Monolayer Graphene on polymer as a material for combining therapy and diagnostic in-vivo: from basic science to medical applications

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After a more than a decade and tens of thousands of publications, graphene produced by chemical vapour deposition on copper foils still remain at the sweet spot regarding cost, speed and quality for large scale production of monolayers on insulators. I will briefly recall the principle of these technique and then present the use of this technology for biological (1) and medical applications from both the academic and industrial point of view. In particular, I will be insisting on the possibility to combine therapeutics (biostimulation, such as stimulated wound healing) and diagnostics (biosensing) features in the same device and using graphene on polymer as the unique material.

To explore more that possibility, I will show results of in-vitro cellular growth (neurons and skin fibroblasts) on graphene-covered glass which shows the stimulation of growth (1) and migration of cells promoted by the graphene substrate together with the possibility of probing their activity (2,3) down to the sub-cellular scale (2) . I will present the preclinical results on animal studies and the perspectives of their commercial use (4) for wound-care, in particular the treatment and diagnostics of chronic wounds (5) that affect the diabetics and elderly.
I will also present more recent works on the realization of in vitro diagnostics based on the same material (6,7) . we are developing a concept of an electronic strip based on a new material for medicine, graphene, whose maturity finally allows its introduction on an industrial scale. The implementation of synthesis techniques of this material from microelectronics allows to produce it in mass at low cost. These sensors powered by a simple smartphone will be coupled with a digital monitoring solution via the smartphone that will improve the diagnosis in the field and the monitoring of chronic diseases. I will detail the functioning of the testNpass (figure 1) , for the detection of the SARS-CoV-2 virus, in particular the process of conversion of the biochemical signal into an electrical signal. Finally, I will show that a myriad of other use cases of this technology exists beyond the detection of pathogens in the field.

References

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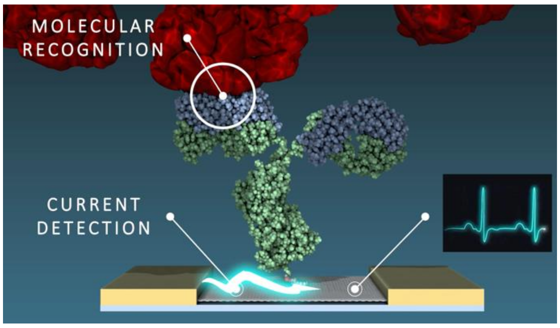

Figure 1. Detection principle of graphene Field effect transistor coated with a monolayer of antibodies. The biomolecular affinity with an antigen is influencing the local charge on the graphene surface which changes its global electrical conductance .

Figure 2. Graphene biosensors printed on polymer .