Title: Coupled Multi-Electrode Investigation of Crevice Corrosion of 316 Stainless Steel

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Abstract:

Crevice corrosion is currently studied using either one of two techniques depending on the data needed. The first method is a multi-crevice former over a metallic sample; this provides information on the severity of crevice corrosion (depth, position, frequency) but delivers little to no electrochemical information [1]. The second method involves the potentiodynamic or potentiostatic study of an uncreviced sample in model crevice solution or under a crevice former in aggressive solution [2].

Crevice corrosion is highly dependent on the position in the crevice. The distance from the crevice mouth will affect the depth of attack, the solution composition and pH, and the ohmic drop and the true potential in the crevice [3-6]. These in turn affect the current density as a function of potential and position. A Multi-Channel Micro-Electrode

Analyzer[1] (MMA) has been recently used to demonstrate the interaction between localized corrosion sites (pitting corrosion and intergranular corrosion) [7]. MMA can provide spatial resolution of electrochemical properties in the crevice. By coupling such a tool with scaling laws derived from experimental data (a simple equation linking the depth of crevice corrosion initiation to the crevice gap), it is possible to produce highly instrumented crevices, rescaled to enable spatial resolution of local corrosion processes. In this study, the use of multi-wires arrays (up to 100 closed packed wires simulating a planar electrode, divided in 10 distinctively controllable groups) electrically coupled through zero resistance ammeters enables the observation of the current evolution as a function of position inside and outside the crevice. For instance, the location of crevice initiation sites and propagation behavior can be studied under various conditions. Experiments can be conducted with various realistic variables. These can either be electrochemical (such as proximate cathode) or physical (crevice former material or position). Using new impedance-capable MMA, it is also possible to monitor the film breakdown and the early stages of crevice corrosion as a function of the wires position. In this talk, the use of multi-electrode array to study crevice corrosion of 316 stainless steel and a Ni-Cr-Mo alloy is reviewed.

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