4.4 Disposable gold electrode

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Due to the good conductivity and chemical inertness, gold electrode becomes an attractive material in electrochemical analysis. There are many different ways to prepare gold electrode, such as electrochemical deposition of gold particles on SPCE, chemical reduction method, and sputtering method etc. The flat surface of gold electrode is one of the favorable character of gold electrode to develop the immunoassay sensor by modifying the molecule with thiol, pyridine and amine group to connect the antigen, DNA, and protein on the surface of gold. The requirement of disposable gold electrode is increased dramatically. With this in mind, the fabrication of diverse disposable gold electrode is necessary and important. Therefore, Zensor has developed numerous custom-built of disposable gold electrode to provide researchers in the world to use for their personal experiment and products. (see Figure 1)

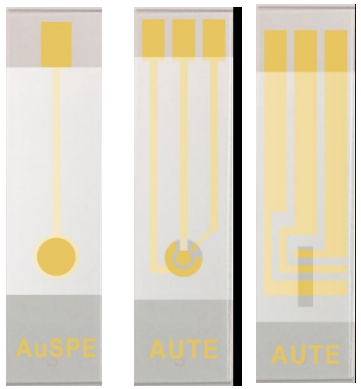

Figure 1. Disposable gold electrodes in Zensor

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4.4.1 Electrochemical redox behavior of gold

The typical cyclic voltammogram of gold in pH 7 PBS is shown in Figure 2. In the positive sweep, it commences to be oxidized with a monolayer oxide formation at the electrode surface at around 750mV (vs. Ag/AgCl) and a reduction reaction of gold oxide occurred at around 200 mV. Furthermore, as published in the literature, another type of oxide gold which is hydrous form may be produced on the metal and its electrocatalytic behavior is quite unusual. In addition, the oxygen reduction is commenced at about -300 mV and the predicted equations are illustrated in Figure 2. [1,2]

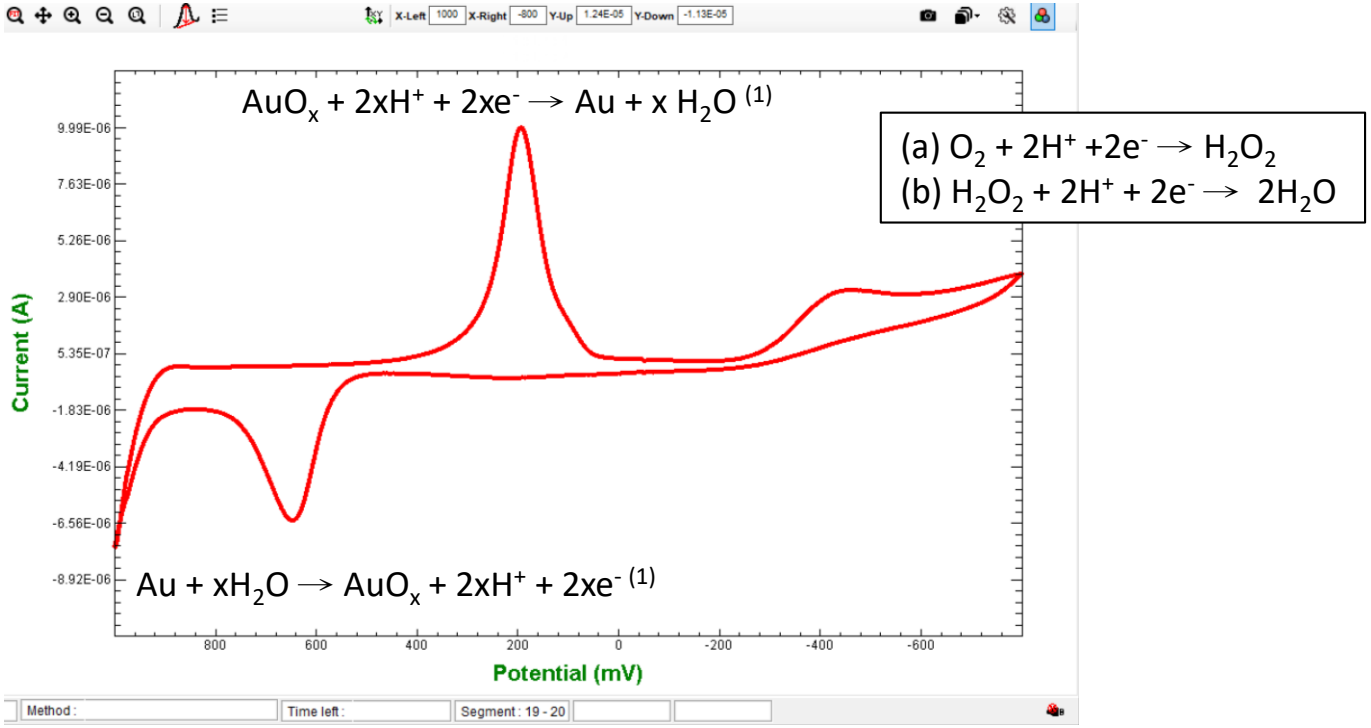

Figure 2. The typical voltammogram of gold

Reference
(1)L D Burke and P F Nugent, Gold Bulletin 1998, 31(2), 39-50
(2)Sidney Barnartt, J. Electrochem. Soc. 1959 volume 106, issue 11, 991-994

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4.4.2 Electrocatalytic behavior of gold

Recently, many publications reveal that the electrocatalytic ability of gold is dramatically increased with the decreasing of its particle size and undergo oxidation at unusually low potential. The reaction mechanism is illustrated that the gold atoms (Au*) get oxidized at the surface of gold electrode to be mediator (AuO_x) and then triggers oxidation of reductant (R) in solution to eventually form the product P_1. (see equation 1) On the other hand, reduction of an oxidant (O) to product P_2 is explained in equation 2. the dissolved oxidant oxidizes the active gold and O is simultaneously reduced to P_2. In the meantime, the oxidixed gold, AuO_x, is reduced to Au* and therefore become a repetitive manner.

(1) $Au^* + xH_2O = AuO_x + 2x\,H^+ + 2xe^-$ (+R → P_1)

(2) $AuO_x + 2x\,H^+ + 2xe^- = Au^* + x\,H_2O$ (+O' → P_2)

Reference
(1)L D Burke and P F Nugent, Gold Bulletin 1998, 31(2), 39-50

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4.4.3 Screen Printed Carbon Electrode Modified with Poly(l-Lactide) Stabilized Gold Nanoparticles for Sensitive As(III) Detection

It has been published that the poly(l-lactide) stabilized gold nanoparticles (designated as PLA–Au^{NP}) with an average particle size of ca. 10 nm were used to modify a disposable screen-printed carbon electrode (SPE) for the detection of As(III) by differential pulse anodic stripping voltammetry. Under the optimal experimental conditions, a linear calibration curve up to 4 ppm with a detection limit (S/N=3) of 0.09 ppb was obtained. The sensitivity was good enough to detect As(III) at levels lower than the current EPA standard (10 ppb). Most importantly, the PLA–Au^{NP}/SPE can be tolerable from the interference of Cu, Cd, Fe, Zn, Mn, and Ni and hence provides a direct and selective detection method for As(III) in natural waters. (1)

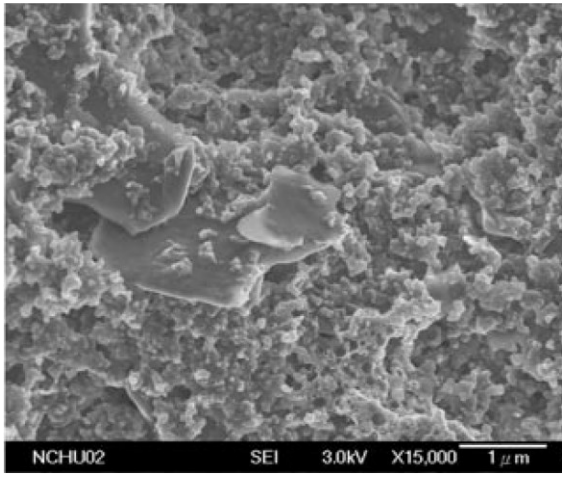

Figure 3. SEM images of the PLA–Au^{NP}/SPE

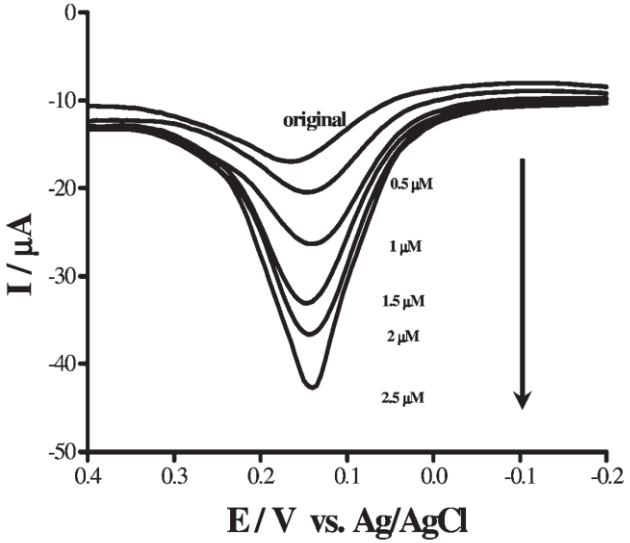

Figure 4. Typical DPSV responses of the water sample obtained by the PLA–Au^{NP}/SPE

Reference
(1)Yue-Shian Song, Govindan Muthuraman, Yi-Zhen Chen, Chu-Chieh Lin, Jyh-Myng Zen, Electroanalysis 18, 2006, No. 18, 1763 – 1770

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