a potential to the solution (**Figure 1**) and a bi-potentiostat, to polarize the source-drain channel, apply the gate voltage and simultaneously record the drain-source and leakage current.

The characteristic transfer curve of graphene FET was recorded (**Figure 2**). The current amplitude was found to be minimal for -0.1V corresponding to the Dirac point, with an amplitude modulation of a few µA.

As-fabricated transistors show electrical performances that match state-of the art SGFET devices previously reported. The behaviour of the as-fabricated SGFET devices is sufficiently robust and sensitive to properly study the influence of ionic strength and pH on SGFET performances. Experiments are now being conducted to investigate this point. Consequently we plan to use the fabricated SGFET to build sound and selective biological sensors.

References

[1] Hayward, J. et al., IDTechEx, 2016-2026: Market Forecasts, Technologies, Players (2016)
[2] Bolotin, K., et al., Solid State Communications (2008) 351-355
[3] Lee, C., et al., Science, (2008) 385-388
[4] Hess, L., et al., Proceedings of the IEEE (2013) 1780-1792
[5] Han, Z., et al., Advanced Functional Materials, (2013) 964-970

Figures

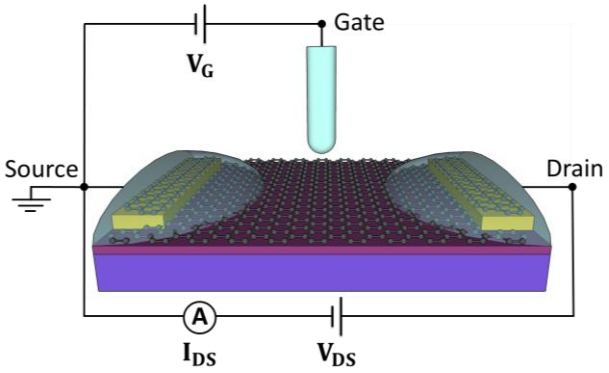

Figure 1: Experimental setup for electrical characterizations in liquid medium

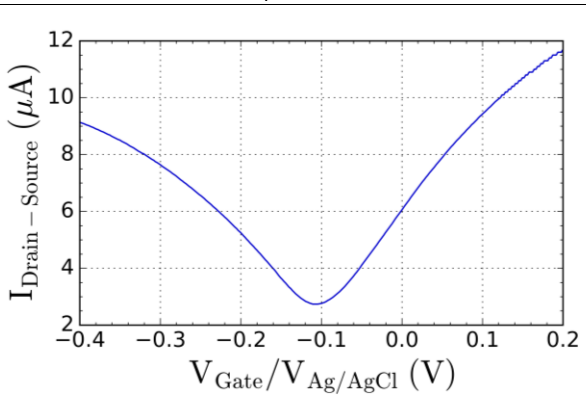

Figure 2: Measured transfer curve of the SGFET