Nanophotonic lab-on-chip biosensors for the next diagnostics generation

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Modern healthcare is demanding novel diagnostic tools that could enable quick, accurate, reliable, and cost-effective results so that appropriate treatments can be implemented in time, leading to improved clinical outcome. Such hand-held point-of-care (POC) devices, able to deliver an instant diagnostics of our health status at home, at doctor's office, at bed side or at resource-limited settings, could become a reality soon thanks to the last advances in nanobiosensors, lab-on-a-chip, wireless and smart-phone technologies which promise to surpass the existing challenges, opening the door to a global health access. Remarkable progress towards POC systems appears continuously in the scientific literature as for example POC technologies coupled to smart-phones, Google glass or paper-based biosensors. However there is still a lack of commercial POC devices as general diagnostic tools due to the many technical challenges to be overcome.

The driving force of our research is to achieve such ultrasensitive platforms for POC label-free analysis accomplishing the requirements of disposability and portability. We are using an innovative design of a nanophotonic biosensor fabricated with silicon photonics technology (an heteromodal nanointerferometer). Full lab-on-chip integration is pursued by incorporating grating couplers for light coupling, independent microfluidics for each sensing channel, photodetectors for the read-out nd signal processing. Advantages as miniaturization, sensitivities clinically relevant, robustness, reliability, potential for multiplexing and mass production at low cost can be offered by our nanodevices.

We have demonstrated the suitability of our lab-on-chip photonic biosensor for the clinical diagnostics with extremely sensitivity, directly using untreated human samples, as for the evaluation of hormones related to endocrine disorders and tumours (below 0.1 pg/ml), the detection of infectious microorganisms (at few cfu/ml) or the detection of microRNA biomarkers related to cancer progression, among others.

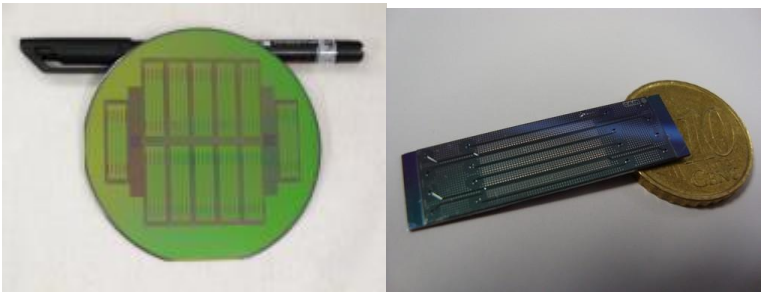

Fig. 1. *(right)* wafer containing nanophotonic biosensors. *(left)* LOC device containing 16 nanophotonic
waveguide sensors integrated with a polymer microfluidics network.