A Comprehensive Study of the Metastable Corrosion Pit Growth

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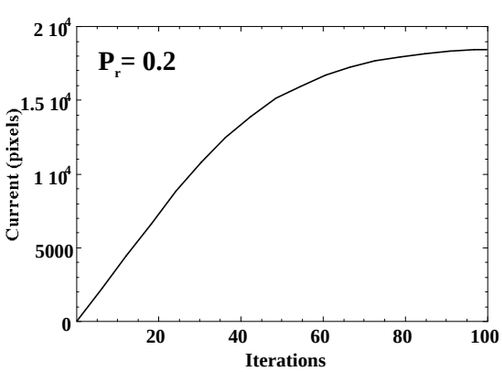
In a previous work[1] numerical simulations of the metastable pit growth has been successfully conducted where the main purpose was the investigation of a pit growth. It was proposed to introduce Monte Carlo method and cellular automata technique as a simulation tools to study of the dynamic of a metastable pit growth focusing on the role of the repassivation process. The basic idea was that as a first approach to replace the repassivation law by probabilistic laws constructed in such a way to take into account the influential electrochemical parameters, namely the applied potential and the local chloride concentration.

Anodic dissolution as well as local repassivation were then properly simulated, showing significant changes in the morphology of the pitting process. A growing pit exhibit an isotropic morphology for low repassivation probability and it ramifies for intermediate values of the probability parameter (p~0.2) until a definitive arrest of the growth for higher probabilities. It was also demonstrated that during the growth regime it is observed a significant change in the mode of pit growth when the probability of the repassivation is varied (see figure.1).

The following paper propose to carry out, in a first step, extensive simulations where two principal factors the repassivation and the ohmic drop are deeply investigated.

Hence, quantitative kinetics analysis are deduced from the simulations and discussed in the light of the various models dedicated to the effect of repassivation and ohmic drop on the metastable-stable transition[3].

In a second step, a simplified method is proposed for modeling the chemistry and potential distribution taking into a count the repassivation phenomena, using the Finite elements method[3,4].The model is based on an assumption that repassivation is governed by the local pH which triggers the internal passive film surface covering. The resulting modeling is compared to the simulation results and discussed in a general comprehensive framework regarding the growth pitting process.



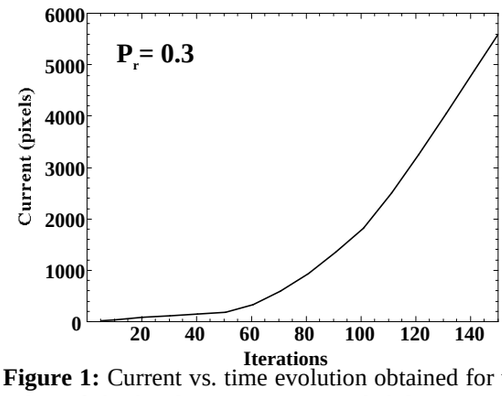


Figure 1: Current vs. time evolution obtained for various value of the local repassivation probability P_r indicating the strong dependence of the growth law on P_{rb}.

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