Graphene functionalization with SARS-CoV-2 antibodies

Sofiya Zorina
Víctor Jesús Gómez Hernández, Alejandro José Martínez Abietar, Elena Pinilla Cienfuegos*

Nanophotonics Technology Center, Universitat Politècnica de València, Camino de Vera, s/n, 46022 Valencia Spain

*epinilla@ntc.upv.es

Current situation of COVID-19 demands a rapid, reliable, cost-effective, facile detection strategy to break the transmission chain and biosensors have emerged as a feasible solution for this purpose. Among the existing variety of biosensors, photonic biosensors allow real-time detection of infinitesimal quantities (even isolated molecules) of a great variety of biochemical substances, since they measure instantaneous changes in the optical properties of matter. Generally, photonic biosensors are composed by two parts: the photonic part, which is responsible for transducing a biochemical change into a change in the optical response; and the chemical part, a molecular recognition element that ensures that only the targeted analyte adheres to the biosensor and provokes the optical change. In this context, Graphene has demonstrated its potential in the rapid detection of SARS-CoV-2 by its integration in a FET-based biosensor [1].
In this work we have developed a faster, less toxic, and a cost-effective functionalization of graphene with PBASE (- 1-pyrenebutyric acid N-hydroxysuccinimide ester), which is a key molecule to immobilize SARS-CoV-2 spike antibodies onto graphene surfaces (Figure 1a). The PBASE functionalization as well as the SARS-CoV-2 antibody immobilization has been probed in Graphene layers and flakes prepared by means of plasma enhanced chemical vapour deposition and the scotch-tape method. Atomic force microscopy together with Raman spectroscopy confirm all the functionalization steps (Figure 1b).

This demonstration would mean the viability of the chemical part of a graphene-based photonic biosensor for ultra-rapid detection of minimal amounts of the SARS-CoV-2 virus in nano-pharyngeal fluid through the integration of functionalized graphene in a low-cost plasmonic metamaterial photonic biosensor that can be manufactured on a large scale.

References

[1] Seo, G., Lee, G., Kim, M.J., et al. ACS nano, 4 (2020), 5135–5142.

Figures

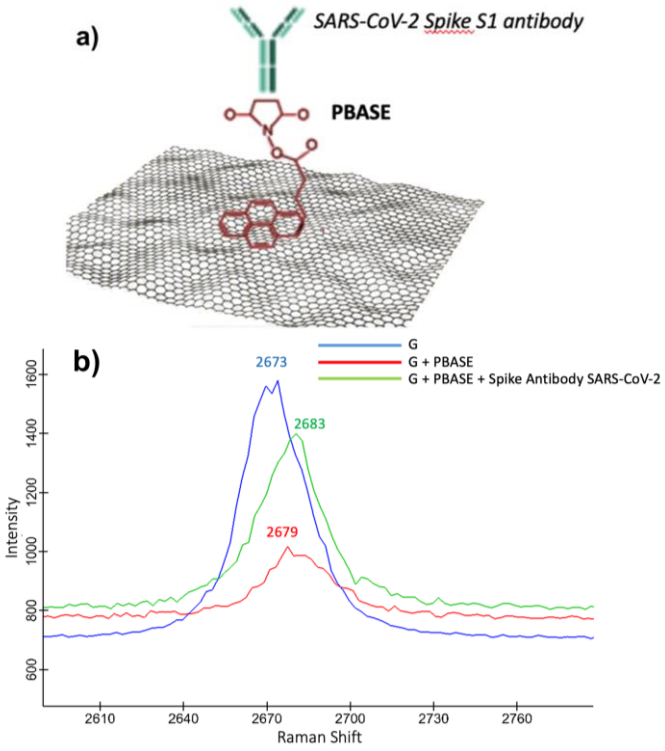

Figure 1: a) Schematic representation of the graphene sheet functionalized with PBASE and SARS-CoV-2 spike antibodies; b) Raman spectra of bare graphene, functionalized with PBASE and with PBASE and SARS-CoV-2 spike antibodies.