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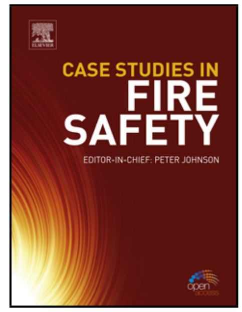

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High Resolution Characterization of Sulfur-Assisted Degradation in Alloy 800

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Highlights

- EAC, IGC, and pitting occurred in Alloy 800 exposed to a 280 °C acid-sulfate environment.
- Nano-scale chemical characterization at crack tips revealed mixed Ti- and Cr-rich oxide(s) with sulfur incorporated.
- Adsorption of sulfur leads to a poorly adherent mixed oxide/sulfide layer, propagating EAC via film-rupture.
- Nano-scale characterization of pits revealed a 10 nm thick sulfur layer and minimal oxides.
- Transition from EAC to pitting occurs at near-complete sulfur surface coverage, which limits oxide nucleation.

Abstract

Environmentally assisted cracking (EAC) initiation tests were carried out by subjecting Alloy 800 tensile specimens to 0.55 mol/kg SO_4^{2-} solution, $pH_{280°C}$ 3, at 280 °C using slow rise-time cyclic loading and in-situ crack detection. EAC, intergranular corrosion (IGC), and pitting were observed. Transmission electron microscopy analysis revealed Ti- and Cr-rich oxides in cracks, and sulfur incorporated in oxide(s) or as sulfide compound(s). This oxide/sulfide film is likely impaired, producing a slip dissolution-type EAC mechanism. For pitting, only a nano-scale sulfur