Área: ELE

Evaluation of palladium decorated nanoporous gold sensor for hydrogen peroxide detection.

Paula C. Falcoswki (PG),[1] Douglas P.M. Saraiva (PG),[1] Mauro Bertotti (PQ)[1]
paula.calli@usp.br ; mbertott@iq.usp.br;
[1]*Department of Fundamental Chemistry, Institute of Chemistry, University of São Paulo - USP; São Paulo – SP, Brazil.*
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Highlights

The synergistic effect of palladium and gold nanostructures were exploited for development of a new hydrogen peroxide sensor.

Abstract

Hydrogen peroxide (H_2O_2) is a metabolite involved in numerous biological processes, acting as a signaling agent in stress response. It is considered the major reactive oxygen species (ROS) in redox regulation. The molecule can reversibly oxidize specific proteins, altering their activity and contributing to different processes in the organism, such as differentiation and the control of growth factors. Moreover, hydrogen peroxide is formed as a defense mechanism of the cell against more harmful ROS, being an indicator of oxidative stress[1]. Therefore, this substance detection is very important in biological systems. Although gold electrodes have poor efficiency for H_2O_2 detection, nanoporous gold (NPG) has been demonstrated to be a good platform for both reduction and oxidation. Palladium electrodes, on the other hand, are a well-known substrate for hydrogen peroxide reduction. Nonetheless, only a few works reported the use of both components together. In this work, we have evaluated the performance of a nanoporous gold electrode decorated with palladium for hydrogen peroxide detection. The nanoporous gold layer was prepared onto a conventional bare Au electrode by the dynamic hydrogen bubble template (DHBT) method (-4 V for 60 s in a 2 mmol L^{-1} gold (III) chloride solution in an acid solution). In this method, hydrogen is formed in the electrode surface concurrently with the gold deposition, which helps the porous formation. The addition of palladium in the electrode surface was carried out by a similar process applying -4 V for 120 s in a 4 mmol L^{-1} palladium (II) bis(acetylacetonate) solution. The comparative response of different electrodes in a 5 mmol L^{-1} hydrogen peroxide solution is shown in Fig. 1. The Au bare electrode presents a small response at about -0.3 V, and a significant potential shift (0.2 V) and a corresponding current enhancement are noticed using the NPG electrode. Performance even better is observed with the nanoporous gold palladium decorated electrode, and its response to hydrogen peroxide excels that obtained with a platinum electrode. The synergic effect between gold and palladium onto the nanoporous surface is a likely explanation for such an outstanding feature. Preliminary voltammetric studies indicated a good correlation between signal and hydrogen peroxide concentration in the 0.5 to 8.0 mmol L^{-1} concentration range. Further studies will be directed to optimize the experimental conditions toward fabricating a sensitive microsensor for hydrogen peroxide detection. The influence of dissolved oxygen on the sensor response will also be the subject of the following studies.

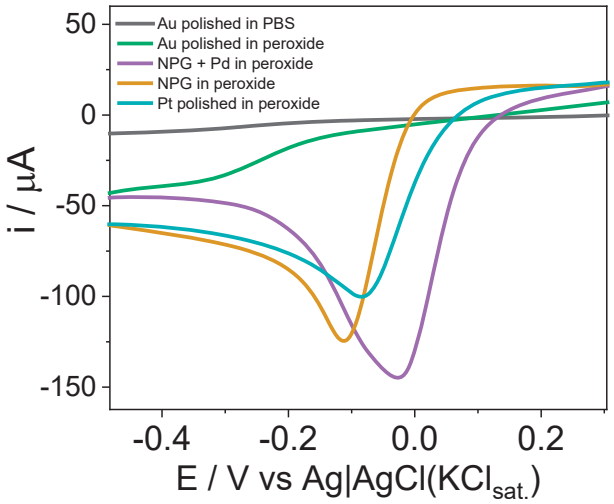

***Fig.1**: Voltammetry of modified and unmodified Au electrodes and platinum electrode in a 5 mmol L^{-1} peroxide solution*

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