Localized Surface Attack of 7xxx Series Aluminum Alloys

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A surface attack somewhat akin to filiform corrosion has been observed to take place on 7075 Al alloy when exposed to chloride solutions and gels [1]. This localized corrosion is a transient phenomenon assisted by surface roughness leaving darkened lines along the corroded path. The corrosion does not retrace the same path. On abraded surfaces the attack moves down the abrasion marks and is activated by the acidity generated by anodic dissolution that generally confines the corrosion to a single abrasion path. An example is shown in Figure 1 for a 7050 alloy abraded on 400#. The lines in the difference-image obtained by digital subtraction and amplification, show the many paths of corrosion in a period of 300 s. The continued propagation of this attack increases with the depth of the abrasion. With deep scratches stable pitting takes place, particularly where the paths of deep scratches cross. The edge of samples bounded by adhesive tape has also been found to be a susceptible geometry [2].

The pH dependence of the propagation or initiation at the head of the travel direction of the corrosion path has been demonstrated using pH indicators, gels and viscous solutions [1]. Visual observations have shown that when a plume of low pH solution, carried from one corroding line by convection, again touches down on the sample it assists initiation of corrosion at that site [1]. Similar observations of the darkening of corroded surfaces along abrasion lines have been made at constant currents in acidic chloride solutions that have shown a dependence on the Cu concentration in the alloy [3].

Al and its alloys have shown a dramatic dependence on surface preparation. Wet abraded samples are distinctly more susceptible than samples prepared by abrasion in air [1]. Surface preparation prior to heat treatment has a dramatic effect on the corrosion of Al alloys and in particular, filiform corrosion [4] where the propagation of corrosion is again highly dependent on pH changes and maintaining acidity at the head of growth [5]. It may be seen in Figure 1b that corrosion has penetrated under the edge of the taped off area emphasized by the broken lines drawn at the edge of tape.

Measurements have been carried out to determine the effects of minor changes in the surface of abraded alloys on the formation of the filiform-like corrosion along abrasion markings, the development and subsequent etching along the underlying intermetallic constituents extruded in the cold rolling direction and dramatic changes in pitting potentials.

References

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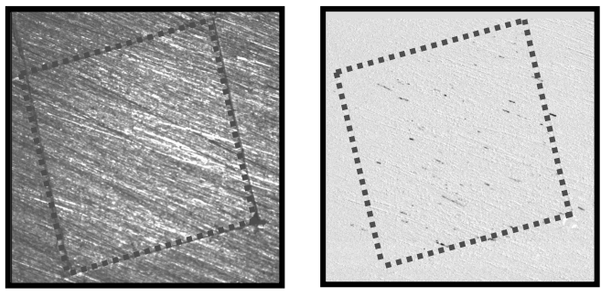

(a) **(b)**

Figure 1. Alloy 7070 abraded on 400# silicon carbide and exposed to 0.05 M NaCl. (a) The real image after 20 minutes (b) The difference image obtained by the digital subtraction and amplification of the image in (a) from an image taken 300 s earlier.