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SUSTAINABILITY & DIVERSITY THROUGH CHEMISTRY



PROGRAMME

Development of self-assembled monolayer of thiol on gold electrodes and application for the in situ formation of gold nanoparticles

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Gold electrodes have been used as electrodic material in the development of self-assembled layouts, using 3-mercaptopropionic acid (MPA) as the base molecule. Pre-treatment of the metal substrate consisted on mechanical polishing, chemical and electrochemical treatment, essential for achieving good stability and reproducibility of the molecular architecture of the sensor. Moreover, the electrochemical treatment provided data for the calculation of the gold electrode active area, which was used to normalize MPA surface coating values, those obtained with desorption measurements of MPA molecules. The modification consisted on coating gold probes with MPA by dipping the pre-treated gold electrode in 25 mmol L⁻¹ solution of this compound. This electrode (Eau/MPA) was used to anchor cysteine (CSH) molecules also through immersion in a 0.1 mol L⁻¹ solution, resulting in a Au/MPA/CSH modified electrode. Since the interaction between MPA and cysteine molecules after these procedures is mainly electrostatic, an electrochemical activation step was carried out by cycling the electrode in 0.1 mol L⁻¹ phosphate buffer solution, pH 7.0, at a slow scan rate. In order to identify a possible covalent interaction formed on this activation step, Raman spectroscopy measurements were performed. The residual thiol groups from superficial cysteine molecules were used to obtain superficial gold nanoparticles, from HAuCl₄ solution, via drop casting process. The absence of the thiol redox couple in the cyclic voltammograms obtained after this procedure was an indicative of the formation of gold nanoparticles, to be confirmed with MEV measurements. The Au/MPA/CSH/AuNp electrode will be used to determine hydrogen peroxide in phosphate buffer solution, as well as other biological compounds.

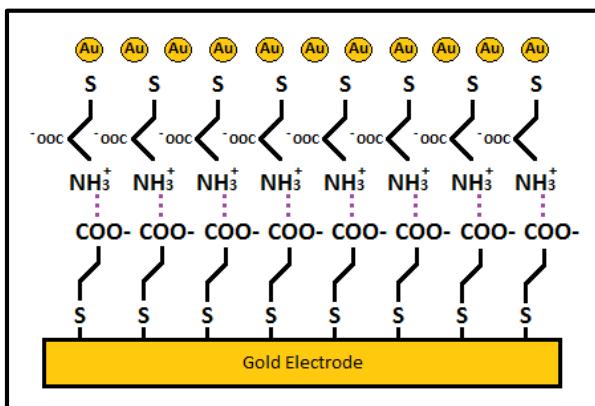


Figure 1 - Scheme of the modified electrode

In addition, this type of surface modification (Eau/MPA), combined with the activation step, can also be used for anchoring certain analytes, such as simple amine based molecules. Therefore, avoiding leaching of the analyte to the solution and making it possible to study the electrochemical processes in a confined environment.

References

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Surface Review and Letters, v. 13, n. 02, p. 297–307, 2006.