# Preparation and Electrochemical Characterization of Glutathione Modified Gold Nanoelectrodes

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**Abstract**

The gold nanomaterials are used extensively in biosensors due to their biocompatibility as well as high effective surface area. Ordered arrays of gold nanostructure materials have exceptional potential to increase the sensitivity of biosensors. We demonstrated the one of low cost technique, how to prepared biosensor based on vertically aligned gold nanorods (NRs) array, which was fabricated by pulsed electrodeposition method.

The advantages of sensing interfaces that contain Au NRs networks are the increased surface area for sensing, improved electrical connectivity through the Au NRs network, and chemical accessibility to the analyte through these networks compared to sensing interfaces based on flat Au surfaces. The next advantage is an electrocatalysis. A biosensor is an analytical tool that fulfills two functions, [1] capturing biological targets and [2] transducing target binding events to measurable signals. One of the linkers for biomolecule binding to sensitive part of biosensor is glutathione (GSH), a very attractive biomolecule for sensors application due to Au-SH binding capability, bio-selectivity and high sensitivity to heavy metal ions. The combination of GSH and nanostructured surfaces could bring many new benefits.

EIS (electrochemical impedance spectroscopy) has been employed to characterize the glutathione monolayer assembled on nanostructured gold electrodes. The EIS measurements of surfaces with various nanoparticles geometry have shown the changes of surface properties during the adsorption process of glutathione GSH. According to the simple equivalent electric network of the electrochemical interface; the EIS parameters were also obtained. The results showed that the proposed method should be used in wider application in biochemistry.

The fabrication of flat gold and nanostructured electrodes, prepared by template based method, has been briefly described in recent paper [3]. The method has been modified by pulse deposition technique, which brings more benefits as homogeneity of nanowires distribution and better controlling of their growing, as it is shown on Fig.1. The using of pulse deposition prevents the collapse of continual deposited NRs. The comparison of flat and nanostructured electrode EIS spectra has also shown an interesting difference in diffusion part of spectra, Fig.2a. The GSH monolayer has been prepared by adsorption method in 0.1 M glutathione for different times. Measuring system Metrohm µAutolab III with FRA2 module supported by NOVA 1.8 software was used for the EIS of electrodes. Samples were measured in 10 ml of phosphate buffer (pH 7.5), frequency range of 1 Hz – 250 kHz and the amplitude of 10 mV. The EIS experiments were carried out in potentiostatic regime under DC zero potential related to reference electrode.

It is supposed that measured biomolecules serve as electron transmitters. In the case of biomolecules higher concentration in the solution, the biomolecules completely covered the electrodes surface. The optimal time for GSH monolayers formation and characterization of the electrodes behavior after monolayer formation were determined. The point, where the electrode has been completely covered by GSH is shown in Fig.2b. In the following step, it is possible to measure only the biomolecules impedance instead of the measurement of impedance count corresponding to the electrode and biomolecules.

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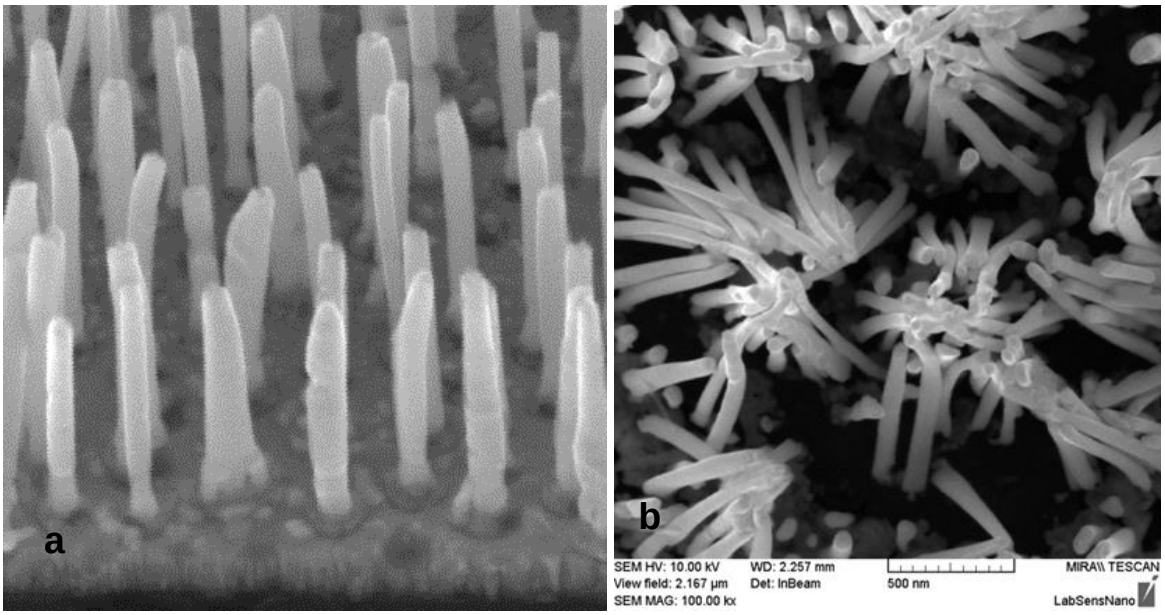


**Fig. 1.,** SEM image of electrode surface covered with pulse deposited Au NRs (a), and overgrowth nanowires deposited by continual deposition (b).

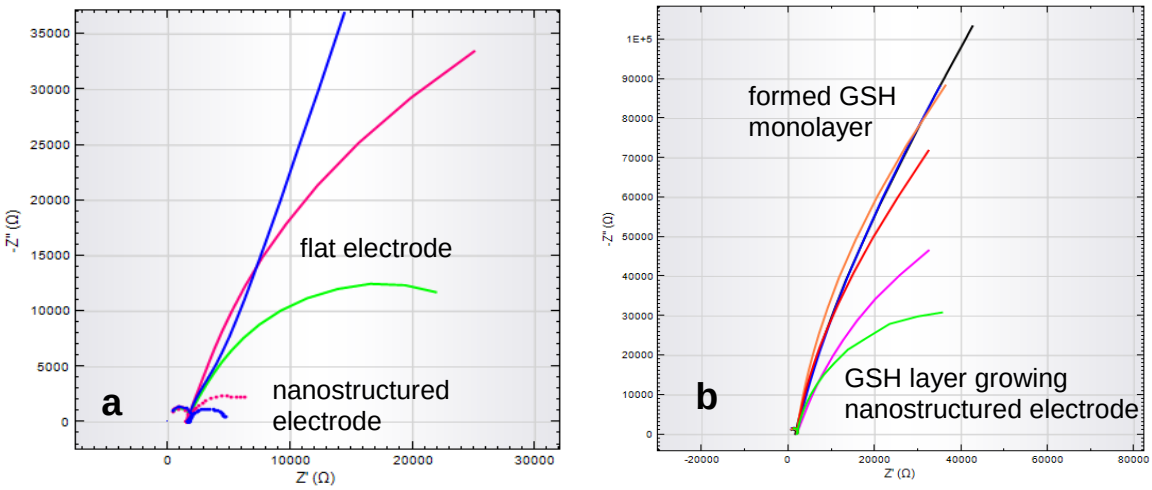


**Fig. 2.,** Nyquist plots of flat vs. Au NRs modified electrodes (a), EIS of GSH monolayer formation (b).