

Ni/NiO thin film Sensors for Mercury ions detection by Square wave anodic stripping voltammetry

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Square wave anodic stripping voltammetry (SWASV) is considered a very interesting electrochemical method for heavy metals detection in comparison to conventional techniques [1]. The main features of this technique are the high sensitivity and reproducibility (standard deviation lower than 5%), besides, the limit of detection is in the ppb level so is comparable with standard techniques such as AAS or ICP, the instrumentation is very inexpensive and easy to use and the detection time is very low.

Among heavy metals, mercury is one of the most toxic for both environment and humans. In fact, it may cause serious health problems to brain, kidney and DNA. The concentration limit imposed by US Environmental Protection Agency (EPA) in drinking water is 10nM (2 µg/l). So is very important to detect this ion at concentrations near to this value with high sensitivity, reproducibility and selectivity [2].

In this work, for the detection of mercury ions, we have fabricated a Ni/NiO electrochemical sensor. In particular, the active material is NiO that exhibits an excellent catalytic behavior towards the reduction of Hg^{2+} and is very cheap [3]. NiO thin film was obtained by annealing of Ni-foil. The effect of annealing time and temperature was studied in order to compare these parameters with the characteristics of the annealed NiO thin film. All samples were characterized by XRD, SEM and EDS analysis.

After synthesis and characterization, electrodes were tested by SWASV for the detection of Hg^{2+} , using $HgCl_2$ as salt, in buffer solutions. All the SWASV parameters, like deposition potential, deposition time, pulse amplitude, frequency, and scan rate were optimized in order to increase the response of the electrode. After that optimization process, SWASV was carried out varying the solution concentration in order to find the sensor features. The effect of the solution pH was also studied using different buffer solutions.

The preliminary results showed that Ni/NiO sensors have a detection limit of 42nM, a linear range from 75 to 600nM with a sensitivity of 0.2228 A/(nM cm⁻²). Further experiments are in progress in order to increase the performance of the sensor (Figure 1).

References

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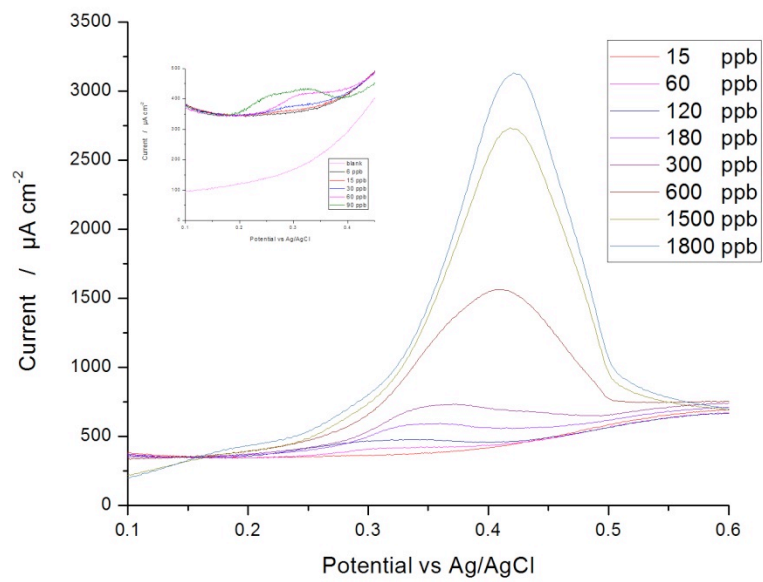


Figure 1. Calibration of Ni-NiO electrode for the electrochemical detection of mercury ions by Square Wave Anodic Stripping Voltammetry