Plasmonic Metal Nanoparticles: A tool for molecular and Bio detection

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Optical detection methods that take profit of the unique properties of metallic nanoparticles have become increasingly important in many fields of application, from biosensors to security and environmental monitoring, due their ease of application and comparative low cost. The interaction of light with metallic nanoparticles induces the formation of dipolar localized surface plasmon resonances (LSPR) – the resonant excitation of the delocalized free electrons within the nanoparticles. This LSPR can result in a strong absorption band in the visible frequency range, and strong electromagnetic fields at the particle surface that polarise the local volume around the nanoparticle inducing light scattering. The type, size and shape of the metallic nanoparticles determine the wavelength of the optical absorption and the scattering cross-section influencing their applicability. By fine tuning these parameters, Au nanoparticles have been successfully implemented for the detection of DNA, in a microfluidic setup, enabling significant discrimination between positive and negative assays using a target DNA concentration of 5 ng/µL, below the limit of detection of the conventionally used microplate reader (i.e., 15 ng/µL) with 10 times lower solution volume (i.e., 3µL). Also, Ag nanoparticles have been successfully applied in the fabrication of low cost plasmonic surface platforms for Surface Enhanced Raman Spectroscopy using physical self-assembled and chemical synthesis methods in rigid (glass and silicon) and flexible (paper) substrates. With these platforms we were able to detect rhodamine 6G (R6G) in the sub ppb range, opening the applicability of these substrates to the detection of chemical substances such as food toxins, pesticides and explosives.