

A PHASE FIELD METHOD FOR MODELLING STRESS CORROSION CRACKS PROPAGATION IN A NICKEL BASE ALLOY

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Abstract: Stress corrosion cracking (SCC) is a very common failure mechanism characterized by a slow, environmentally influenced crack propagation in structural components. The mechanisms proposed to explain at the microscopic scale the cracking propagation processes are not able to elucidate all aspects of this phenomenon in different metal/environment systems. This work is concerned with the development of a new multiphysics model for understanding the phenomena of crack propagation under the effect of SCC. This new model is based upon: (i) the Phase field method, based on a variational formulation of brittle fracture with regularized approximation of discontinuities; (ii) a robust algorithm capable to prescribe the displacements (over the boundary of a small sub-volume) and crack onset obtained by image processing based on digital image correlation in the sample during the numerical simulations; (iii) a coupling with diffusion model informed with first-principles computations of diffusion coefficient. In this new model, the phenomenon of environmentally assisted cracking phenomena was successfully represented as well the interactions between cracks and the subsequent shielding effects. The analyses, performed on several samples of Inconel 600 alloy with a crack network, show a remarkable agreement between the cracks morphology and history obtained by the model and by the experiments.