Gold nanorod for LSPR based biosensors

Ilaria Mannelli[1,2], J.-Pablo Salvador[2,1], M.-Pilar Marco[1,2]

[1]Applied Molecular Receptors Group (AMRg), Institute for Advanced Chemistry of Catalonia (IQAC) of the Spanish Council for Scietific Research (CSIC)
[2]Centro de Investigación Biomédica en Red en Bioingeniería, Biomateriales y Nanomedicina (CIBER BBN)
c/Jordi Girona, 18-26 - 08034-Barcelona (Spain)
ilaria.mannelli@iqac.csic.es

Noble metal nanoparticles have attracted great attention due to their unique optical properties, in particular the localized surface plasmon resonance (LSPR). Because of the LSPR phenomenon, the nanoparticle extinction spectrum is affected by the particle size and shape as well as the constituting material and the surrounding dielectric media. Nanorods are an extreme case of anisometric nanoparticles that typically display two plasmon resonance peaks: transversal, fixed at around 530 nm, and longitudinal that changes with the GNR aspect ratio and exhibit a high sensitivity to refractive index changes [1]. Several analytical and bioanalysis applications, in which the nanorod optical properties are exploited, have been presented in the last years. Within them, various LSPR based biosensor formats have been proposed. The identification of an analyte could be accomplished by recording the shift of the LSPR peak. A specific bioreceptor is immobilised on the nanoparticle surface and the analyte/receptor biomolecular interaction modifies the dielectric properties of the surrounding medium, with consequent changes in the resonance peak.

In view of this, a study for the development of an immunosensor for anabolic androgenic steroids (AAS) based on the use of gold nanorods has been performed. In recent years the assumption of dietetic supplements and drugs is drastically increased because of current social and cultural habits. Most of these substances are included in the list of prohibited compounds of the World Anti-Doping Agency and within them the AAS. A World Anti-Doping Code has been drawn up in order to coordinate effective anti-doping programs [2]. In this context, the demand of new rapid, efficient and throughput detection systems is always present.

In this work, first, a surface chemistry for conjugating antibodies specific for AAS to gold nanorods has been optimized and the obtained bioconjugates have been characterized. Moreover, the analytical performances of the bioconjugates are under evaluation in a capture competitive sensor format, in which the competitors are directly immobilised onto the sensor surface and the antigen-antibody recognition took place when the specific antibodies labeled with gold nanorods were introduced (Figure 1). Preliminary results demonstrated that the detection signal is due to the appearance of a plasmon peak only where specific antigen/antibody interaction occurs and that it is related to the different amounts of nanorods interacting with the surface.

In future, the identification of several prohibited substances can be accomplished by using bioconjugate nanoparticles differing in shape and size (label-encoded microarray) or by the location in the microarray (site-encoded microarray).

References

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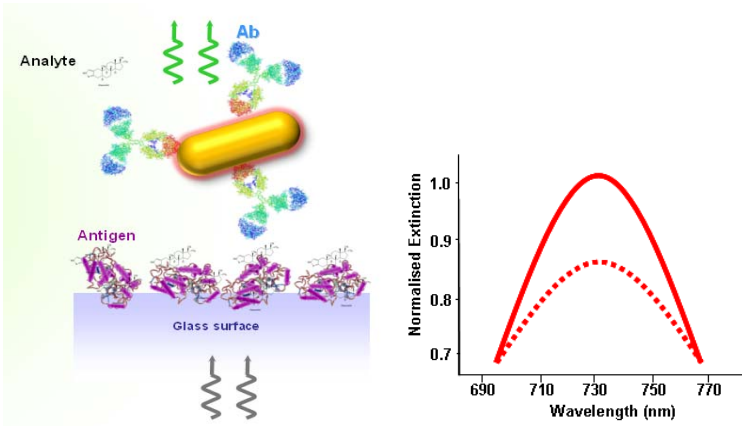

Figure 1

Gold nanorods addition over functionalized surface produces a change in the intensity of the plasmon peak.