

Electrochemical biosensing using nanochannels: from the stochastic sensing to the use of nanoporous membranes

Alfredo de la Escosura-Muñiz

NanoBioAnalysis Group-Department of Physical and Analytical Chemistry, University of Oviedo, Oviedo, Spain
alfredo.escosura@uniovi.es

Selective transport in protein-based ion channels is already used in living systems for electrical signaling in nerves and muscles, being this natural behavior approached for the use of biomimetic nanochannels in biosensors. On the basis of this principle, nanopores and nanochannels-based platforms stand out from the variety of nanostructured materials, bringing new advantages for biosensor development and applications. The emerging use of arrays of solid-state nanoporous membranes has opened the way to different and versatile sensing systems ranging from electrical to optical detection devices [1].

The purpose of this talk is to give an overview on the recent trends in the use of nanochannels for electrochemical biosensing applications [2]. Some general considerations on the principles of the stochastic sensing, before focusing on the applications for DNA, protein, virus and other analytes detection will be given. Special focus will be put in recent approaches for the *in situ* monitoring of biomarkers for wound infection diagnosis as well as antimicrobial agent evaluation [3,4].

The state-of-the-art of the developed technology may open the way to new advances in the integration of nanochannels with (bio)molecules and synthetic receptors for the development of novel biodetection systems that can be extended to many other applications with interest for clinical analysis, safety, and security as well as environmental and other industrial studies and applications.

References

- [1] A. de la Escosura-Muñiz, A. Merkoçi, *ACS Nano*, 6(9) (2012) 7556
- [2] A. de la Escosura-Muñiz, A. Merkoçi, *TrAC - Trends Anal. Chem.*, 79 (2016) 134
- [3] A. de la Escosura-Muñiz, K. Ivanova, T. Tzanov, *ACS Appl. Mater. Interfaces*, 11 (2019) 13140
- [4] A. Iglesias-Mayor, O. Amor-Gutiérrez, C. Toyos-Rodríguez, A. Bassegoda, T. Tzanov, A. de la Escosura-Muñiz, *Biosens. Bioelectron.*, 209 (2022) 114243

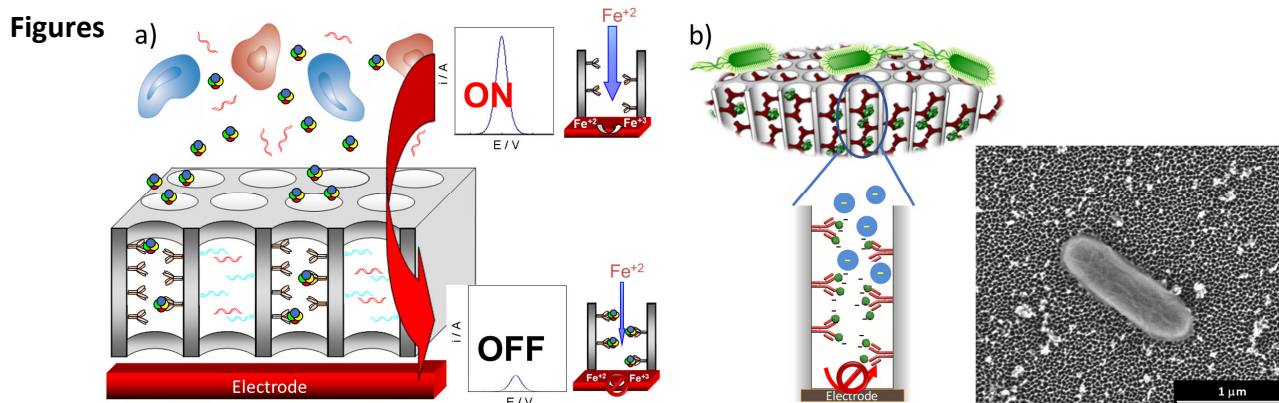


Figure 1: a) Schematic representation (not in scale) of the electrochemical biosensing strategies using nanoporous membranes, based on the concept of the stochastic sensing. b) Scheme and HRSEM image illustrating the bacteria culture on nanoporous membranes and the continuous capturing of secreted virulence factors by antibodies inside the nanochannels, leading to their steric/electrostatic blocking.

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