NANOCOMPOSITE PLASMONIC SENSORS FOR BIOMEDICAL APPLICATIONS

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We analyze absorption spectra of spherical gold nanoparticles embedded in polyethylene glycol diacrylate. The designed wearable platforms could detect specific target analytes in localized surface plasmon resonance and fluorescence modes, in order to obtain a dual-mode sensor.
Keywords: plasmonic biosensors

1. Introduction

The scientific community has been giving an increasing interest to the wide applications of Localized Surface Plasmon Resonance (LSPR) based biosensors, which provide unique advantages compared to other sensing technologies. These benefits include single-molecule sensitivity and the possibility to scale down the whole detection setup, this being crucial while realizing point-of-care (POC) diagnostic tools. LSPR biosensors are based on the presence of nanostructures, whose dimensions are much smaller than the wavelength of the light used for their excitation. We propose an optical platform based on bottom-up chemically synthetized spherical gold nanoparticles (Au-NPs) embedded in Poly-(ethylene glycol) diacrylate (PEGDA). As a hydrogel, PEGDA represents a biocompatible, flexible, transparent material that can be used as a substrate for creating wearable, 3D, plasmonic biosensors [1]. The optimization of the LSPR response of such device could be coupled with another well-known phenomenon: the Plasmon-Enhanced Fluorescence (PEF), obtaining a dual-mode diagnostic tool for performing Immunometric immunoassays [2] for the detection of cancer biomarkers, immunoglobulins, viruses and toxins. Au-NPs/PEGDA platforms can be used to achieve continuous and in-vivo monitoring of the physiological responses to specific therapies.

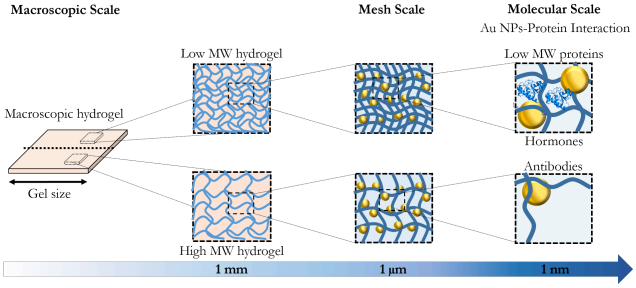

Fig. 1 PEGDA/AuNPs Nanocomposites targeting principle.

2. Fabrication and Optical Characterization

To obtain a flexible system, we embed Au-NPs in PEGDA (MW=700 Da). It is possible to tune the performance of the flexible sensor by varying the PEGDA hydrogel mesh size, as well the concentration of the AuNPs (Fig.1). Colloidal Au-NPs were prepared with a bottom-up approach, stabilized with Citrate (Seed and Growth synthesis [3]), and then embedded into/onto PEGDA (polymerized through UV-light exposure). The fabrication process scheme is reported in Fig. 2.

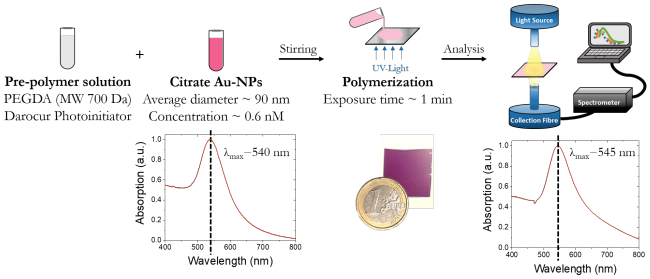

Fig. 2 Nanofabrication and Characterization of PEGDA/Au-NPs nanocomposites.

The optical characterization of the realized sensors is performed through a custom-made transmission mode setup, measuring the absorption, the sensitivity and the performance parameters of the sensor. Finally, Biotin was covalently immobilized onto the Au-NPs and successfully detected via LSP resonance red shift.

3. Discussion and Conclusions

The optical characterization of these novel nanocomposite materials shows very promising results. In fact, we obtained a large-scale, cost-effective and flexible material and we successfully detected Biotin conjugation. Next step will be the coupling of the functionalized plasmonic sensor with a specific labelled target, to exploit Plasmon-Enhanced Fluorescence.

References

1. Rebelo, R., Barbosa, A. I., Caballero, D. et al., *Biosensors and Bioelectronics*, **130**, 20-39, (2019).
2. D. Wild and E. Kodak, *The Immunoassay Handbook*, (2013).
3. Bastùs N. G., Comenge J., and Puntes V, *Langmuir*. **27**, 11098–11105 (2011).