Graphene-Paper Electrodes as New Platforms for Amperometric Biosensing

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Graphene paper (G-paper) is a paper-like material possessing high flexibility and large surface area; it can be shaped in different geometries, featuring a high electrical conductivity (*ca.* 10^5 Sm^{-1}), tuneable surface chemistry and mechanical stability even after hundreds of thousands bending times [1]. We recently proposed the use of G-paper for the realization of electrochemical devices (named GPE) on flexible plastic and textile supports (Fig. 1) [2]. They were applied in the enzymatic detection of lactate in sweat, featuring higher selectivity with respect to commercial, carbon-based screen-printed electrodes (C-SPE and Gr-SPE); this performance is obtained thanks to the activation of electrocatalysis towards NADH oxidation, afforded by oxidized moieties naturally present on the electrode surface.

The properties of G-paper can be tuned by inclusion of various components in the material. In particular, we tested the electrocatalytic properties of G-Paper after the inclusion of graphene oxide (GO) to activate the electrochemical oxidation of H_2O_2, and those of electrode platforms after functionalization with Prussian blue for H_2O_2 reduction. This allowed us to expand the application spectrum of the G-paper based platforms toward the realization of wearable biosensors for the detection of various biomarkers. As an example, we will show the performance in the detection of glucose, using glucose oxidase as mediator on the electrode surface.

References

[1] A. Scidà et al., Materials Today 21 (2018), 223
[2] F. Poletti et al. Advanced Functional Materials 32 (2022), 2107941

Figures

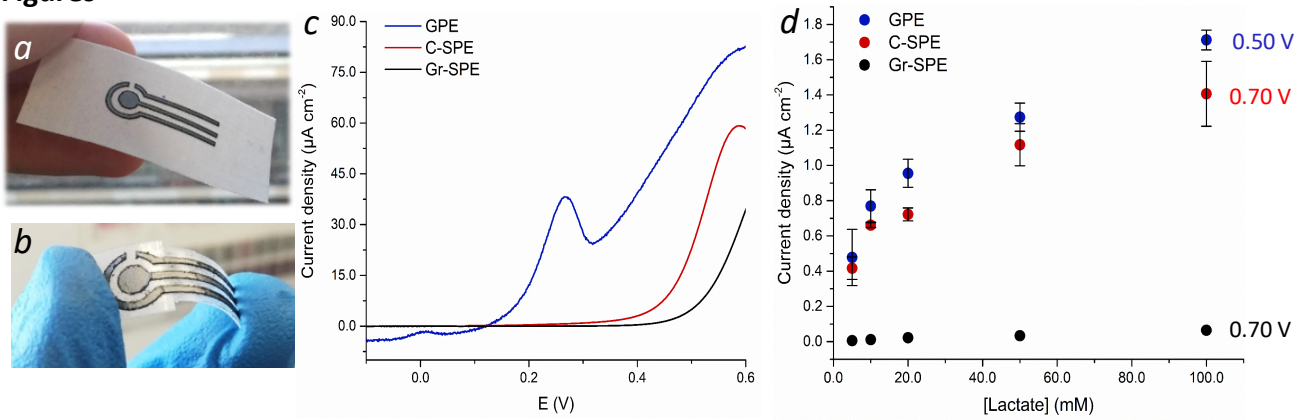

Figure 1: G-paper based electrodes on *a)* cotton and *b)* PET; *c)* Voltammetric signal (blue line) recorded at 1.0 mM NADH (0.1 M PBS, 0.1 M KCl) in comparison to commercial devices (red and black lines); *d)* calibration plot of lactate in sweat at GPE (blue dots) in comparison to commercial devices (the different potential chosen for these experiments reflects the voltametric behaviour shown in *c*).