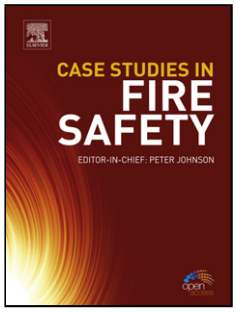

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PII: S0010-938X(17)30909-5
DOI: http://dx.doi.org/10.1016/j.corsci.2017.08.025
Reference: CS 7178

To appear in:

Received date: 19-5-2017
Revised date: 29-7-2017
Accepted date: 21-8-2017

Please cite this article as: Lu Qin, Yanling Pei, Shusuo Li, Xinbao Zhao, Shengkai Gong, Huibin Xu, Role of volatilization of molybdenum oxides during the cyclic oxidation of high-Mo containing Ni-based single crystal superalloys, Corrosion Sciencehttp://dx.doi.org/10.1016/j.corsci.2017.08.025

Role of volatilization of molybdenum oxides during the cyclic oxidation of high-Mo containing Ni-based single crystal superalloys

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Highlights

- The volatilization of refractory metal oxides may influence the mass changes during the transient oxidation in the high refractory elements-containing single crystal superalloys.
- The spallation of the oxide scales determines the mass change of the samples during the steady oxidation in the cyclic oxidation test.
- Thicker oxide scales show stronger tendency to spallation owing to the higher elastic strain energy.
- Finite element calculations show the stress distributions of the oxidation systems in the Ni-based single crystal superalloy.

Abstract: The cyclic oxidation behavior of two high-Mo containing Ni-based single crystal superalloys with different Al contents at 1100 °C has been investigated. The higher formation tendency of the continuous and dense α-Al_2O_3 scales in the alloy with higher Al content can prevent the volatilization of MoO_3 through decreasing the diffusion of Mo. Besides the spallation of oxide scales, the volatilization of refractory metal oxides can also result in the mass loss of the samples in the cyclic oxidation tests, especially in the Ni-based single crystal superalloys with high contents of refractory elements and weak formation tendency of continuous α-Al_2O_3 scales.

Keywords: Ni-based Superalloy; Cyclic Oxidation; Al Content; Volatilization; Mo; Rare Earth Effect (REE).

1. Introduction

Ni-based single crystal superalloy is one of the most potential new-generation materials for high-temperature structural applications in turbine blades of industrial gas turbines and jet engines, owing to the good mechanical properties and oxidation properties [1]. Among them, the high-Mo containing Ni-based superalloys show good mechanical properties and are attractive to the researchers and engineers[2-4].

The mechanical properties of the Ni-based single crystal superalloys are guaranteed by adding W, Mo through solid-solution strengthening and Al, Ti, Ta