

Label-free nanophotonic biosensors as integrated solution for early and rapid diagnostics

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Abstract

Photonic biosensors have emerged as a promising alternative for medical diagnostics, offering a versatile technology for rapid and sensitive analysis of biomarkers in a label-free format and integrated in point-of-care (POC) devices. Especially those based on nanoplasmonics and silicon photonics have demonstrated an exceptional potential for tackling current challenges in POC testing, thanks to their unique robustness and reliability, high sensitivity, and simple adaptation to a large variety of targets, including proteins, nucleic acids, cells, or pathogens. Our research aims to provide novel nanophotonic biosensors for clinical diagnostics and biomedical studies. We focus on two main technologies: Surface Plasmon Resonance (SPR) biosensors, and its derivatives in nanoplasmonics, and a pioneering silicon nanophotonic interferometer, the Bimodal Waveguide (BiMW) biosensor. Our work involves the whole process in biosensor production, from design and nanofabrication until the final validation in real clinical scenarios. We have demonstrated successful applications for early cancer diagnostics, gluten-free diet and anticoagulant treatment monitoring, for genomic and epigenomic cell regulation studies, and for infectious pathogen detection. Since March 2020, we are leading a large research project for implementing nanophotonic biosensors as a tool for COVID-19 diagnostics. In this presentation, I will give an overview of our most recent work and the latest advances in photonic biosensor development for medical diagnosis, including sensor design and POC integration, surface biofunctionalization strategies, and label-free bioassay approaches that will enable a reliable implementation in the clinical practice.

Bio

Dr. Maria Soler received her PhD in Biochemistry and Biomedicine in 2015, under the supervision of Prof. Laura M. Lechuga from the Catalan Institute of Nanoscience and Nanotechnology (ICN2, Barcelona, Spain). Her PhD dissertation focused on the development of nanoplasmonic biosensors for clinical point-of-care diagnostics, and it was recognized with the Extraordinary Doctorate Award (UAB) and the Pioner 2015 Award, granted to thesis with special interest in technology transfer and commercialization. Then, Dr. Soler moved to the Ecole Polytechnique Federale de Lausanne (EPFL) for a postdoctoral stage in the laboratory of Prof. Hatice Altug (2015-2018). During this time, she was in charge of the bioanalytical applications research line, working in groundbreaking projects for the application of nanoplasmonic biosensors for single-cell activity monitoring. In 2018, Dr. Soler returned to Spain, where she is working as a Senior Researcher at the ICN2. Currently, she is leading a brand-new research line for developing novel nanophotonic sensors for biomedical studies and personalized therapy applications.