279 Nanophotonic lab-on-chip biosensors for point-of-care diagnostics: from concept to real applications

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The dream of having a device in the palm of our hand able to deliver an instant diagnostics of our health status could become a reality soon thanks to the last advances in nanomedicine, nanobiosensors and lab-on-a-chip which promise to surpass the existing challenges, opening the door to a global health access. Such point-of-care (POC) diagnostic tools could afford the identification of any disease (as cancer) or any alteration in our cellular pathways at the earliest stage possible in a fast, simple and cost-effective way.

Nanophotonic biosensors (mainly those based on nanoplasmonics and silicon photonics) have revealed themselves as promising candidates for achieving truly point-of-care devices. Advantages as miniaturization, sensitivities clinically relevant, integration capabilities, reliability, and potential for multiplexing can be offered by these nanophotonic technologies [1].

The main objective of our research is to achieve such ultrasensitive platform for POC label-free analysis accomplishing the requirements of disposability and portability. Figure 1 shows a scheme of the POC platform we envisioned as our main goal. The platform includes nanophotonic biosensors integrated with microfluidics (see Fig. 2), diffractive nanogratings for incoupling in the sub-micron channels, custom-designed read-out methods (as photodetectors or CCD), data acquisition and processing electronics. The nanophotonic sensors are based on novel nanophotonic bimodal interferometric waveguides *(patents granted)* [2] based on silicon technology which have, as main characteristic, an extreme sensitivity.

Noticeably, we have implemented a first POC laboratory prototype which allows the label-free detection of biomolecular interactions with extreme sensitivity [3]. Most relevant, we have recently

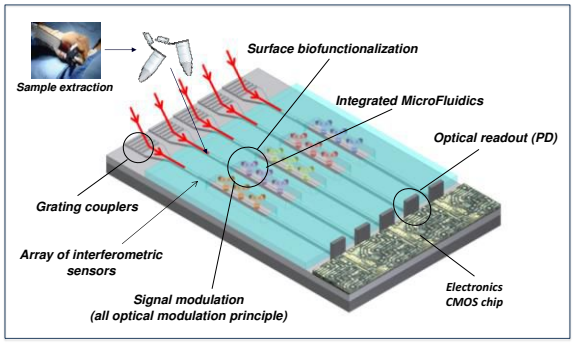

Figure 1. Scheme of the LOC platform based on nanophotonic interferometric sensors

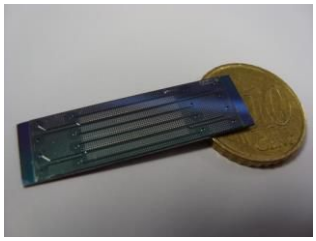

Figure 1. Photograph of one chip containing 16 nanophotonic sensors integrated with a polymer microfluidics network.

demonstrated its ability to directly detect human hormones at physiological levels in human fluids (below 0.1 pg/mL) or microorganisms (at very few cfu/mL) through the immunointeraction with their specific antibodies.

References

[1] M.C. Estevez, M. Álvarez and L. M. Lechuga. Laser & Photonics Reviews, **6** (4), 463 (2012)

[2]EP2278365;PCTES08070142;US20110102777

[3] D. Duval et al. Lab on chip **12** (11) 1987 (2012).