

**Zhou, H.,** Cherkaoui, M., A finite element analysis of the reactive element effect in oxidation of chromia-forming alloys, Philosophical Magazine, Vol. 90, No. 25, 2010, pp. 3401–3420

### **Abstract**

In many situations, failures such as spallation or cracking occur when chromia-forming alloys are subjected to high-temperature thermal treatment. On the other hand, a small amount of reactive element addition can remarkably increase the adherence between chromia scales and alloys. A two-dimensional finite element model has been developed to analyze the effects of reactive elements on the selective oxidation of chromia scale-forming binary alloys. The quantitative relation between the diffusivities of chromium ions and the activities of reactive element (yttrium) has been derived for the first time and has been incorporated with a continuum thermodynamic model accounting for stress–diffusion interaction in the oxidation of Cr–Fe alloys. The model predicts that the diffusivities of Cr ions are affected by the activities of reactive element compounds, which eventually leads to a decrease of the interfacial spallation driving force, as well as an increase of the interfacial adherence.

### **Keywords**

Reactive element, Chromia-forming alloy, Selective oxidation, Finite element model