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All-graphene flexible electrodes: novel platforms for wearable biosensing

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In recent years, the increasing request for a personalized approach to health and fitness goals is drawing research efforts on the development of wearable, non-invasive devices for continuous detection of biomarkers such as glucose, cholesterol, or lactate in sweat and in other biological fluids. Graphene and its related materials have attracted a growing interest in various field and are increasingly exploited in electrochemical (bio)sensing thanks to their unique properties [1,2]. In particular, graphene paper (G-paper) is a flexible, electrically conductive, paper-like material which has a large surface area and can be shaped in different ways; it features a high electrical conductivity ($1x10^5$ Sm^{-1}), mechanical and chemical stability even after one billion bending times [3]. We report the advantages in the use of G-paper for the realization of electrodes on flexible plastic and textile supports, as well as their application as wearable (bio)sensing platforms (Figure 1). A comparison with commercial graphite electrodes demonstrates that our novel devices outperform them in sensing of nicotinamide adenine dinucleotide (NADH), a key molecule for enzymatic biosensing. The possibility to functionalize the surface of our electrodes by stably anchoring suitable enzymes and redox mediators, or even to modify pristine G-paper with proper amount of graphene oxide to tune its properties, allows the realization of a wide plethora of flexible electrochemical biosensors. As an example of application of this new sensor platform, we report the stable deposition of lactate dehydrogenase for enzymatic detection of lactate.

References

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Figures

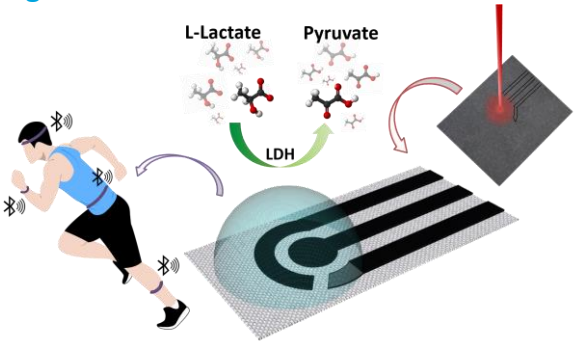

Figure 1: Exemplificative preparation of G-paper platform on cotton textile and its application for lactate detection during training.