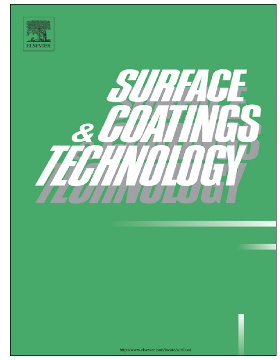
Accepted Manuscript



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PII: S0257-8972(18)30006-9
DOI: https://doi.org/10.1016/j.surfcoat.2018.01.006
Reference: SCT 22989

To appear in: *Surface & Coatings Technology*

Received date: 2 October 2017
Revised date: 31 December 2017
Accepted date: 2 January 2018

Please cite this article as: R. Kromer, J. Cormier, S. Costil, D. Courapied, L. Berthe, P. Peyre , High temperature durability of a bond-coatless plasma-sprayed thermal barrier coating system with laser textured Ni-based single crystal substrate. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Sct(2017), https://doi.org/10.1016/j.surfcoat.2018.01.006

High temperature durability of a bond-coatless plasma-sprayed thermal barrier coating system with laser textured Ni-based single crystal substrate

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Abstract

Thermal barrier coating systems are usually build-up with bond coats to ensure a good adhesion of the ceramic top coat and to protect the substrate against oxidation and corrosion. Such system is often subjected to complex thermo-mechanical loading. Because of the very different damage processes encountered during service operations, a simplified system was investigated by removing the bond-coat. Recently adhesion bond strength was enhanced using laser surface texturing of the substrate in thermal spraying processes. Atmospheric plasma spray yttria-stabilized-zirconia thermal barrier coating system was deposited on the Ni-based AM1 single crystalline superalloy without bond coat. Adhesion bond strength was already increased compared to conventional processing method. Top coat durability was evaluated at high temperature and damage mechanisms were studied. Isothermal and cyclic oxidation tests showed durability of 1000h and 400 cycles at 1100°C. The oxidation mechanisms at the substrate/top coat interface changed due to fast solidification during the laser texturing process. Then, TBC system was studied under high temperature mechanical solicitation in tension creep. The textured interfaces were not damaged after 1% creep strain while top-coat/substrate interfacial cracking was observed for grit-blasted specimens. Moreover, no preferential crack development in the substrate was observed. Patterns provided an enhanced adhesion by changing the stress distribution near the interface.

Keywords: laser texturing, thermal barrier coating system, oxidation, mechanical adhesion, creep.

1 Introduction

Thermal barrier coatings (TBC) are widely used on nickel-based superalloys substrates submitted to prolonged exposures to combustion gases at high operating temperatures in order to increase gas