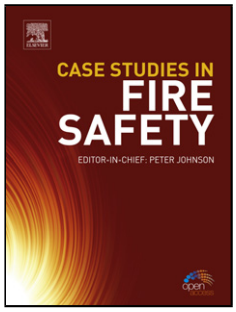

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Author: T-T. Nguyen J. Bolivar Y. Shi J. Réthoré A. King M. Fregonese J. Adrien J-Y. Buffiere M-C. Baietto

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A Phase field method for modelling anodic dissolution induced stress corrosion crack propagation

T-T. Nguyen[a], J. Bolivar[b], Y. Shi[b], J. Réthoré [a,1], A. King[c], M. Fregonese[b], J. Adrien[b], J-Y. Buffiere[b], M-C. Baietto[a]

[a] *Université de Lyon, CNRS, INSA-Lyon, LaMCoS UMR5259, France*
[b] *Université de Lyon, CNRS, INSA-Lyon, Université Lyon 1, MateIS UMR5510, France*
[c] *Synchrotron Soleil, Psyche beamline, L'Orme des Merisiers, 91190 Saint Aubin, France*

Abstract

The phase field method is a powerful tool for studying microstructural evolution in various domains of material sciences, including phase change, initiation and propagation of fracture. In this work, a new formulation is developed based on the phase field method for modeling stress corrosion cracking (SCC) induced by anodic dissolution. This method was applied for modelling SCC of an aluminum alloy (2xxx series) in a saline medium (NaCl), which allows considering the effects of both electrochemical and mechanical processes. The classical phase transition model for material dissolution is coupled with the mechanical problem in a robust manner, providing an efficient tool for studying the competition between electrochemical and mechanical contributions to fracture. A numerical implementation based on finite elements is elaborated. The numerical results are compared to experimental data obtained by in situ microtomography.

Keywords: Stress corrosion cracking, anodic dissolution, crack propagation, phase field

1. Introduction

Stress-corrosion cracking (SCC) is a common failure mechanism characterized by a combination of a mechanical load, a corrosive environment and a susceptible material. The occurrence of SCC induces premature failure of the material, which is recognized as potentially dangerous. In that context, a detailed investigation regarding SCC role is necessary to accurately predict the strength and failure of materials and structures.

Email address: julien.rethore@ec-nantes.fr (J. Réthoré)
[1]Now at GEM, CNRS UMR 6183 CNRS / Ecole Centrale de Nantes / Université de Nantes