CONTROLLED PARTICLE ETCHING AS A METHOD TO IMPROVE THE CORROSION PROTECTION OF A CHROMATE CONVERSION COATING ON THE 2024 ALUMINUM ALLOY

Oliveira*, M. A. S., Thim, G.P., Ribeiro,R.M.
Chemistry Department, Instituto Tecnológico de Aeronáutica (ITA), Pça Mal Eduardo Gomes, 50, CTA, São José dos Campos, SP, Brazil CEP 12228-901, *e-mail:dora@ief.ita.br

It is known that the cathodic reactions occurring on aluminum alloys are strongly affected by the nature and amount of intermetallic phases present in the metal. The high cathodic activity at the particle surfaces leads to a local high pH around these particles. As a result, the anodic and cathodic reaction rates increase and the dissolution of the matrix around the particles finally leads to the physical separation of the particles from the surfaces. In this work, cathodic polarization etching was used to remove copper containing particles from the 2024 aluminum alloy surface and to study the effect of this removal on the corrosion protection afforded by a chromate conversion coating.

The cathodic polarization experiments were performed using a conventional electrochemical cell with the as received 30x15x0.6 mm 2024 aluminum alloy coupons as working electrodes, a saturated silver/silver chloride as reference electrode, and platinum wire as counter electrode. The exposed area of the working electrodes was 1.0 cm^2. The electrolyte solution was a mixture of phosphoric acid, ethanol and water. All potentials were measured at room temperature (≈ 25 ^oC) and were controlled with a MQPG-01 potentiostat. The applied potentials were, respectively, –0.8, -1.0, -1.1 and –1.25 V. EDS x-ray was used for qualitative analyses of copper containing particles on the interface matrix/oxide and on the matrix. All experiments were performed in triplicate.

The first part of this work consisted in determining the potential range within which the copper containing particle removal at the interface copper/oxide was optimal. To find this range, the 2024 alloy was cathodically polarized at potentials more negative than the corrosion potential (–0.66 V) for 20 min. The qualitative results for EDS x-ray analyses of copper in equal areas at the interface matrix/oxide and at the matrix of samples, polarized at each different potential, are presented in Table 1.

The EDS results shown in Table 1 suggest that the potential range within which the copper containing particle removal at the interface copper/oxide is optimal is –1.0 to –1.1 V.

The second part of this work consists in treating the 2024 aluminum alloy samples polarized at –1.0 V with a chromate containing solution, usually used to make a chromium conversion coating. Samples treated in this way have been investigated at our lab using the EIS technique. The EIS results of samples treated in this way will be compared with the EIS results for samples chromium conversion coated without the cathodic polarization particle removal. The results for this comparison will be presented soon.

Table 1. EDS x-ray analyses of copper at the interface matrix/oxide and at the matrix of 2024 aluminum alloys cathodically polarized at different potentials.

Applied Potential (V/Ag/AgCl)	Copper (%) Matrix	Copper (%) Interface
-0.8	5.3±0.5	1.03±0.09
-1.0	5.3±0.5	0.48±0.04
-1.1	5.3±0.5	0.59±0.05
-1.25	5.3±0.5	1.4±0.1