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Peridynamic Investigation of Surface Stability in Stress-Assisted Corrosion

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ABSTRACT

The peridynamic stress-assisted corrosion model is used to study the stability of the corrosion front of metallic materials under tensile mechanical load. The results show that the solution diffusion trends to smooth the corrosion front, while stress corrosion roughens the corrosion front and leads to higher stress concentrations. Compared to the initial concave profile, the initial convex profile helps to reduce the stress-assisted corrosion rate and reduces the role of stress in stress-assisted corrosion. The critical stress of stress-assisted corrosion is introduced in the research, below which the roughness of the corrosion front gradually decreases, meaning that the corrosion front is stable. The critical stress of stress-assisted corrosion is found through the real-time roughness evolution of the corrosion front. By analyzing the influence of the mechanical-chemical coupling coefficient and the applied potential on critical stress, it is found that the influence of external voltage on critical stress is smaller than that of mechanical-chemical coupling coefficient. Applying this peridynamic stress-assisted corrosion model to the corrosion of metals with initial holes or impurities finds that the impurities help maintain the stability of the corrosion front compared with holes, thereby reducing the risk of stress corrosion cracking.

KEYWORDS

Peridynamic; stress-assisted corrosion; surface stability; roughness

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