Accepted Manuscript

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PII: S1572-6657(17)30706-3
DOI: doi:10.1016/j.jelechem.2017.10.004
Reference: JEAC 3564

To appear in: *Journal of Electroanalytical Chemistry*

Received date: 12 July 2017
Revised date: 12 September 2017
Accepted date: 2 October 2017

Please cite this article as: Anandhakumar Sukeri, Mauro Bertotti , Electrodeposited honeycomb-like dendritic porous gold surface: An efficient platform for enzyme-free hydrogen peroxide sensor at low overpotential. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jeac(2017), doi:10.1016/j.jelechem.2017.10.004

Electrodeposited honeycomb-like dendritic porous gold surface: an efficient platform for enzyme-free hydrogen peroxide sensor at low overpotential

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Abstract

In this work, a one-step electrodeposition so-called "dynamic hydrogen bubble template" (DHBT) method was proposed to fabricate a porous Au film electrode. Field emission scanning electron microscopy and cyclic voltammetry techniques were used to characterize the as-prepared film, and results confirmed the formation of honeycomb-like dendritic (HCLD) porous structures with enhanced surface area and roughness factor. The resulting HCLD-porous Au film electrode was explored for enzyme-free H_2O_2 reduction and a remarkable electrocatalytic activity was observed in terms of reducing the overpotential ~0.5 V towards more positive potential with ~3-fold enhancement in current signal in comparison to the bare Au electrode. The fabricated sensor displayed excellent analytical response in amperometric mode at an applied potential of -0.1 V in a linear range from 0.02-0.36 mmol L^{-1} with a detection limit of 0.003 mmol L^{-1} and a sensitivity of 1176 µA mmol L^{-1} cm^{-2}. Besides, the sensor exhibited good selectivity and reproducibility. Lastly, the proposed sensor was evaluated for real application using mouthwash liquid samples via standard addition method and the recovery value was found to be ~ 97%.

Keywords: DHBT method, high surface area, porous gold structures, enzyme-free H_2O_2 sensor, low overpotential