Photonic sensors based on molecular gates and plasmonic structures

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Abstract

Biological sensors have been applied in a wide range of applications such as food safety control, medical diagnostics, environmental control or drug discovery. A biosensor consists of a recognition element used to interact with a specific target and a transducer (in our case an optical transducer based on index and colour intensity changes) that can convert this interaction into a quantifiable signal.

This paper presents the development of a low-cost and compact biosensing device. The proposed system combines the advantages of gated porous materials and localized surface plasmons resonances (LSPR). Firstly, arrays of gold nanoparticles are fabricated by e-beam lithography and lift-off process on a glass or silicon substrate in order to create LSPR structure. After that, a porous silica film is dip-coated by a surfactant template method on the LPSR structures. Finally, molecular gates are attached to the porous support: they are capable of being 'opened' or 'closed' when certain external stimuli are applied allowing the release of previously entrapped cargo (colored or fluorescent materials) in the porous. [1].The sensing scheme in Fig 1 is based on detecting the change of color/fluorescence of the device. For this purpose, Rhodamine B was introduced in the porous substrate. The pores were grafted with a suitable hapten able to recognize antibodies prepared for the recognition of finasteride, capping the pores and inhibiting dye release. Fig. 2 shows the shift of the resonance of the plasmonic structure when surrounding environment indices change due to the colorant realizing. Sensitivity values of 500-800 nm per refractive index unit has been obtained by using plasmonic dimers resonant structures, which give rise to very large field enhancement in their gap region [2] [3].

References

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Figures

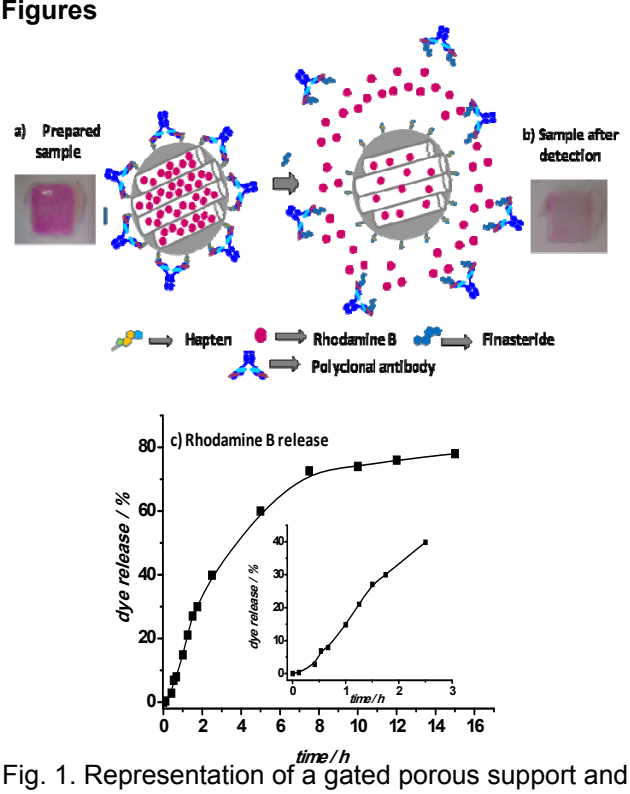

Fig. 1. Representation of a gated porous support and its behavior for finesteride sensing.

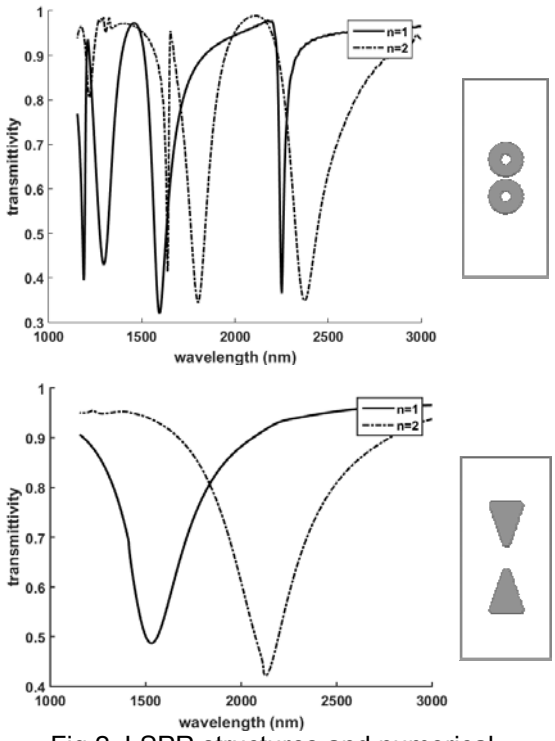

Fig 2. LSPR structures and numerical simulations of the transmission spectra for different surrounding medium indices.