Carbon and Platinum Nanostructured Electrodes on Miniaturized Devices for Biomedical Diagnostics

Irene Taurino

Integrated Systems Laboratory, École polytechnique fédérale de Lausanne, Station 14
CH-1015 Lausanne, Switzerland
Irene.taurino@gmail.com

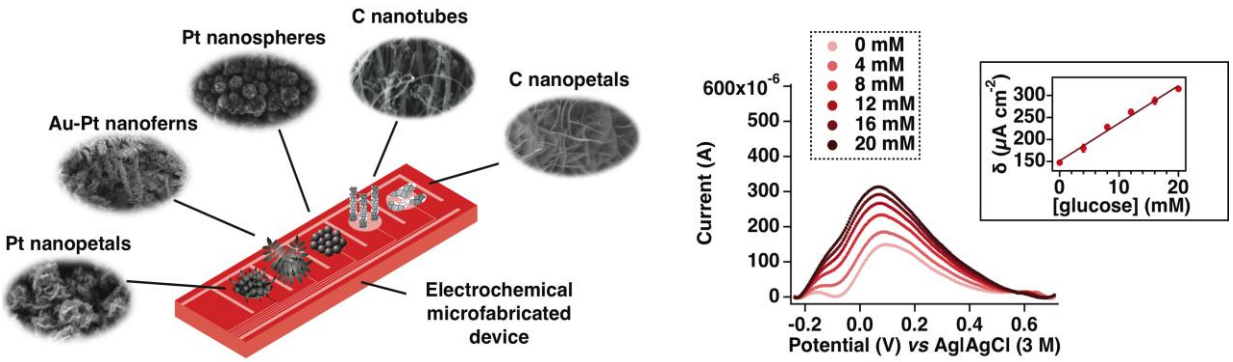
Abstract

Monitoring of a set of metabolites (e.g., glucose, lactate) and ions (e.g., potassium) in human fluids is of significant importance in medicine [1]. Instrumentation designed for a timely multi-sensing should be able to do several measurements from a small volume sample. Consequently, the development of a tiny device is a crucial requirement. Electrochemical miniaturized devices are particularly advantageous because of the inexpensive and reproducible fabrication procedures and the simple analytical measurements [2]. A continuing challenge in their fabrication is the detection of metabolites and ions in the physio-pathological concentration range. Modifying electrodes with nanostructures can solve this issue as due to their high electrocatalytic activity and large surface-to-volume ratio [3-5]. Tailored nanostructuration methods are extremely important to boost the sensor sensitivity, selectivity and stability over time [3].
In this talk I will illustrate novel protocols to modify electrodes with carbon and metal nanostructures without the use of binders that can mask the nanomaterial promising properties and can compromise the time-stability of the nanostructures in aqueous environment. Carbon nanomaterials were selectively deposited on electrodes by CVD [6,7] and nanoporous metal layers by template-free electrodeposition processes [8]. Both nanostructuration approaches generated electrodes with significantly enhanced detection performance as compared to the bare counterparts for sensing human metabolites and ions [7-10].

References

[1] Moser, I., *et al.,* Biosensors and Bioelectronics, **17.4** (2002) 297-302.
[2] Albery, W. J., *et al.,* Journal of the Chemical Society, Faraday Transactions 1: Physical Chemistry in Condensed Phases, **82.4** (1986) 1033-1050.
[3] Taurino, I., *et al.,* BioNanoScience, **2(4)** (2012) 185–195.
[4] Taurino, I., *et al.,* Electrochimica Acta, **93** (2013) 72–79.
[5] Taurino, I., *et al.,*Thin Solid Films, **548** (2013) 546–550.
[6] Taurino, I, *et al.,* Nanoscale, **5(24)** (2013) 12448–12455.
[7] Taurino, I., *et al.,* Nano letters, **14(6)** (2014) 3180–3184.
[8] Taurino, I., *et al.,* Scientific Reports, **5** (2015) 15277.
[9] Taurino, I., *et al.,* Talanta, **130** (2014) 423–426.
[10] Sanzó, G. and Taurino, I, *et al.,* Bioelectrochemistry, (2016) *In Press*.

Figure



Multisite electrochemical sensor including microelectrodes modified with CVD carbon nanomaterials and template-free electrodeposited Pt and Au-Pt nanoporous layers (left). Electrochemical measurements of different concentrations of a metabolite (glucose) and relative calibration curve (right).