Graphene Nanostructures Integration in Nanophotonic Biosensors

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Biosensors are profiled as next-generation diagnostics devices, offering point-of-care rapid testing with excellent performance. Among them, the Bimodal Waveguide (BiMW) interferometric biosensor has demonstrated outstanding sensitivities, multiplexing capabilities, and high potential for integration in compact and user-friendly devices [1]. One of the major challenges in the advance of biosensor technology is the reproducible biofunctionalization of the sensing area. The lack of precise control during the arrangement of the biorecognition interface severely limits the detection selectivity and reliability of actual devices, hampering the mass-production and implementation in the clinical field. By proposing an advanced method to produce functionalized graphene nanostructures with atomic precision, we aim to develop a universal sensor biofunctionalization protocol, which will facilitate a biorecognition molecular template control at the nanometer scale.

Here, we combine the possibility to functionalize graphene building blocks with atomic precision via a bottom-up synthesis approach to support the production of different graphene nanoarchitectures (i.e., graphene nanoribbons and nanoporous graphene) containing selective anchoring groups such as amine, carboxyl and epoxy groups. The quality of the functionalized graphene template is dictated by the on-surface synthesis approach carried out in UHV conditions [2]. Additionally, the graphene successful integration on the BiMW biosensor is obtained by a direct transfer to preserve the stability of the graphene under flow conditions. Finally, as a proof of concept, nucleic acids biomarkers will be detected applying a universal biofunctionalization protocol for the early, non-invasive diagnostic of melanoma cancer.

REFERENCES

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(2) C. Moreno et al., Science, 360, (2018) 199 – 203

FIGURES

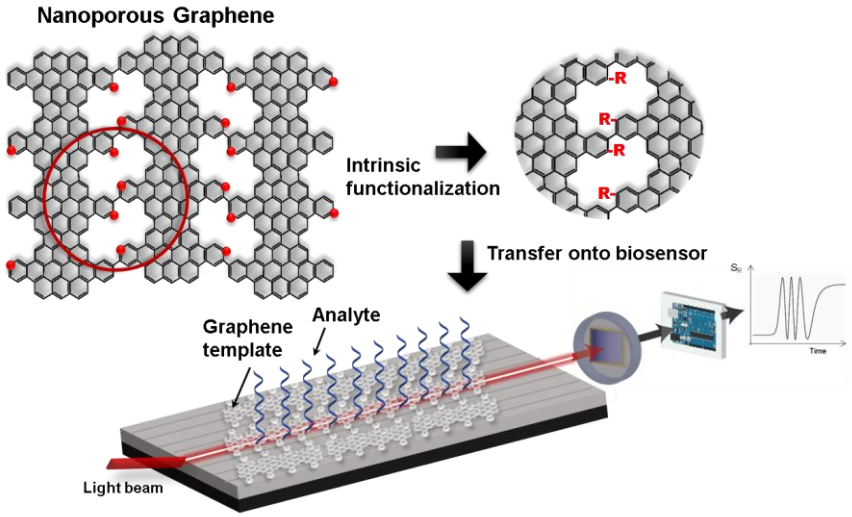

Figure 1: Nanoporous graphene (NPG) template presents the functional groups arranged in the porous sites. At the biosensor area the DNA analyte is monitored while bonding to the graphene template.