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Atmospheric Pitting and Galvanic Corrosion of High Strength Al Alloys

Z. Feng, S.C. Morton, M.S. Thomson, and G.S. Frankel
Fontana Corrosion Center, The Ohio State University
Columbus, OH 43209 USA

The corrosion and protection of high strength Al alloys has received a lot of attention over the recent years owing to their importance in the aerospace and defense industries. Much of that work has been performed on samples immersed in bulk electrolytes. However, Al in general and high strength Al alloys in particular are used in atmospheric conditions in which the environment contacting the sample surface is an adsorbed moisture layer in equilibrium with humid air, droplets of spray or condensation, or precipitation. Such atmospheric environments can influence the initiation and growth of various forms of corrosion by changing local aggressiveness and the solution resistance between active anodes and cathodes.

This talk will focus on two forms of atmospheric corrosion of high strength Al alloys: atmospheric pitting of AA7075-T6 and galvanic corrosion of coated AA2024-T3 panels with uncoated SS316 and Ti-6Al-4V fasteners.

The atmospheric pitting work was performed on AA7075-T6 under chloride droplets without or with chromate, vanadate, or cerous inhibitors. The experimental methods included the Scanning Kelvin Probe along with video monitoring, as well as optical profilometry. Under ineffectively inhibited conditions, secondary droplets were observed to form adjacent to the main droplet. The attack progressed by large-scale separation of anodic and cathodic regions under the droplet, with the anodic region initiating near the edge of the droplet at the site of the secondary droplet. A model is described for the formation of the secondary droplet and associated attack, by deliquescence of water vapor due to an excess of ions from the anode diffusing to the edge of the droplet.

The second topic utilizes a test panel that allows accelerated testing of coated panels in the field and in laboratory chambers through galvanic coupling with uncoated noble fasteners [1]. Measurements of galvanic current using a zero-resistance ammeter in a salt fog chamber and of metal loss using an optical profilometer have been shown to useful for quantifying the extent of attack [2]. In this work, we show how an acceleration factor can be defined to represent the extent of corrosion acceleration provided by the galvanic coupling relative to a sample uncoupled to noble fasteners.

References

1. C.A. Matzdorf, W.C. Nickerson, B.C. Rincon Troconis, G.S. Frankel, Longfei Li, and R.G. Buchheit, “Galvanic Test Panels for Accelerated Corrosion Testing of Coated Al Alloys, Part I: Concept,” Corrosion, 2013, http://corrosionjournal.org/doi/pdf/10.5006/0905.

2. Zhicao Feng and G.S. Frankel “Galvanic Test Panels for Accelerated Corrosion Testing of Coated Al Alloys, Part II: Measurement of Galvanic Interaction,” Corrosion, 2013, http://corrosionjournal.org/doi/pdf/10.5006/0907.