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Abstract

In this work, an aluminium 6061 alloy was heat-treated by designed retrogression and reageing (RRA) and coated with diamond-like carbon (DLC) interphase film by electrodeposition, which acts as a conversion coating, in order to assess the corrosion protection by potentiodynamic polarization testing when the samples are exposed to a simulated sea environment. The electrodeposition was performed using three sustainable electrolytes: a) 5% CH_3COOH electrolyte obtained from sugar cane juice, b) an electrolyte with CH_3COOH (obtained from sugar cane juice) + $C_4H_6O_6$ + $C_6H_8O_7$ + $NaHCO_3$ and c) a 5% CH_3COOH electrolyte for anodizing and DLC deposition. Scanning electron microscopy was performed on the coated samples before the corrosion tests in order to relate polarization resistance (R_p) to the coating microstructural features. The correlation between R_p, corrosion rate (*C.R.*) and mechanical strength (UTS) to the heat treatments, performed on the coated Al 6061 alloy, was established by a multivariate regression analysis, which allows to find the best combination of the heat treatments and electrodeposition electrolytes for further composite coatings design and development. The electrochemical testing on the electrodeposited films showed that the polarization resistance was greatly increase, from an initial value for the Al 6061-T6 of 126 up to 17300 Ωcm^2 for the coated conditions, which implies a reduction in corrosion wear about 99.29 %.

Keywords: Al 6061 alloy; DLC-coatings; Ageing; Retrogression; Reageing; Corrosion behavior; Robust regression.

1. Introduction

Several industries as aerospace, automotive, aeronautical, biomechanical, and food packaging demand coatings with high performance in several properties such as: adhesion, corrosion and abrasion resistance, biocompatibility and environmental risk reduction [1], [2], [3], [4]. The most used coating system consists of a minimum of three separate deposits. A first deposit, which is usually a carcinogenic risk chromate conversion coating [5] that is the result of the substrate pretreatment (<10-60 nm), which provides low corrosion protection and