THE CORROSION BEHAVIOR OF Ag NANOWIRES-MODIFIED GRAPHITE ELECTRODE IN ARTIFICIAL SWEAT SOLUTION

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Abstract

An electrochemical study was performed to evaluate the corrosion behavior of a graphite electrode modified with Ag nanowires in artificial sweat solution. The electrochemical setup consisted of a PGZ 402 model Voltalab 80 potentiostat (Radiometer Analytical) connected to three electrodes that were inserted into a glass cell. The auxiliary electrode was a Pt plate with S_{geom} = 1.13 cm^2, the reference electrode was an Ag/AgCl (sat. KCl) electrode, and the working electrode was either an unmodified graphite pallet or the Ag nanowires-modified graphite sample. The modification method utilized to obtain the Ag nanowires-based electrode was the drop-casting method. Basically, a volume of 10 µL suspension was removed from an alcohol suspension containing laboratory-synthesized Ag nanowires and subsequently applied on one of the surfaces of a previously polished graphite pallet. The sample was obtained after a 24-hour drying stage at 23 ± 2 °C. Before the corrosion test, it was inserted into a polyamide support to ensure a constant S_{geom} of 0.28 cm^2. This ensemble was immersed in the electrolyte solution consisting of artificial sweat. The corrosion behavior study was carried out at 23 ± 2 °C by performing experiments with electrochemical methods specific to corrosion studies, such as the open circuit potential method and the potentiodynamic polarization technique with Tafel representation. The polarization curves were recorded at the scan rate of 1 mV/s and the VoltaMaster 4 v. 7.09 software was used to determine the values of the following corrosion parameters: the corrosion potential (E_{corr}), the corrosion current density (i_{corr}), the polarization resistance (R_p), the corrosion rate (ν_{corr}), the anodic Tafel slope (β_a) and the cathodic Tafel slope (β_c). The corrosion inhibition efficiency (IE%) was also calculated, with the equation provided by Birdeanu *et al.* [1].

The main conclusion of the study is that the electrode most susceptible to corrosion in artificial sweat solution is the Ag nanowires-modified one. If the investigation were aimed at identifying the sample with the highest corrosion resistance then the modified electrode should have been discarded. However, this is not the case. The study is part of a larger experimental scheme aimed at outlining the antibacterial effect of the Ag nanowires. The low corrosion resistance of the electrode implies an intense release of Ag ions into the electrolyte. As the concentration quickly increases, the environment becomes toxic for bacteria. Future experiments will involve the presence of such microorganisms.

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References

[1] A.-V. Birdeanu, M. Birdeanu, E. Fagadar-Cosma, J. Alloys Compd. 706 (2017) 220.