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The Corrosion resistance of Ag and Ag-Au/a-C nanocomposite coatings deposited by dc magnetron sputteringAli Salehizadeh¹, Ricardo Serra², Isabel Carvalho³, Sebastian Calderon⁴, Sandra Carvalho³, Albano Cavaleiro⁵¹Mechanical Engineering Department, Coimbra, Portugal ²SEG-CEMMPRe, Coimbra, Portugal, Portugal ³CFUM-UP, Guimarães, Portugal ⁴INL, Braga, Portugal ⁵SEG-CEMMPRe, Coimbra, Portugal, Portugal

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Ag-doped DLC nanocomposite thin films were found to be promising coatings for biological applications owing to their great capability for antibacterial activity. However, the practical clinical purposes of the DLC coatings doped with Ag-nanoparticles require to tackle with two main concerns: bacterial colonization and also to corrosion under an aggressive biological environment. Furthermore, the bimetallic Ag-Au nanocomposites showed a higher antibacterial efficiency due to an improved activity of Ag atoms surrounded on the Au nanoparticle surface. In this research, we deposit the Ag-DLC and (Ag-Au)-DLC coatings onto the stainless steel (SS) by means of DCMS. To mimic the biological conditions, the coatings are exposed to the simulated urine solution. The ICP-OES analysis demonstrated a higher Ag release in the Ag-DLC coating. The surface morphology of the coatings was carried out before and after 14d immersion into artificial urine. The corrosion resistance of the coatings under immersion condition was characterized by the EIS technique. An appropriate equivalent circuit based on the two-layer model consisting of the inner intact barrier layer together with a thinner porous surface layer was proposed to simulate the electrochemical features. Furthermore, the results demonstrated that the inner intact layer resistance of (Ag-Au)-DLC coating is bigger than in Ag-DLC coating expressing higher corrosive resistance against the aggressive solution over Ag-DLC coating. A higher protective feature of Ag-Au doped DLC coating can be due to changes in the corrosion potential of the Ag-Au alloy with respect to pure Ag, and therefore, the alloy in contact with the carbon matrix will oxidize less when compared to Ag-DLC coating. Eventually, the galvanic coupling between Ag and carbon matrix is also constrained when Au is added.

Keywords

DCMS

Ag and Ag-Au nanocomposite coating

Corrosion resistance

EIS

Ag release