**Leveraging light and electrons for the design of nanostructured biosensors**

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Biosensors fabricated on the nanoscale offer exciting new avenues in the quest to better understand, treat and manage diseases. Thin films of porous silicon are ideally suited for the construction of optical sensor matrices since they can be easily functionalised with biomolecular probes and displays strong optical interferences and 1D photonic effects. They can also serve as effective nanostructured electrodes. We describe the preparation of porous silicon based optical and electrochemical biosensors and their performance in the detection of analytical targets ranging from proteins, enzymes, small molecules and nucleic acids. Over the last decade, porous silicon has received significant attention in studies aiming at the design of chemo- and biosensors. This is not surprising since nanocrystalline porous silicon films are ideal hosts for the detection of chemicals, mainly due to their large internal surface area and the ease of chemically functionalising the surface, as well as their optical and electrochemical properties. Most remarkably, porous silicon acts as both matrix and transducer in biosensor devices. Changes in luminescence, interferometric reflectance and photonic resonances have been used to detect binding of diverse chemicals and biomolecules.

Here, describe the fabrication and functionalisation of porous silicon films, the conjugation of biomolecules to these films and their application as interferometric and photonic biosensors operating via in-situ signal amplification. We demonstrate that these biosensors can monitor various biochemical interactions with high sensitivity. The amplification of the signal from the initial ligand binding event is achieved by catalysed porous silicon degradation induced by DNA duplexes, transition metal complexes, by common redox enzymes or via light enhancement in microcavities.

We also report the design of porous silicon films as electrochemical biosensors and the surface chemistry required to achieve reliable performance. We provide examples related to the detection of analytical targets as diverse as virus, microRNA and protein biomarkers.

Finally, we will cover the use of porous silicon in surface-assisted laser desorption/ionisation mass spectrometry and explain how these systems allow ultrasensitive and rapid detection of small molecules in body fluids and tissue sections.

**References:**

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