Reduced graphene oxide transistors: towards wearable e-platforms

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Graphene related materials (GRMs) have already shown their great potential in many fields (opto-electronics, energy, composites etc.) [1]. Among the different GRMs, reduced graphene oxide (rGO) can be deposited as an ultra-thin film by drop casting, dip coating, rapid freezing spray coating and vacuum filtration. The implementation of rGO thin film into a transistor layout is recently attracting the interest of different scientists. The main reason resides on the rather straightforward fabrication of GO-based thin-film together with its high chemical reactivity. Although the rGO cannot electronically compete with graphene, the oxygenated groups (*e.g.* -OH, -COOH, -COC-) can be targeted by several click reactions. For instance, different (bio-)chemical sensors based on rGO transistors have been successfully demonstrated. DNA, urea and different metal cations have been efficiently detected [2]. These devices can afford the detection of these analytes directly in aqueous solution. In fact, these transistors exploit the liquid as the gate dielectric (see Fig.1) This particular configuration does not only enable low power electronic devices, but it allows one to track the electrical features of a liquid [3].

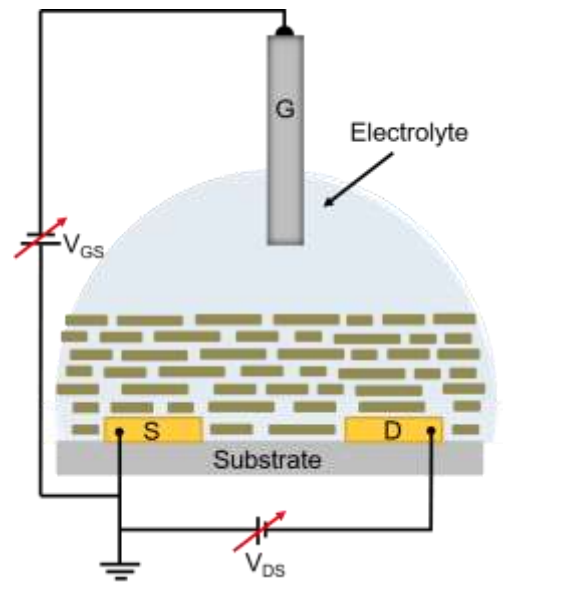

Figure 1: Liquid-gated transistor based on rGO

Here, it will be presented our recent activity on the development of an innovative protocol of fabrication of flexible liquid-gated transistors (LGTs). In particular, our main objective was the development of an approach, which can be easily scaled up and free of harmful chemicals. As a result, we exploited laser-scribing for the electrodes patterning onto PET foil, a total green deposition, patterning and reduction of the GO film, and finally the use of lateral flow paper for a smart and practical guidance of liquids onto the electronic device. We demonstrated the proof-of-concept of our technology by tracking bi-distilled water and synthetic sweat.

References

[1] Ferrari, A. C.; Bonaccorso, F.; Fal'ko, V.; Novoselov, K. S.; Roche, S.; Bøggild, P.; Borini, S.; Koppens, F. H. L.; Palermo, V.; Pugno, N.; et al. Science and Technology Roadmap for Graphene, Related Two-Dimensional Crystals, and Hybrid Systems. Nanoscale 2015, 7 (11), 4598–4810.

[2] Stine, R.; Robinson, J. T.; Sheehan, P. E.; Tamanaha, C. R. Real-Time DNA Detection Using Reduced Graphene Oxide Field Effect Transistors. Adv. Mater. 2010, 22 (46), 5297–5300.

[3] Kergoat, L.; Herlogsson, L.; Braga, D.; Piro, B.; Pham, M.-C. C.; Crispin, X.; Berggren, M.; Horowitz, G. A Water-Gate Organic Field-Effect Transistor. Adv. Mater. 2010, 22 (23), 2565–2569.