

Nanocrystalline rare earth oxide coatings for increased oxidation resistance of chromium dioxide forming alloys.

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Abstract

The use of rare earths to increase high temperature oxidation resistance of many chromium dioxide and alumina forming alloys is quite well known. The rare earths can be added as elements (or as oxide dispersions) to the alloys or applied as an oxide coating to the alloy surface. The sol-gel technique is considered to be very efficient to apply fine nano-crystalline oxide coatings. Oxide gel coatings of various rare earths such as lanthanum, cerium praseodymium, neodymium, samarium, gadolinium, dysprosium, yttrium, erbium and ytterbium on an iron-20 wt% chromium alloy surface were prepared to determine their influence on isothermal and cyclic oxidation behavior (RT-900°C) of the alloy. The crystallite size, morphology and coverage of the different RE oxides were studied and compared. The crystallite size, morphology and coverage of the rare earth oxide gels varied with the type of rare earth. The isothermal and cyclic oxidation resistance of the alloy increased with increase in time at temperature required to reach a specific chromium dioxide layer thickness. This in turn was influenced by characteristics of the rare earth oxide coating such as crystallite size, morphology, stability, coverage and rare earth ion radius.

Key words: Rare earth oxide, sol-gel, coating, iron-chromium alloy, high temperature cyclic oxidation, chromium dioxide, morphology, coverage, ion radius, protection, oxide spalling.