4D MICROSTRUCTURAL AND ELECTROCHEMICAL CHARACTERIZATION OF DISSIMILAR-METAL CORROSION IN NAVAL STRUCTURAL JOINTS

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Dissimilar metal corrosion in aircraft and naval structures has proven to be a persistent challenge. Decades of research in the area have shown that such complex contact surfaces are subject to a combination of corrosive environments and mechanical loads. Hence, this multi-faceted problem must be understood from electrochemical, microstructural and mechanical standpoints to comprehensively understand corrosion damage in these systems.

In this work, we have focused on studying corrosion in a dissimilar metal couple consisting of an Al7075-T651(plate with threaded/unthreaded holes) anode and Ti-6Al-4V cathode(screws/rivets). Synchrotron X-ray tomography was used to perform *in situ* corrosion fatigue experiments on the dissimilar metal couple specimen in a 3.5 wt% NaCl environment to gain insights on the corrosion assisted crack initiation and propagation process.
The evolution of microstructure during the accelerated corrosion of bare Al7075-T651 in a 3.5 wt.% NaCl environment was also investigated. Interrupted Tafel testing was used to understand the evolution of corrosion and pitting on the alloy surface at each stage of the experiment. Additionally, the role of grain boundaries and a variety of second phase particles with their associated changes in morphology was studied. A confluence of methods comprising potentiodynamic polarization, X-ray microtomography and the FIB-SEM have been used.
Our latest efforts in this area attempt to incorporate diffraction contrast tomography(DCT) to study corrosion behavior in Al7475. The technique is akin to 3D EBSD and allows us to investigate the role that grain boundaries, triple points and inclusions can have on the initiation and propagation on pitting.

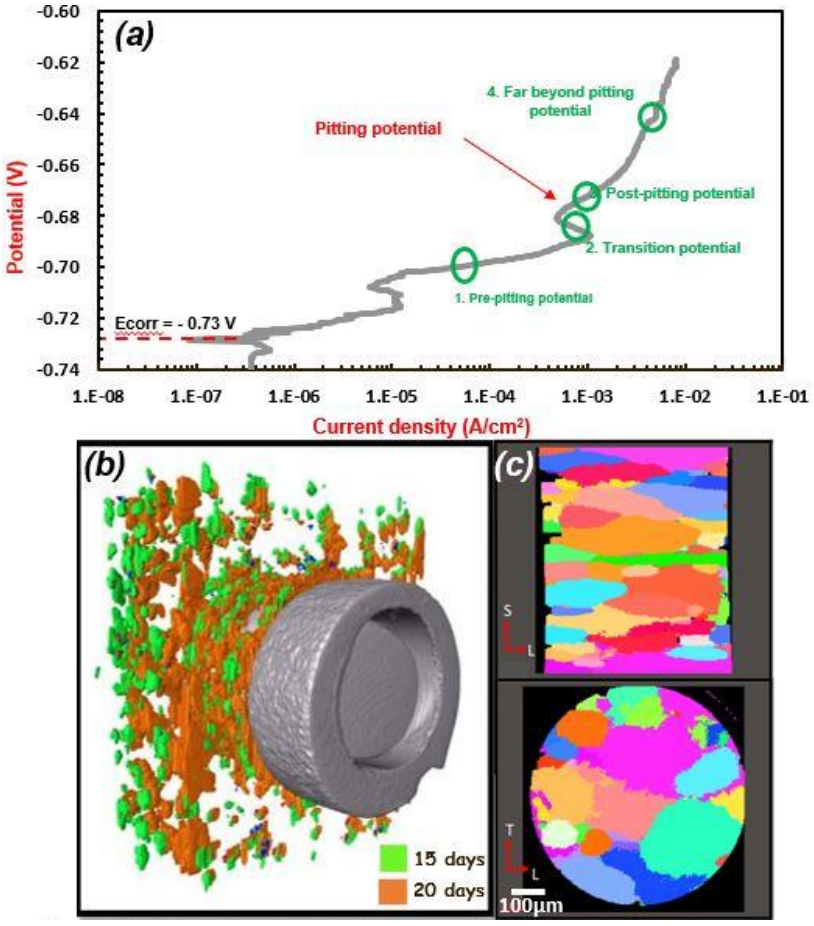

Figure 1:(a) Potentiodynamic polarization curve of Al7075-T6511 showing regions where the experiment was interrupted, (b) Pitting corrosion in Al7075-T651/Ti-6Al-4V couple after 15 and 20 days of immersion corrosion in 3.5 wt.% NaCl solution, (c) DCT of Al7475 showing 3D grain structure along the SL and TL directions.