LEGOCHIP: Multifunctional Nanoporous Graphene Integration in Operational Nanophotonic Biosensor Devices

Main area: Sensors from GRMs and their heterostructures
Keywords: nanoporous graphene; nanophotonic sensor; surface functionalization; filtration membrane; cancer diagnostics; bottom-up synthesis
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Abstract

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 formation 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 a disruptive concept to manufacture functionalized nanoporous graphene (NPG) architectures with atomic precision, LEGOCHIP will face the challenge to develop a universal sensor biofunctionalization protocol. Beyond its universal character, the protocol will facilitate a bio-recognition molecular patterning control in the nanometer scale. Taking advantage of the unimodal pore size distribution in our graphene sheet, we also aim at significantly enhancing the sample pre-treatment by designing highly selective single-layer graphene membranes for advanced filtration of biological samples (blood, plasma, and serum).

LEGOCHIP, by integrating the novel multifunctional NPG into cutting-edge photonic sensing nanotechnology (bimodal waveguide (BiMW) interferometers), is thereby foreseen as a key innovation to boost the implementation and technological transfer of biosensor devices to the clinical field. Operational biosensor devices will be fabricated, tested, and validated for the direct detection and label-free analysis of novel microRNA biomarkers in clinical samples for the early diagnosis of melanoma (i.e., skin cancer) and continuous monitoring of high-risk patients.

The nanostructuration and covalent functionalization, the fabrication of single layer membranes, and the realization of biosensors for early diagnostics are independently identified as central milestones in different WPs of the Graphene Flagship. LEGOCHIP targets each of these challenges within an integral scheme by putting together a transversal Consortium that bridges fundamental research at the atomic scale with technology with a level of readiness over 6. By integrating the nanoporous graphene recently developed by the Consortium into pioneering nanophotonic interferometric devices, we aim at realizing a new lab-on-a-chip biosensor to be positioned well beyond the state of the art. Further, the LEGOCHIP system is foreseen as a general-purpose toolkit, which could be easily adapted and implemented for other purposes, such as basic biology studies or environmental monitoring. The strong multidisciplinary component of this project, together with the collaborations and partnerships that will be fostered, will contribute to a groundbreaking progress in different scientific areas, including materials sciences, nanophotonics, chemistry and biochemistry, and clinical oncology.

Consortium

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