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The Role of Chromate Conversion Coatings On Filiform Corrosion of Coated Aluminium Alloys

N. Le Bozec, D. Persson and D. Thierry (Swedish Corrosion Institute)

Beamline(s): X26A

Introduction: Chromate is widely used as conversion coating on aluminium alloys for aerospace and automotive applications. Chromate is known to reduce both the initiation and propagation of filiform corrosion on aluminium alloys [1]. However, chromate is toxic and therefore there is a need to understand the mechanisms of inhibition of chromate on aluminium alloys in order to find an environmental friendly alternative. XANES provides a unique in-situ tool for this kind of investigation.

Methods and materials: Aluminium alloys AA 6016 were chromated (alodine) and covered with a 5 μm thick organic coating. The specimens were scribed and the corrosion was initiated using 1 wt% NaCl. The samples were thereafter exposed to humid air at 85% RH at 25°C. XANES measurements were performed on filaments at 5992 eV (pre-edge peak, Cr(VI)) and at 6020 eV (edge peak, total Cr).

Results: Figure 1 shows a map of the ratio Cr(VI)/total Cr over a filament. Cr(VI) is depleted at locations closest to the head of the filament probably due to a reduction of Cr(VI) to Cr(III). A ratio of 0.15 to 0.12 is measured. However, at locations closest to the tail, no change in the ratio of Cr(VI) to total Cr was observed. It should be noted that the ratio Cr(VI)/total Cr in the original chromate conversion coating is 0.2. In addition, an important increase in the ratio of Cr(VI) to total Cr was observed in a corroding region formed in the scratch close to the chromate conversion coating (ratio around 0.5). The present results seem to indicate that filiform corrosion starts as pitting in the scratch. Due to its electrical charge, chromate ions will then migrate to the anodic places (e.g. the pits), which is in agreement with a previous study [2]. This leads to a depletion of Cr(VI) in the regions under the organic coating close to the pits. These Cr depleted areas will then act as weak points where filiform corrosion may be initiated and propagate. During the filiform corrosion process, the pits in the scratch repassivate and the anodic site is deplaced to the head of the filament. The propagation of filiform corrosion is however limited due to the reservoir of chromate in the conversion coating.

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References:

[1]. Axelsen S., Persson D., and Thierry D., “Effect of Climatic Parameters on Filiform Corrosion of Aluminium” in *Corrosion and corrosion prevention of low density metals and alloys*, Shaw B.A., Bucheit R.G., and Movan J.P., Ed., the Electrochemical Society meeting, p. 295-303, Phoenix, Arizona, USA, 2000.

[2]. J. Zhao, G. Frankel and R. L. McCreery, “Corrosion Protection of Untreated AA-2024 T3 in Chloride Solution by a Chromate Conversion Coating Monitored with Raman Spectroscopy”, J. of Electrochem. Soc., 145, 7, p. 2258-2264, 1998.

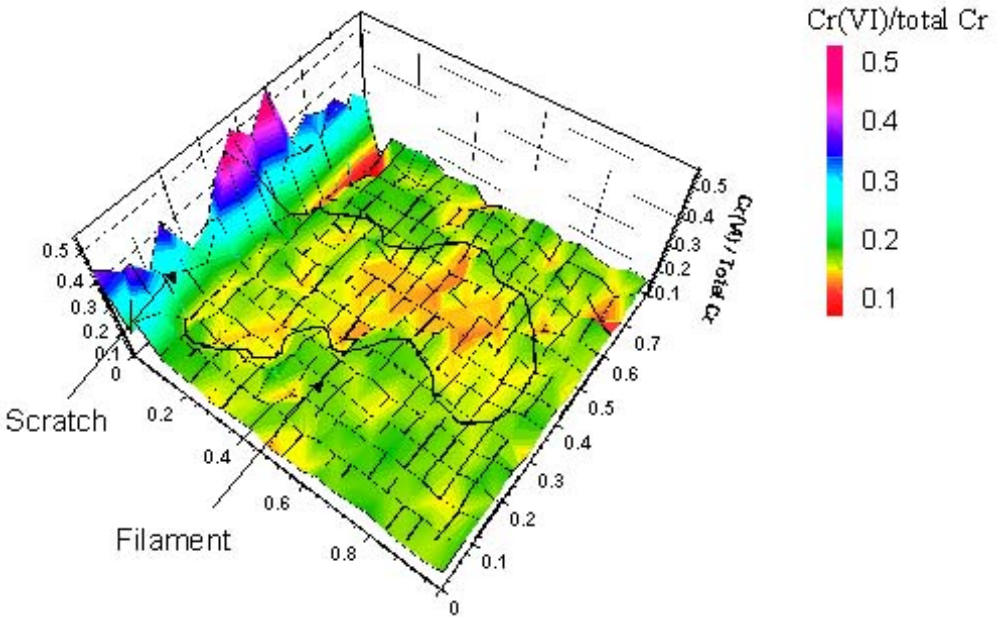

Figure 1: map of the ratio Cr(VI)/total Cr over a filament formed on coated AA6016