INTERGRANULAR CORROSION AND GRAIN DISSOLUTION WITH PERIDYNAMICS

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In polycrystalline material, intergranular corrosion (IGC) is a major cause for failure initiation and leads to significant reduction in strength. The sharp and narrow defects along grain boundaries induced by the corrosion damage along grain boundaries act as stress concentration sites, from which cracks can easily develop. While progress has been made on certain aspects of modeling IGC damage, it can be said that a fully predictive model is no yet available. In this work, we introduce a peridynamic (PD) model (see [1] and [2]) for IGC damage ([3]). We use mixed potential theory and mass transfer in the electrolyte to model IGC. The model considers different dissolution rates for grains and grain boundaries based on their corresponding Tafel kinetics. We validate our model quantitatively against published experiments for IGC in a AA2024 foil immersed in NaCl solution. In addition, we show that new PD model can successfully capture the combination of grain boundary corrosion and grain dissolution at higher potential values (see Fig. 1), in agreement with experimental observations. We extend the model to treat general micro-galvanic corrosion and compare our results with experimental ones.

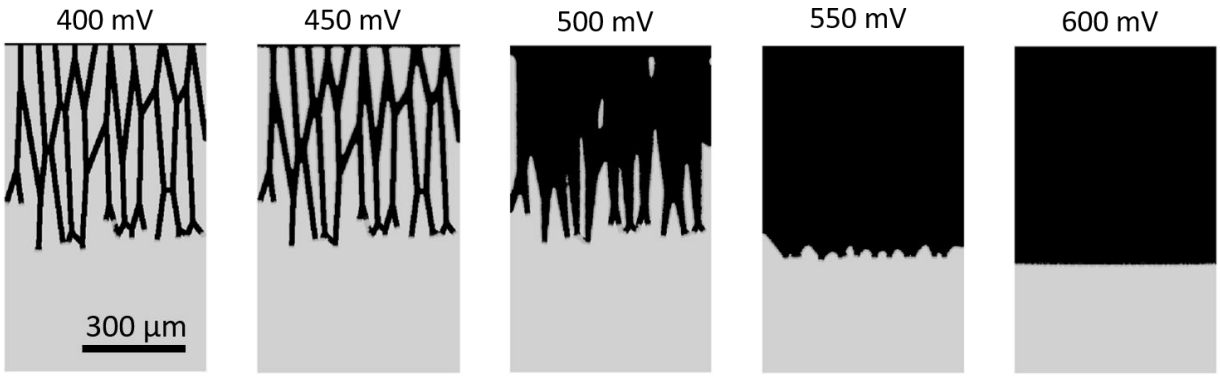

Figure 1 – Peridynamic simulations (sample morphology) for corrosion of AA2024-T3 sheet exposed to 1M NaCl solution in L-direction for 4 hours at different applied potentials.

References

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