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NANOSTRUCTURIZATION OF BARE GOLD ELECTRODES FOR BIOFUEL CELL APPLICATIONS: DROP-CASTED NANOPARTICLES *VS* ELECTROCHEMICALLY FORMED SURFACES

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Direct electron transfer (DET) between redox enzymes and electrodes has been widely studied to understand electron transfer and develop third-generation biosensors and biofuel cells [1]. Since the potential drops caused by mediated electron transfer (MET) are higher than the DET ones, the latter usually exhibit lower onset potentials and, consequently, higher open circuit voltages (OCV). These properties become crucial to maintaining modern, ultra-low-power devices such as implantable sensors [2-3]. Many efforts have been addressed to improve DET reactions towards the nano-structurization of bare electrode surfaces. However, even in labs, their modification is challenging. Scalable nano-structuring methods of nano-structurization would be of great interest for biosensor and biofuel cell applications.

The electrochemically fabricated nanoporous gold (nPG), as well as highly nanoporous gold (hPG) electrodes, represent a very promising alternative for the scale production of nanostructured electrodes. The morphology of the hPG electrode exhibits a well-defined porous structure with a diameter ranging from 12 to 43 µm, as confirmed by scanning electron microscopy (SEM) analysis (Fig. 1 a). The porous gold matrix is made of oval–shaped structures with sizes ranging from 33 to 97 nm (Fig. 1 b). In this study, nPG, hPG and Au NPs modified electrode surfaces were synthesized and further used to improve DET-based bioanode performances. It was shown that the glucose dehydrogenase-based bioanode exhibit higher current densities on the hPG electrodes compared to nPG and drop-casted Au NPs-modified gold electrodes (Fig. 1 c)

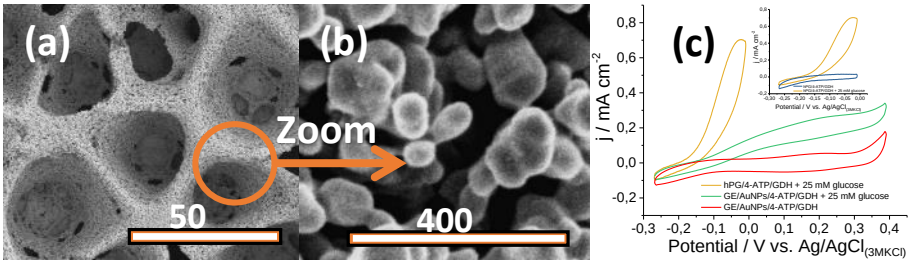

Fig. 1. Top-side SEM images of the highly porous gold (hPG) electrode (a, b) produced via two-step electrochemical processes: electro-deposition and hydrogen bubble template. Cyclic voltammograms (c) show the DET performances of bioanodes based on glucose dehydrogenase immobilized on the hPG and Au NPS-modified gold electrodes.

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