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EFFECT OF OXYGEN ON COPPER CORROSION

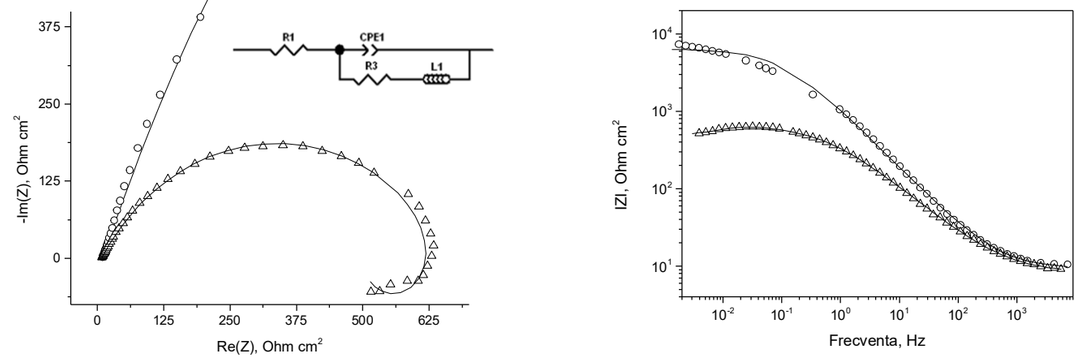
Viorica Mîrzac, Universitatea de Stat de Medicină şi Farmacie „Nicolae Testemiţanu”, Chișinău, Republica Moldova

Introduction

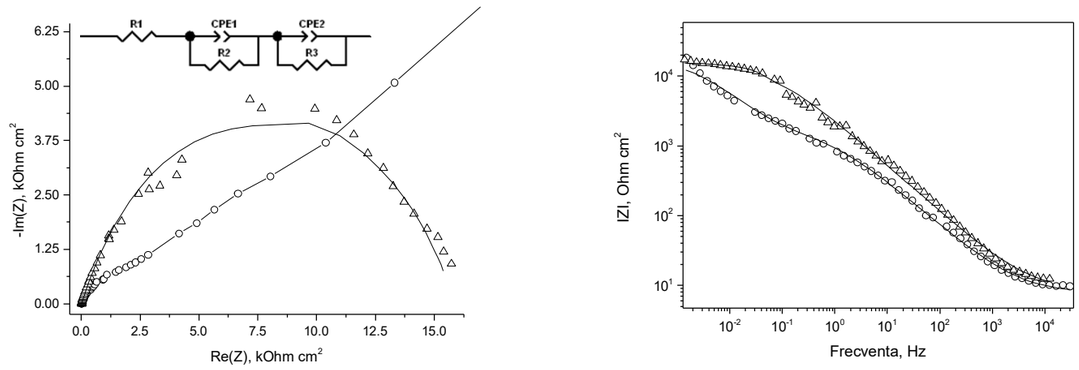
Knowledge of the corrosive properties of surfaces is important in the context of selecting materials according to their characteristics. Changing the parameters of the metal over time or characterizing the corrosion result allows the determination of the corrosion rate and corrosive properties.

Keywords

copper corrosion, corrosion inhibition.



Nyquist and Bode plots for copper coatings in pirofosfate solution in absence of argon (Δ) and in presence of argon (○). The fitting results are solid lines. In insert the equivalent circuit used for data fitting is shown.



Nyquist and Bode plots for copper coatings in Na_2SO_4 0,5 M solution in absence of argon (Δ) and in presence of argon (○). The fitting results are solid lines. In insert the equivalent circuit used for data fitting is shown.

Purpose

Studying the effect of oxygen on the corrosion of copper in corrosive electrolytes.

Material and methods

The open circuit potential (OCP) of the 2.5 cm^2 copper sample is measured vs. Ag/AgCl, at room temperature, with PARSTAT 2273 potentiostat (Princeton Applied Research), in the pyrophosphate electrolyte (g L^{-1}: $CuSO_4 \cdot 5H_2O$ - 12,5; $Na_4P_2O_7 \cdot 5H_2O$ - 100; pH = 8) and 0.5M Na_2SO_4 solution as a corrosive medium. The corrosion process of Cu coatings was investigated by EIS (electrochemical impedance spectroscopy). EIS was measured at OCP potential with a frequency range of 10^{-3}-10^4 Hz in pyrophosphate and 0.5 M Na_2SO_4 solution, using an amplitude of 10 mV. The test data was fitted by ZView2 software.

Results

The obtained data has shown copper OCP decrease in the pyrophosphate electrolyte from -0.209 V (in the absence of argon) to -0.218 V in the presence of argon (30 minutes prior to and during the measurement). In the 0.5M sodium sulphate solution, the copper OCP has dropped to negative values in the presence of argon -0.027 V compared to -0.006 V. Thus, inert argon led to inhibition of the corrosion process. The variation of copper OCP in the 0.5M sodium sulphate solution was more pronounced (0.021 V) than in the pyrophosphate electrolyte (0.009 V).

The corrosion resistance of copper coatings in pyrophosphate solution in the presence of argon is 5701.39 Ohm higher than in its absence. The corrosion resistance of the copper coatings in 0.5 M Na_2SO_4 solution in the presence of argon is 3242.68 Ohm higher than in its absence. The increase of the resistance reduces the corrosion rate in the presence of inert argon.

Conclusions

Decreasing the concentration of oxygen in the system decreases the rate of the reduction process of dissolved oxygen. Therefore, the OCP moves to cathodic values and the corrosion rate of copper decreases. The increase of the corrosion resistance in the absence of oxygen leads to a decrease in the corrosion rate.