Nanophotonics biosensor platforms for ultrasensitive biological analysis

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COVID-19 pandemics has evidenced the urgent need of having portable diagnostic tools that enable rapid testing and screening of the population with sensitivity and specificity levels comparable to laboratory techniques. Biosensor technology is one of the best prepared to tackle the challenging goal of offering fast and user-friendly diagnostics tests than can be employed at the point-of-need. Photonic biosensors are systems that seize different light-based phenomena for the fast detection and quantification of substances. Specifically, nanophotonic biosensors based on evanescent wave detection can provide sensitive, reliable, and selective analysis, while reducing test and therapeutic turnaround times, decreasing and/or eliminating sample transport, and using low sample volume.

In our group, we have demonstrated cutting-edge nanophotonic biosensors based on Nanoplasmonics and on Silicon photonics technologies that enable ultrasensitive analysis of body fluids in a few minutes. By custom tailoring the biochemistry of the sensor biochips, our nanophotonic biosensor technology can perform direct detection of proteins, genetic biomarkers, or pathogens within <15 min, with high sensitivity and selectivity. The diagnostic potential has been demonstrated and validated among others, for the drug monitoring of anticoagulants in plasma, antibiotic allergy diagnosis in plasma, early cancer diagnosis (colorectal and lung cancer) and bacterial, and viral infectious diseases. During COVID-19 pandemic, our nanophotonics biosensor has been fully validated with hundreds of clinical samples for the direct detection of anti-SARS-CoV-2 immunoglobulins in COVID-19 patients, confirming excellent diagnostic performance.