

# Nanomaterials and Biosensors for health application

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## Introduction

The field of biosensors has been acknowledged among the most promising to satisfy the growing demands of healthcare systems in terms of fast, precise and personalized medical diagnosis. Biosensors can have an important role particularly concerning chronic diseases like cancer, which are leading causes of death with great social and economic burden, since current diagnostic methods are still expensive and time-consuming.

**MAIN AIMS** This work aims to deploy cost-effective disposable devices for non-invasive detection of circulating biomarkers of disease (e.g., proteins, metabolites, oxidative stress biomolecules) in point-of-care. Improved sensor performance for high sensitivity and specificity is achieved by incorporating innovative concepts:

- ◆ Nanoparticles and nanostructured materials
- ◆ Biomimetic imprinting technologies
- ◆ Dual-detection methods
- ◆ Miniaturized and greener approaches
- ◆ Equipment-free and low-cost solutions

## Methodology

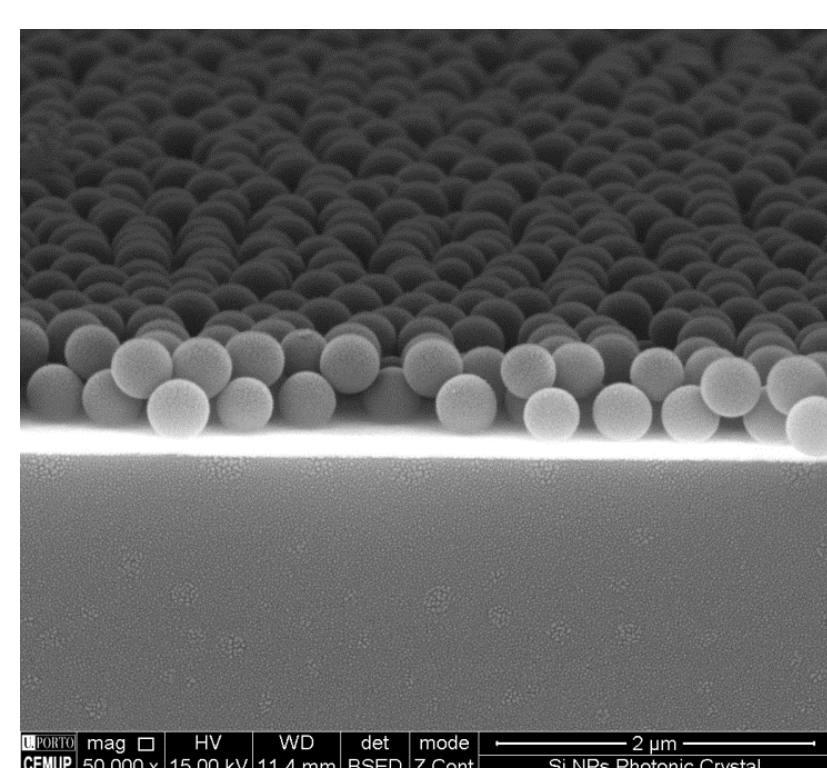
### Selective recognition

- molecular imprinting technology;
- immuno-based assays

Molecularly imprinted polymer (MIP)

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Nanofabrication of the substrate,  
study of transducer elements

Nanostructured materials for optical  
detection (e.g., colorimetric, SERS)

Electrochemical polymerization and  
detection

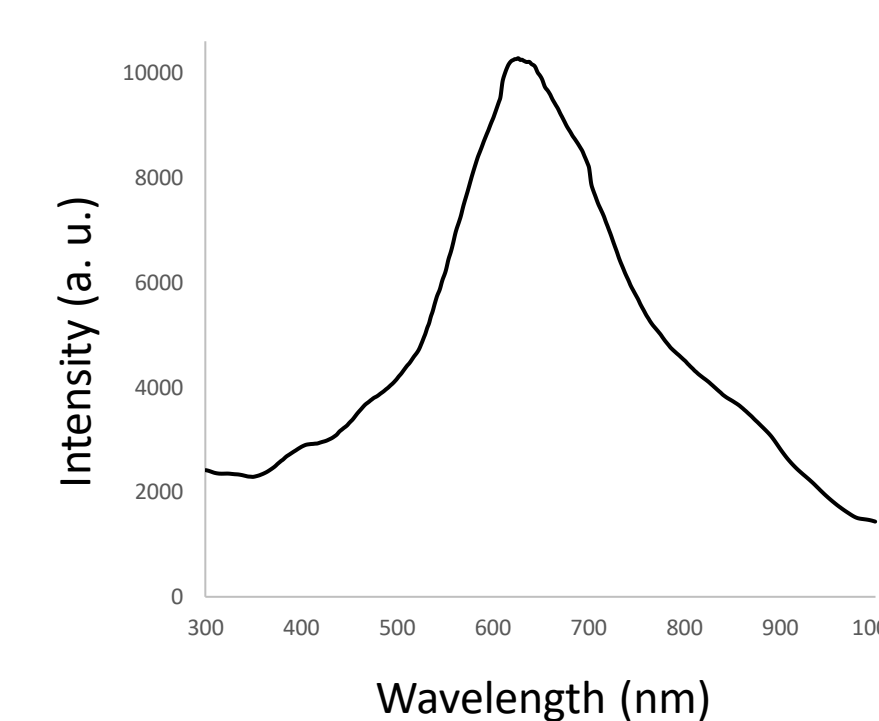
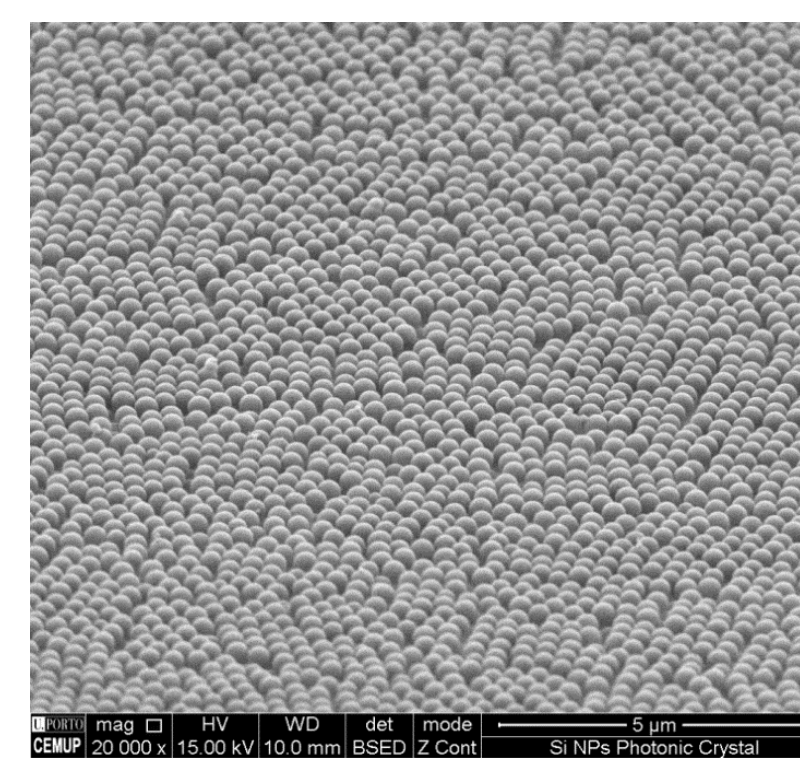
Novel sensors based on dual-detection  
(optical and electrochemical) methods

Biosensor assembly and validation

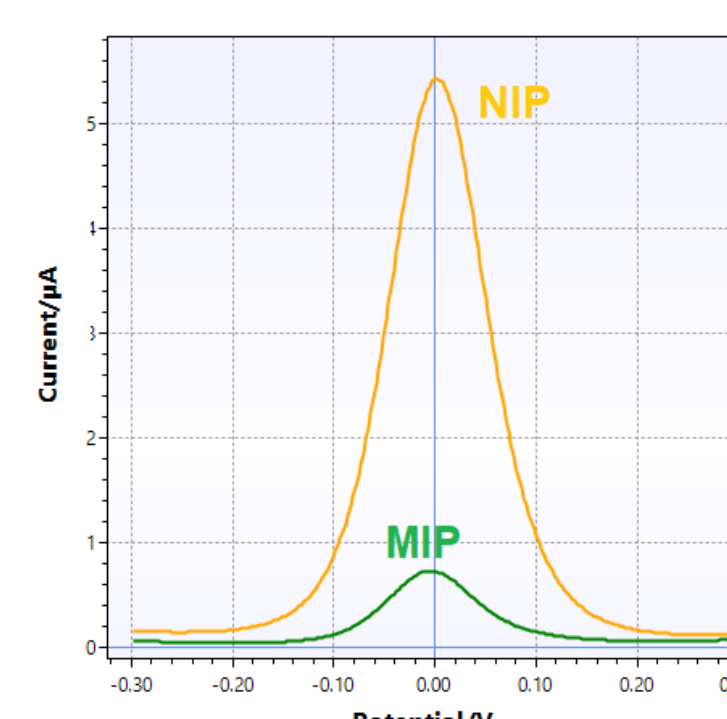


## Results

Photonic crystals that present structural colour have been used as optical transducers in label-free biosensors

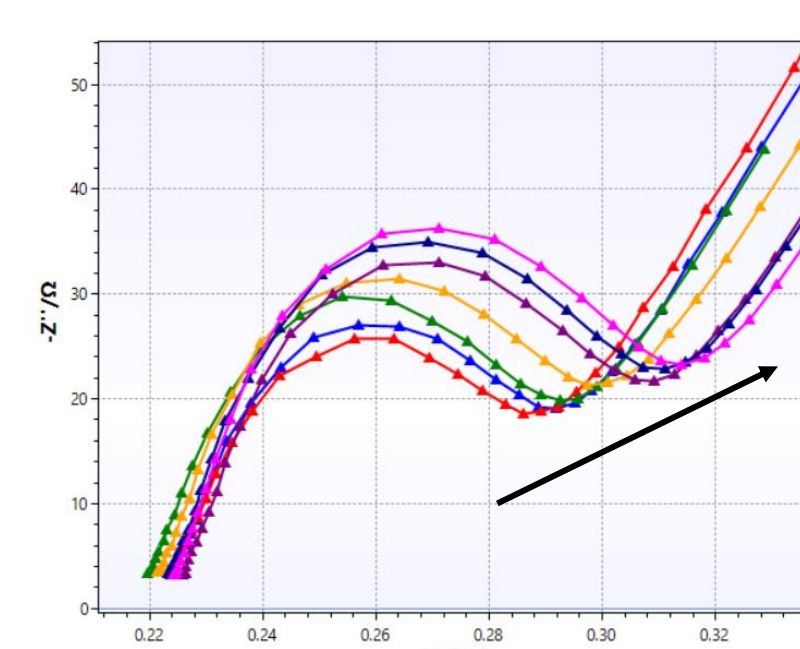


Self-assembled silica nanoparticles



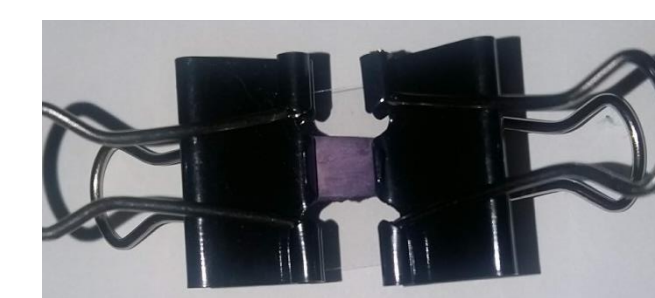
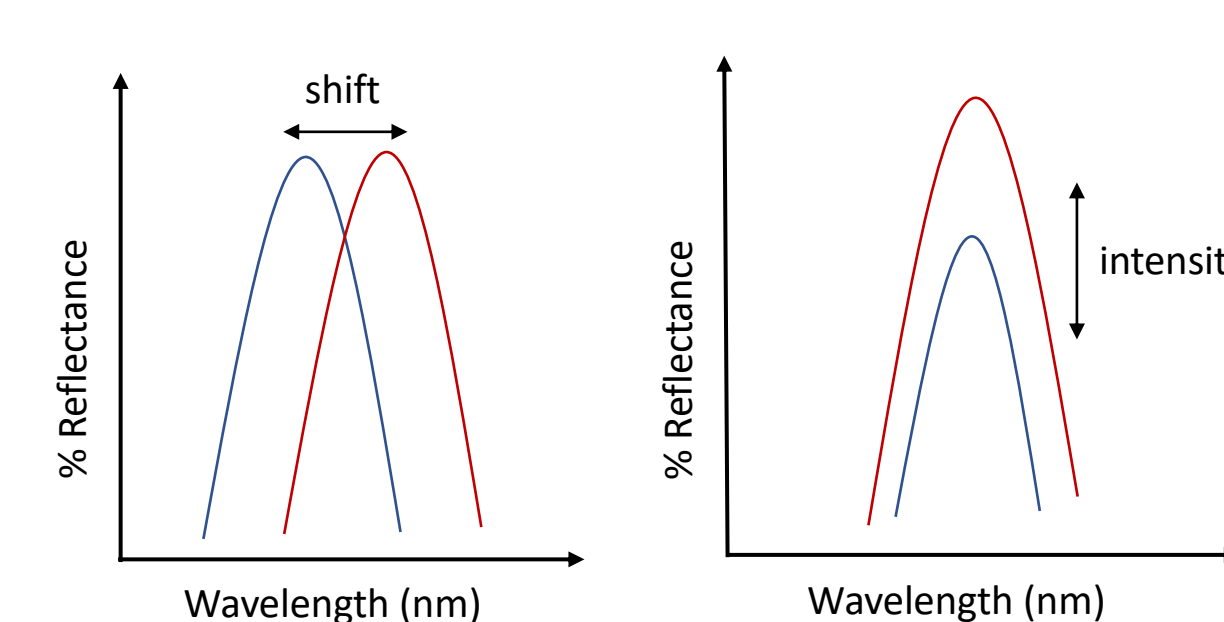
- The MIP-based sensor was compared with a control, the non-imprinted polymer (NIP)
- Both optical and electrochemical signals can be monitored

### Electrochemical response



Impedance increases with  
increasing target biomolecule  
concentrations

### Optical response



## General considerations

- Sensor technologies display significant advantages as simple and low-cost solutions for point-of-care diagnosis
- Straightforward approaches can be successfully accomplished by conjugating the specificity of MIPs with electrochemical and optical sensitive detection
- Nanomaterial-based sensors can be used for rapid and easy detection of numerous biomolecules useful for various health applications

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