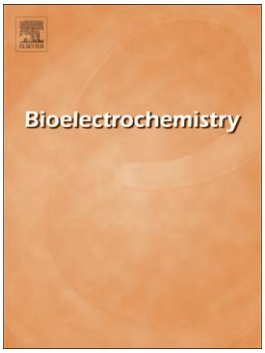

An overview of dealloyed nanoporous gold in bioelectrochemistry

Xinxin Xiao, Pengchao Si, Edmond Magner

PII: S1567-5394(15)30037-2
DOI: doi: 10.1016/j.bioelechem.2015.12.008
Reference: BIOJEC 6903

To appear in: *Bioelectrochemistry*

Received date: 2 November 2015
Revised date: 23 December 2015
Accepted date: 30 December 2015

Please cite this article as: Xinxin Xiao, Pengchao Si, Edmond Magner, An overview of dealloyed nanoporous gold in bioelectrochemistry, *Bioelectrochemistry* (2015), doi: 10.1016/j.bioelechem.2015.12.008

An overview of dealloyed nanoporous gold in bioelectrochemistry

Xinxin Xiao[a,b], Pengchao Si[*a] and Edmond Magner[*b]

[a]Key Laboratory for Liquid-Solid Structural Evolution and Processing of Materials, Ministry of Education, School of Materials Science and Engineering, Shandong University, Jinan 250061, People's Republic of China. E-mail: pcsi@sdu.edu.cn

[b]Department of Chemical and Environmental Sciences and Materials and Surface Science Institute, University of Limerick, Limerick, Ireland. E-mail: edmond.magner@ul.ie

Abstract

Dealloyed nanoporous gold (NPG) is a relatively new class of materials with potential applications in a wide range of fields, especially in electrochemistry. This review describes recent progress in the use of NPG electrodes for applications in bioelectrochemistry.

Keywords: nanoporous gold; glucose biosensor; electrochemistry; electron transfer

1. Introduction

Dealloyed nanoporous gold (NPG) is a porous material containing three dimensional frameworks of bicontinuous pores and ligaments, that is prepared by electro-/chemically dissolving the less noble component from Au alloys (Figure 1 and Figure 2A) [1]. For such materials to act as a support for enzymes, it is essential that the pore diameter sufficiently large to accommodate the enzyme and to enable effective transport of substrate to the enzyme. The pore sizes of NPG can be tailored in the range from ~5 to 700 nm [2] by tuning the composition of the alloy and the dealloying conditions [3]. NPG possesses advantages such as high surface-to-volume ratio, good electrical conductivity, chemical stability, biocompatibility and permeability [3]. NPG has been the subject of much attention for a range of applications including catalysis [4-6], optical sensing [7, 8] and analysis [9]. NPG electrodes have been used in the development of immunosensors [10-12], DNA sensors [13, 14], enzymatic biosensors [15, 16] and as enzyme-free sensors [17-19].

In this mini-review, we describe the use of dealloyed NPG for bioelectrochemical applications in biosensors and enzymatic biofuel cells. The review focuses on NPG fabricated via dealloying methods, rather than porous gold electrodes obtained with other methods (template methods etc.).

2. Dealloyed NPG fabrication and characterization

2.1 Fabrication

Corrosion processing of alloys with preferential removal of the less noble component (i.e. dealloying), originally known as “depletion gilding”, was established by the Indians of pre-Columbian Central America in order to create a layer of pure gold by etching copper from Cu/Au alloys [20]. Forty and Pickering showed that dealloying of a binary alloy resulted in a “spongy” morphology [20, 21]. In 2001, Erlebacher et al. demonstrated that the formation of pores was due to an intrinsic dynamic formation process [22, 23]. In the fabrication of NPG from