

## Biosensing and controlled interaction with cellular systems via structured interfaces

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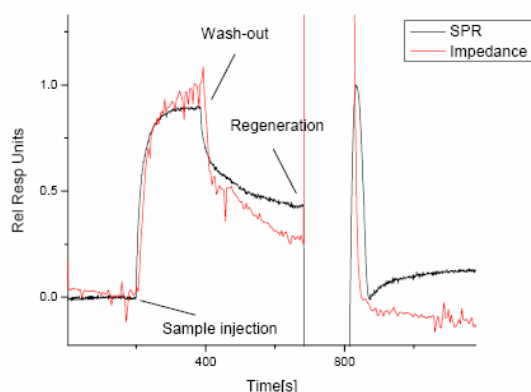
**INTRODUCTION:** Aiming to detect a wide range of target analytes, from low molecular weight compounds to whole cells we have considered the capabilities of structured metallic surfaces and combined electric and optical instrumentation as sensitive bioanalysis platforms able to provide real time monitoring of complex bio-interfaces (cell-“smart” substrates).

We will present some of our latest developments on harvesting the enhancing capabilities of nanogold plasmonics in conjunction with affinity compounds for biosensing, from platforms development to combined (electrochemical and optical) analysis set-up interfaced in small volumes.

**METHODS:** Multichannel, differential impedance spectroscopy (MDIS) in combination with SPR methods, (Surface enhanced) optical fluorescence assays are elaborated to develop, optimize and analyze specific nanostructured platforms (affine and cell based biosensors).

Surface functionalization and nanopatterning add the required selectivity and specificity to the otherwise nonspecific, yet powerful methods like electrochemical and SPR assays for biosensing.

**RESULTS:** We have developed a dual MDIS and SPR system, with integrated microfluidics with multiple channel detection capabilities. The capabilities of the system were investigated during bioaffinity reaction using modified gold sensors. The behavior of the dual system was evaluated during non specific protein adsorption, for specific detection of pathogen cells and low molecular weight target analyte.



*Fig. 1 Dual signal for protein adsorption (BSA 1 mg/ml on gold)*

In the case of detecting a suspension of pathogen cells (*E. coli*) the attainable sensitivities,  $10^5$ - $10^6$  cells/ml are better than the ones provided using bench top SPR instrumentation.

For a low molecular weight compound (gentamicin) we could achieve the required detection limits to comply with international regulations regarding the maximum residual limits.

The combined MDIS and SPR assay enables accurate assessment of recognition events (Ag-Ab) while eliminating the nonspecific influences, providing mutual validation and expanding the analyte detection range, from low molecular weight compounds to cells.

Preliminary results dealing with electro-optical characterization of (nano)functionalized interfaces for cell detection will be presented.

### DISCUSSION & CONCLUSIONS:

Improvement in the sensitivity of the SPR sensors is an important issue for many applications, and we are investigating several alternative configurations such as combined electrical/SPR assays, Localised Surface Plasmon Resonance (LSPR) based on gold nanostructures or surface enhanced Total Internal Reflection Fluorescence microscopy.

Experimental verification of the concept has been achieved in designing immuno-affinity biosensing platforms for target analytes ranging from whole cells to low molecular weight compounds.

Preliminary data on exploring the influence of nanotopographies/nanopatterns, on cell attachment are presented. The proposed system combines the ultimate single molecule detection capabilities and high resolution on interfacial processes provided by SPR/TIRFM with the complementary virtues of impedance measurements to non-invasively appraise interfaces and non homogeneities.

**REFERENCES:** O.A. Sadik, E. Gheorghiu, H. Xu, D. Andreescu, C. Balut, M. Gheorghiu, D. Bratu, "Differential Impedance Spectroscopy for Monitoring Protein Immobilization and Antibody-Antigen Reactions", *Analytical Chemistry*, **74** (2002), 3142-3150.

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