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Cyclic Oxidation Characteristics of HVOF Thermal-sprayed NiCoCrAlY and CoNiCrAlY Coatings at 1000 °C

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Abstract

Thermal-sprayed MCrAlY coatings have become widespread in various industries such as power plants, aeronautics, and oil and gas firms. High-temperature oxidation behavior of these coatings is therefore of significance. Spraying of two prevalent MCrAlY powders (NiCoCrAlY and CoNiCrAlY) on Hastelloy substrate by high velocity oxygen and fuel method and exposing them to 1000 °C air for resolving of their cyclic oxidation behavior are presented in this paper. The coatings were characterized by x-ray diffraction, scanning electron microscopy and energy-dispersive x-ray spectroscopy. The obtained oxidation kinetic indicated that at 1000 °C, the thermally sprayed NiCoCrAlY coating has greater resistance to oxidation than CoNiCrAlY. While oxidation rate of the former follows a parabolic rate equation with specific rate of 5.1×10^{-3} $(\mu m)^2.h^{-1}$ at 1000 °C, the oxidation rate for the latter has a specific rate of 12.1×10^{-3} $(\mu m)^2.h^{-1}$.

Keywords: MCrAlY coatings; High Velocity Oxygen and Fuel; Cyclic Oxidation; Thermally Grown Oxide

1. Introduction

Progress in turbine technology requires highly developed coatings with qualified specifications such as resistance to diverse aggressive environments, consistent coating-substrate thermal expansion and prolonged resource of the advantageous elements like Al and Cr [1, 2]. Simultaneous meeting of these demands is arduous for overlay coatings. After so many attempts for improvement of the efficiency of various coatings, MCrAlY (M=Ni, Co, or both) has been