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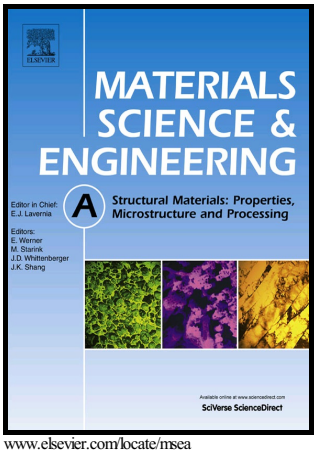

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Hot Corrosion and Low Cycle Fatigue of a Cr_2AlC-Coated Superalloy

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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_2AlC 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_2SO_4 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_7C_3 second phase diminished protectiveness by promoting internal oxidation and embrittlement of the coating.

Keywords: Cr2AlC
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