A Model of Damage Evolution During Crevice Corrosion of Nickel Base Alloys

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The goal of this project is to formulate a diffusion based mathematical model for crevice corrosion of alloys that includes damage evolution, e.g. changes in the surface morphology inside the crevice. The model is based on a solution of the La Place equation and uses a finite element mesh with a moving boundary to calculate damage evolution. As input to the model experimental potentiodynamic polarization data are used to determine the dissolution rate as a function of potential (distance) along the crevice. To date we have been successful in modeling the damage evolution in pure nickel in sulfuric acid solution (IR control, Fig.1). In this presentation recent developments in accounting for the influence of mass transport, solution reactions and alloy stoichiometry on damage evolution will be presented. As part of this work we have conducted the requisite corrosion electrochemistry experiments necessary for model input (potentiodynamic polarization data as a function of species concentration, analysis of mass transport limited reactions) and model benchmarking and validation (damage profiles, local current and potential maps). The knowledge gained through modeling and simulation coupled with experimental measurements of actual damage in artificial crevices provides feed-back and validation as well as insight into the fundamental mechanisms.

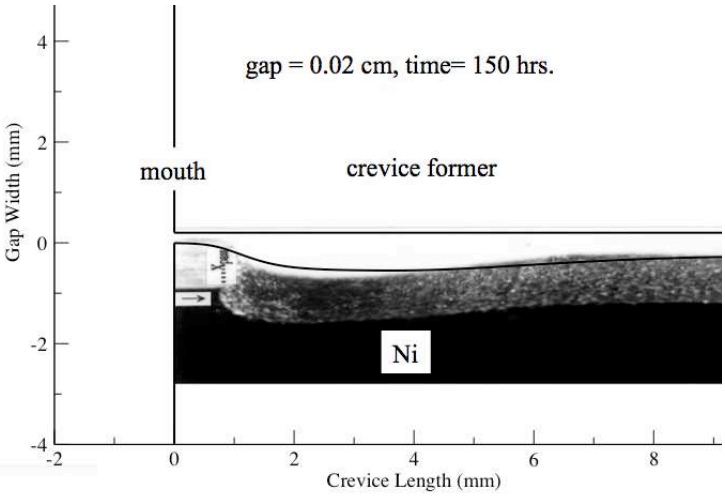

Figure 1 Damage evolution for Ni in sulfuric acid calculated by our model overlayed with actual damage profile from Abdulsalam and Pickering, JECS 1998.

Acknowledgments

Work on this project was made possible by a grant from the US DoD UCC/TCC program # 1000000149, administered by the USAFA and Richard Hayes (Deputy Director - CPO) and Daniel Dunmire (Director - CPO).