Evaluation of PCB based gold electrode array cleaning methods for electrochemical biosensor applications

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Abstract

Gold electrode arrays are widely used for biosensor applications[1]. However, photolithography which is the most common method for array microfabrication is very expensive and needs clean room facilities. Electrode surface cleaning (pretreatment) is crucial step for biosensor development as it affects efficiency of self-assembly monolayers (SAM)[2] and formation of the recognition element.

Soft gold electroplating on printed circuit board (PCB) is emerging method providing cheap and alternative process for biosensor array fabrication[3].

We report the first evaluation for different surface pretreatments of PCB based gold electrode array for electrochemical biosensor applications. In this study, several cleaning methods were investigated including physical, chemical and electrochemical. We tested: UV/ozone; plasma etching; potassium hydroxide–hydrogen peroxide; sulfuric acid–hydrogen peroxide (Piranha); nitric acid–hydrochloric acid (aqua regia) and electrochemical cyclic voltammetry in sulfuric acid. For optimization, we tested different exposure times, concentrations and combination of two or more methods.

Following cleaning, gold electrode surface was characterized by electrochemical cyclic voltammetry in sulfuric acid and peak-current potential differences in potassium hexacyanoferrate, contact angle to evaluate hydrophobicity, and finally a DNA hybridization assay after functionalization of gold surface with DNA capture probe.

A peak separation equal or below 100 mV was used as criteria to determine a cleanness of gold surface. PCB arrays treated with UV/ozone for 10 minutes and with a solution of potassium hydroxide (50 mM) / hydrogen peroxide (25%) for 10 minutes exhibited the best performance.

References

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