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Electrochemical determination of copper and thiourea in the presence of an animal glue from strongly acidic solutions employed in the electrorefining processes of copper

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One of the last stages in the copper production process is the electrorefining. In this stage, both high purity (>99.99%) and commercially valuable copper cathodes can be obtained. New methodologies are required in order to overcome the high demands related with increasing production and improve the quality of copper cathodes. For this purpose, it is necessary the design of a system to controls the entire process through the measurements of key parameters such as copper and additives concentration (thiourea and animal glue).

Copper ions concentration is probably one of the main factors that affect the kinetics of the electrorefining process during the industrial production. Thiourea is an organic additive that favors the three dimensional nucleation of metallic copper. This enables to have control over the morphology including a great decreasing of defects in the final cathodic deposits. An inefficient dosing (as either in defect or in excess) of thiourea relative to the amount of copper present, causes irregular morphology in the cathodes.

The purpose of this study was to optimize the quantification methodologies for both copper and thiourea from strongly acidic solutions (H_2SO_4 170-180 g L^{-1}) and in the presence of animal glue. In this paper we show the optimal conditions and the analytical characteristics of the proposed methodologies.

For copper determination in these conditions, chronoamperometry technique was employed with a gold ultramicroelectrode (UME) as working electrode. UMEs has the advantage of enable to carry out measurements with low current, steady stage and short times responses. It was demostrated that there was neither influence of the acidity of the medium nor the concentration of animal glue, i.e., the slopes obtained under different conditions showed no statistically significant differences.

With this methodology, it is possible to make both rapid and reproducible (RSD = 1) determinations, with a wide range of linearity (5 -50 g L). This allows the direct determination of copper in this matrix. Further, it was possible the direct determination of thiourea in this matrix by linear sweep cyclic voltammetry using a Pt macroelectrode. This determination was acid concentration dependent within a linear working range that lies between 0 and 3.0 mg L^{-1} thiourea.

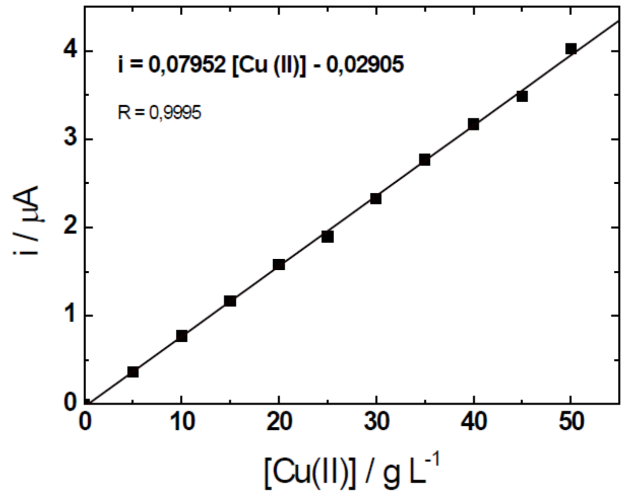

Figure 1: Calibration curve of copper obtained by chronoamperometry using Au ultramicroelectrode of 25 µm diameter. Concentration range 5 g L^{-1} - 50 g L^{-1}, in medium of H_2SO_4 180 g L^{-1}, 1,25 mg L^{-1} of animal glue and 2,40 mg L^{-1} of Thiourea.

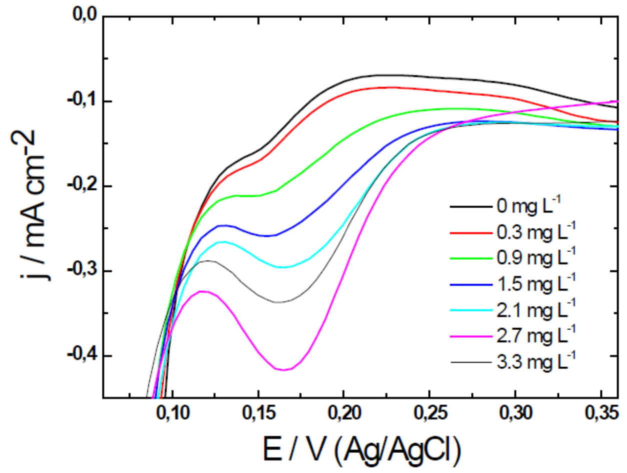

Figure 2. Thiourea voltamperograms with several concentrations (0 to 3.3 mg L^{-1}) in 180 g L^{-1} H_2SO_4 and 15 g L^{-1} Cu (II). Gold macroelectrode (area = 0.0201 cm^2). Sweep rate: 0.05 V s^{-1}.

References:

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