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Abstract

Spallation failure of oxide scale in high-temperature environment, usually occurring at the oxide-alloy interface, primarily originates from the interfacial defects such as cracks. At the same time, the substrate alloy usually experience plastic deformation during high-temperature oxidation process. In this study, we extend our previous work on stress-diffusion interaction in the oxidation of Fe-Cr alloys by including the inelastic deformation of alloys and use it to study the growth mechanism of a crack lying along oxide-alloy interface. The results predict that the plasticity of alloy helps to prevent the crack from growing. It is also found that faster diffusion of species will lead to higher level of interfacial failure driving force. Reduction of Cr ion diffusion in oxide by introduction of the reactive element in the alloy will help to prevent interfacial crack growth.

Keywords

Elastic-plastic, Fe-Cr alloys, Finite element, Interfacial crack, Oxidation.