

Analysis of local changes in pH during dissolution of aluminum alloy 2024-T3 in aqueous NaCl

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Local changes in solution chemistry play a role in the series of complex processes that take place during corrosion of aluminum alloy 2024-T3 (1- 6). These processes include the dissolution of Al and Mg from Al<sub>2</sub>CuMg s-phase particles, leaving behind a porous Cu remnant (1) that may act as an efficient cathode for oxygen reduction and has been predicted to produce local alkalinity (1-3). This local alkalinity may result in a Cu-enriched surface near the particle remnant by promoting the preferential dissolution of aluminum in this region (3,4). Closely spaced efficient cathodes may lead to overlapping zones of local alkalinity and produce a microelectrode effect (3), where broad area dissolution of the matrix aluminum is expected to occur, leading to significant Cu enrichment (3). The Cu remnants cease to function as local cathodes when they become covered with corrosion product or dissolution leaves them electrically isolated from the matrix (2,3,5).

In an effort to elucidate the role of local pH changes in the corrosion of 2024-T3 we have done in-situ observation using scanning confocal microscopy with fluorescein as an electrolyte pH indicator (6,7) and have employed modern image analysis techniques to characterize local changes in pH during open circuit exposures to aerated, dilute NaCl solutions. Image analysis allows us to compare integrated intensities for spatially separated sites that may be undergoing balancing anodic and cathodic reactions and to begin to relate observed fluctuations in fluorescein emission intensity to experimental emission vs. pH curves. Regions of local alkalinity (bright area) and of local acidity (dark area) with their respective areas and average intensities are shown in Figure 1. Figure 2 shows the capture and cataloging of individual sites that are lower or higher in pH than a selected reference image. Image analysis of these in-situ pH studies presents a more detailed and complete description of the solution chemistry changes taking place during corrosion of this alloy which, in turn, impacts the current models for this process.

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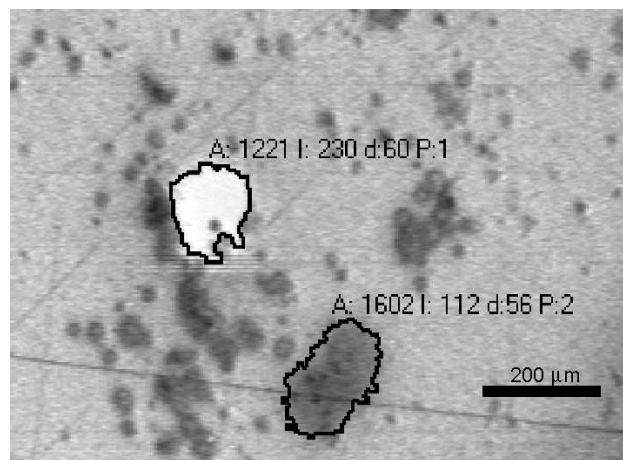


Fig. 1 In-situ confocal microscope image of Al alloy 2024-T3 in 50mM NaCl during exposure to dilute NaCl processed to show area and average intensity of each region.

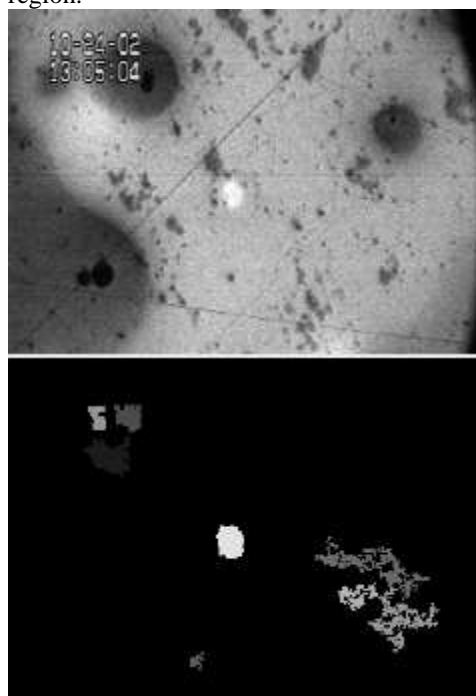


Fig. 2 In-situ confocal microscope image (above) with detected regions of reduced and elevated pH (below).

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