

# Author's Accepted Manuscript

Hot Corrosion and Low Cycle Fatigue of a  
Cr<sub>2</sub>AlC-Coated Superalloy

J.L. Smialek, J.A. Nesbitt, T.P. Gabb, A. Garg,  
R.A. Miller



PII: S0921-5093(17)31425-9

DOI: <https://doi.org/10.1016/j.msea.2017.10.098>

Reference: MSA35701

To appear in: *Materials Science & Engineering A*

Cite this article as: J.L. Smialek, J.A. Nesbitt, T.P. Gabb, A. Garg and R.A. Miller, Hot Corrosion and Low Cycle Fatigue of a Cr<sub>2</sub>AlC-Coated Superalloy, *Materials Science & Engineering A*, <https://doi.org/10.1016/j.msea.2017.10.098>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## Hot Corrosion and Low Cycle Fatigue of a Cr<sub>2</sub>AlC-Coated Superalloy

J.L. Smialek<sup>1</sup>, J.A. Nesbitt<sup>1</sup>, T.P. Gabb<sup>1</sup>, A. Garg<sup>1</sup>, R.A. Miller<sup>1</sup>

<sup>1</sup>NASA Glenn Research Center, Cleveland, OH

### Abstract

Low temperature Type II hot corrosion is a serious problem for low cycle fatigue (LCF) failure of advanced turbine disk alloys operating at increased temperatures. Accordingly, the present effort studied 15-20 μm corrosion resistant Cr<sub>2</sub>AlC sputter coatings on Low Solvus High Refractory (LSHR) disk alloy LCF test specimens. These were cycled to failure at 840/-430 MPa and 0.33 Hz, after 500 h oxidation and 50 h of Mg-Na<sub>2</sub>SO<sub>4</sub> hot salt corrosion, all at 760°C. The coating successfully prevented hot corrosion pitting that was responsible for a 90% decrease in uncoated LCF specimens. However, fractography identified unintentional 15-30 μm deep defects produced by grit blast surface preparation of coated samples. These acted as failure origins and introduced anomalous life reduction for some coated test specimens. Furthermore, the presence and growth of an undesirable Cr<sub>7</sub>C<sub>3</sub> second phase diminished protectiveness by promoting internal oxidation and embrittlement of the coating.

Keywords: Cr<sub>2</sub>AlC  
coating  
hot corrosion  
superalloy  
fatigue

### 1.0 Introduction

Superalloy turbine disk advances have targeted 760°C as a realistic, near-term elevated temperature goal. These advances were enabled by dual heat treated microstructure and LSHR (low solvus, high refractory concepts[1]. However, higher temperatures will increase the potential for oxidation-induced embrittlement. [2,3] Furthermore, Type II low temperature hot salt corrosion (LTHC) emerges in the 700-800°C range. Since Type II is often associated with non-uniform pits, such surface defects are often identified as the strength limiting flaws in low cycle fatigue (LCF) tests. To that end, a number of coating efforts have been initiated to alleviate the problem.[4] Ideally, coatings should not themselves embrittle the surface or decrease LCF

Download English Version:

<https://daneshyari.com/en/article/7974185>

Download Persian Version:

<https://daneshyari.com/article/7974185>

[Daneshyari.com](https://daneshyari.com)