Plasmonic nanoparticles-based architectures for immunosensing and gene sensing

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To successfully tackle future challenges, such as the spreading of infectious diseases and antimicrobial resistance, a "one health" approach is now essential. Accordingly, detailed monitoring of natural resources' quality and fast and sensitive diagnostic tools to recognize and manage infectious diseases are crucial strategies to be pursued.

Among the detection methods, biosensors are gaining relevance. Plasmonic nanoparticles (PNPs) are multifunctional optical transducers for biosensing thanks to the Localized Surface Plasmon Resonance (LSPR) phenomenon. It occurs when electromagnetic radiation of a suitable frequency impinges the PNPs causing the collective oscillation of electrons in resonance with the incident light. For PNPs, the resonance frequency lies in the visible or near-infrared wavelength range, thus allowing us to monitor the LSPR phenomenon by UV-Visible absorption spectroscopy. A change in the refractive index of the surrounding medium produces a variation in the LSPR wavelength. Consequently, PNPs are optimal building blocks for fabricating optical components for biosensing. The present contribution shows the investigation of PNP-based nanoplatforms in three different nanostructured architectures.

Firstly, a gold nanorods (AuNRs) array on an ITO substrate is used to fabricate an immunosensor to quantify *Escherichia coli* cells in water. Secondly, the same AuNRs array, after a suitable biofunctionalization, is exploited for developing a gene biosensor. The third configuration consists of organizing silver nanocubes on a gold layer, resulting in a metasurface that, once bioactivated, can detect pathogens. Remarkably using PNPs provides access to thermoplasmonic heating, endowing the realization of reusable biosensors.