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CONACYT

Identification Arsenic (V) by cyclic voltammetry and recovery of Arsenic by electrodeposition

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Introduction: Exposure to arsenic through contaminated water is a latent threat to human health. Arsenic is carcinogenic and its consumption can cause harmful effects to health leading to death. Taking into account the toxicity of arsenic, the World Health Organization (WHO) and US Environmental Protection set the maximum permissible limit of arsenic in drinking water to 0.010 mg/L (US EPA, 2001, World Health Organization, 1993 and 2006).

Experiment: In the detection of arsenic, a conventional three electrode cell was used. A Ag0 / AgCl as the reference electrode (RE), a platinum electrode as the working electrode (WE), and a graphite electrode as an auxiliary electrode (AE). Arsenic recovery tests were carried out with solutions containing a mixture of As(V) and As(III) with a pH adjusted to 2 by HCl. Potential sweeps were performed in a range of 0.8 V at -0.6 V, in order to observe at cathodic or reduction potential necessary to electrodeposit the arsenic in the metal electrodes. The electrodes used for the potential sweeps were a copper working electrode, with $1cm^2$ area, encapsulated and mirror polished. Subsequently, the electrodeposition of As(III) and As (V) was performed using 5 x 5 cm, two-sided copper electrodes 25 cm^2 of area, for 60 minute at different voltages of 0.5, 1.0 and 1.5V.
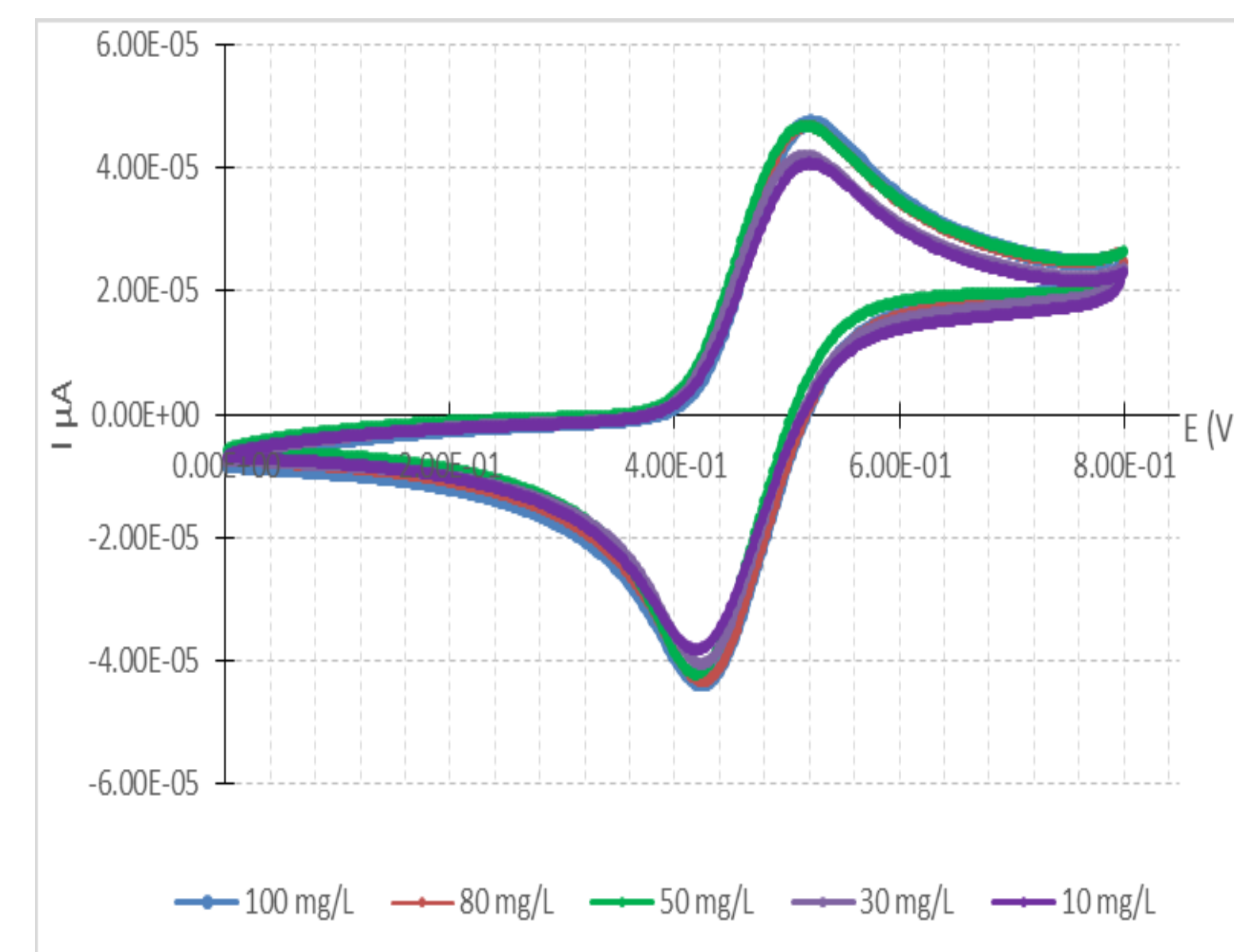

Results: experimental tests were performed with high and low concentrations pH 2 adjusted with HCl, experiment was exposed to constant bubbling to N_2. Figure 2 shows the displacement of the anodic peak by identifying As(V) at 10 mg/L at an amperage of -3.84 µA and -4.39 µA at a concentration of 100 mg/L confirming that the magnitude of the anodic peak is proportional to the Amount of As present. Identifying the oxidation and reduction of the metalloid. The behavior of the oxidation reduction in low concentrations is shown in Figure 3.

Figure 2. Voltamperogram high concentrations of As(V) at $1.33x10^{-4}$ M, $4.00x10^{-4}$ M, $6.67x10^{-4}$ M, $1.06x10^{-3}$ M, $1.33x10^{-3}$ M, plus 0.001 M KCl and a concentration of 0.01 M IK.
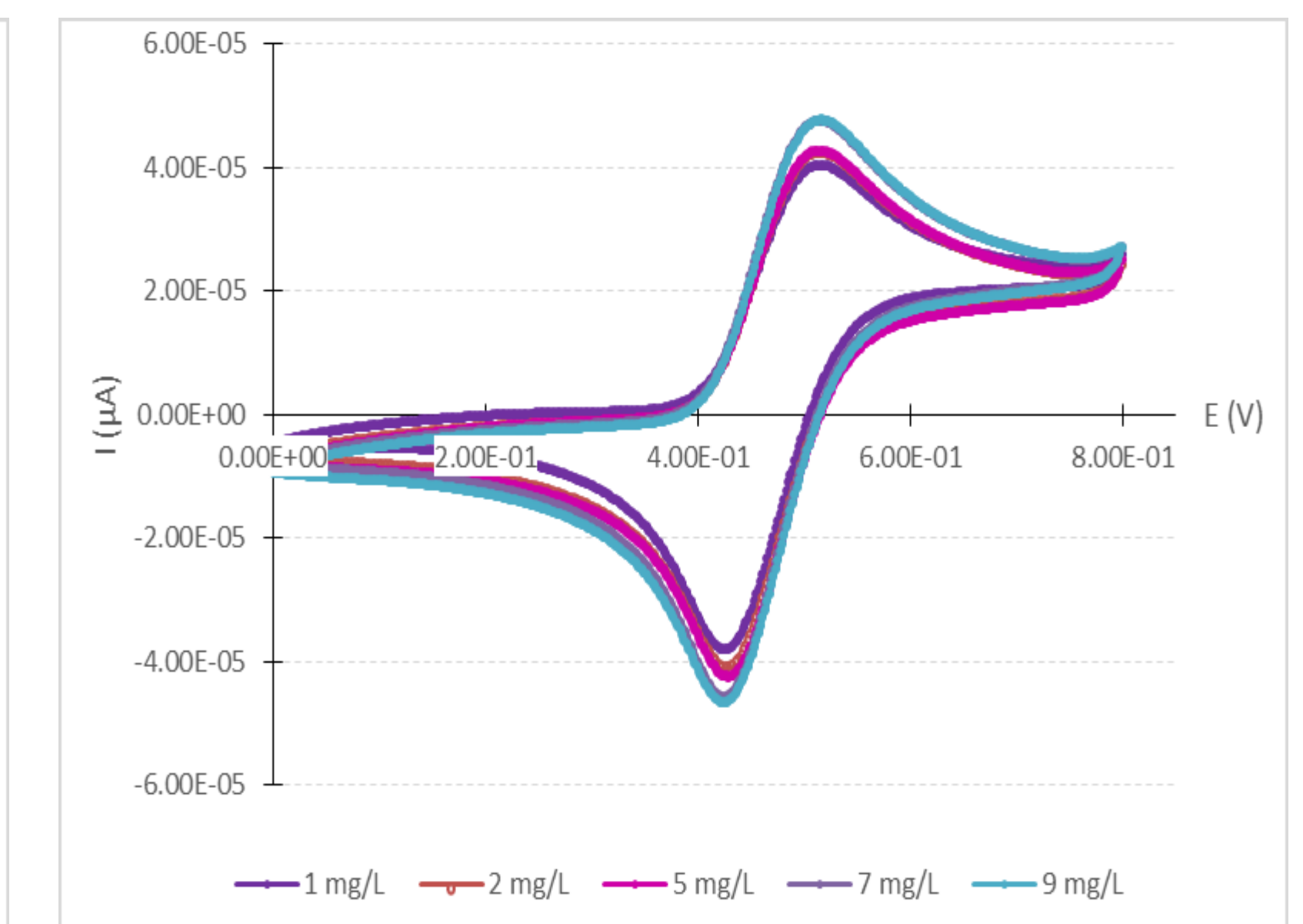

Figure 3. Voltamperogram low concentrations of As (V) $1.33x10^{-5}$ M, $2.66x10^{-5}$ M, $4.00x10^{-5}$ M, $5.33x10^{-5}$ M, $6.67x10^{-5}$ M, $8.00x10^{-5}$ M, $9.34x10^{-5}$ M, $1.06x10^{-4}$ M, $1.20x10^{-4}$ M, $1.33x10^{-4}$ M, plus the addition of 0.001 KCl and 0.01M IK.

Figures 4 and 5 show the curve of calibration for identification of arsenic V obtained in the experiments with high and low concentrations.
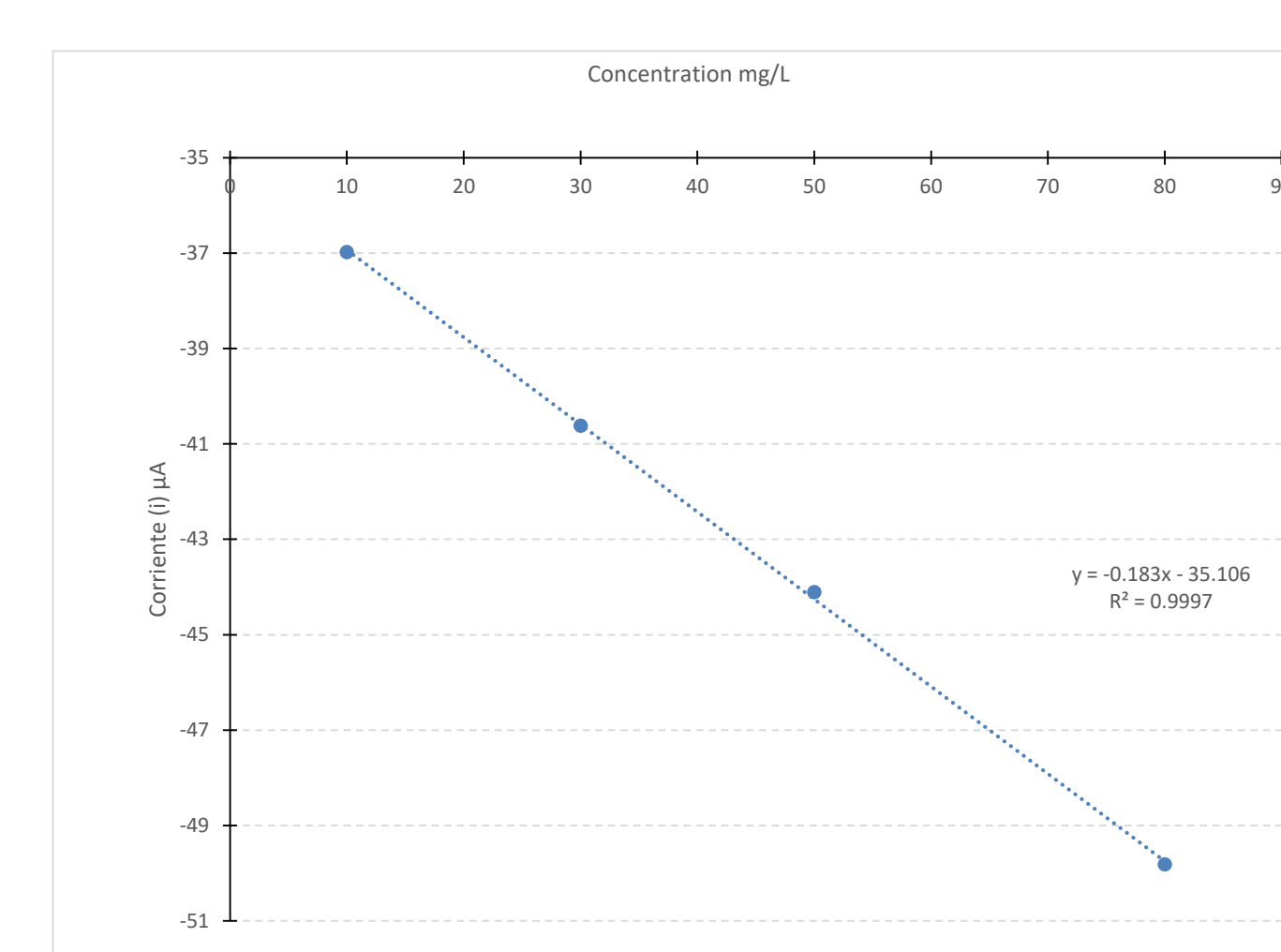

Figure 4. Calibrationcurve of As(V) High concentrations. Base electrolyte 0.001M KCl, pH 2 adjusted with HCl.
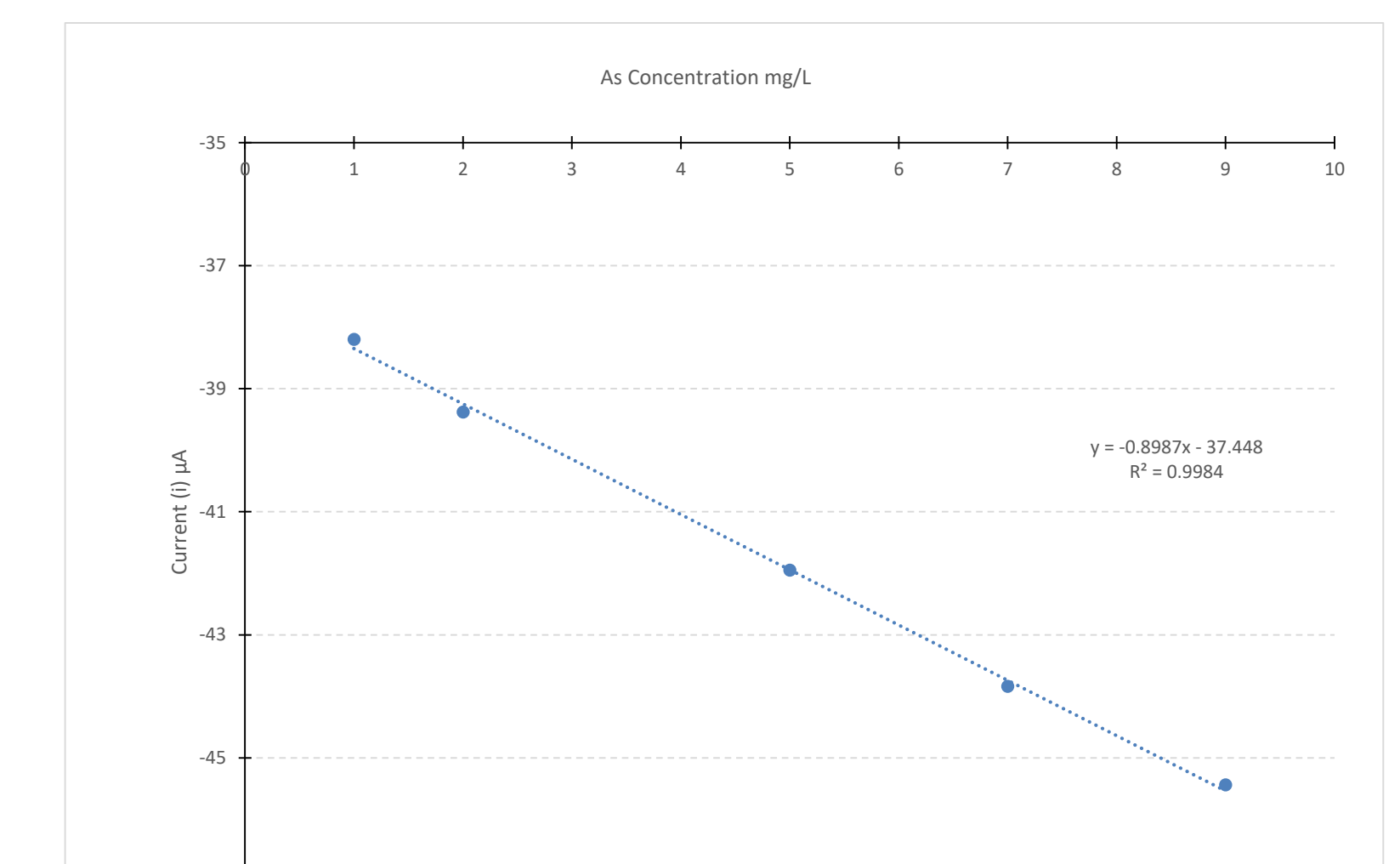

Figure 5. Calibration curve of As (V) low concentrations. Base electrolyte 0.001M KCl, pH 2 adjusted with HCl, 5 mL of IK.

In the Electrodeposition was observed that the arsenic is removed from the solution almost in its entirety. To verify that the arsenic was electrodeposited efficiently, analytical chemical tests were performed with the Arsenator in the initial sample and the final sample obtained after one hour of work. Figure 6 shows the metal with Arsenic.
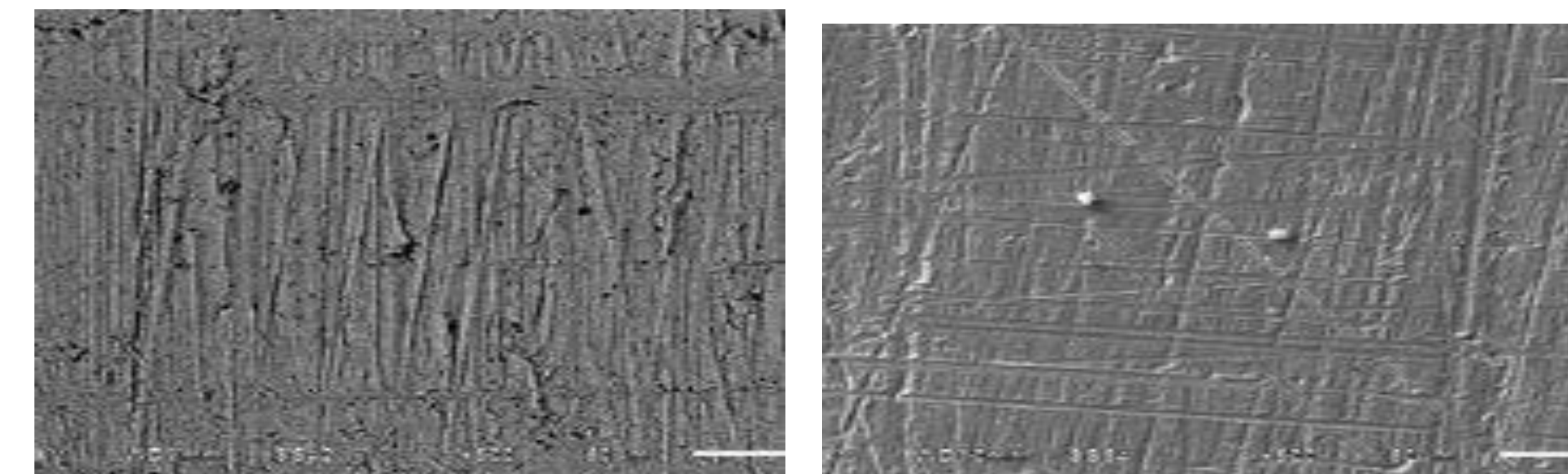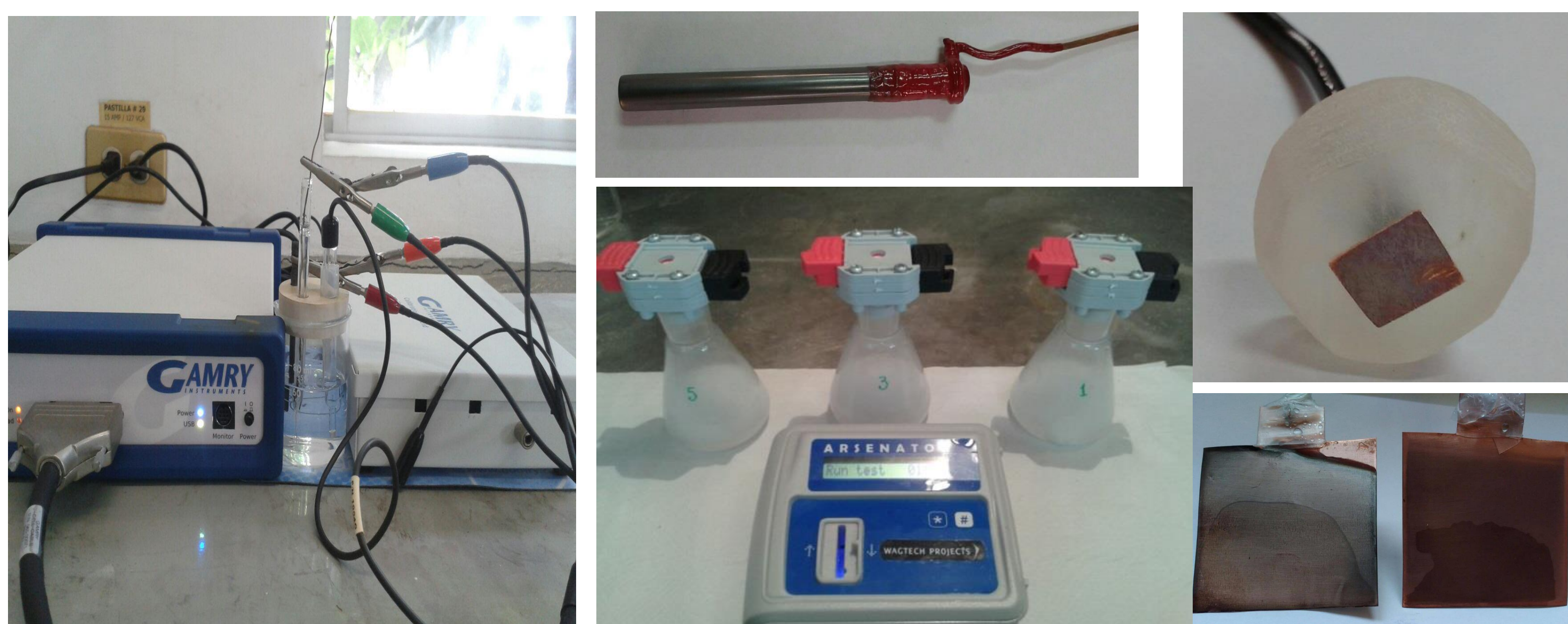

Figure 6. Images obtained in the MED, metal with arsenic.

Conclusions:

The identification of As(V) by cyclic voltammetry is a technologically viable option due to the reduction of time and costs, with high sensitivity and friendly to the environment.
It is possible to recover the arsenic by electrodeposition with efficiencies greater than 50%.

Acknowledgement:

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