Effects of water vapor on protectiveness of Cr2O3 scale at 1073 K

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INTERNATIONAL CONFERENCE ON ADVANCES IN MANUFACTURING AND MATERIALS ENGINEERING (ICAMME 2017)
Book Group Author(s): IOP
Book Series: IOP Conference Series-Materials Science and Engineering
Volume: 290
Article Number: UNSP 012085
DOI: 10.1088/1757-899X/290/1/012085
Published: 2018
Document Type: Proceedings Paper

Conference

Conference: International Conference on Advances in Manufacturing and Materials Engineering (ICAMME)
Location: Int Islam Univ, Kuala Lumpur, MALAYSIA
Date: AUG 08-09, 2017

Abstract

Fe-Cr alloy is commonly being used as boiler tube's material. It is subjected to prolonged exposure to water vapor oxidation. The ability to withstand high temperature corrosion can normally be attributed to the formation of a dense and slow growing Cr-richoxide scale known as chromia, Cr2O3 scale. However, oxidation may limit the alloy's service lifetime due to decreasing of its protectiveness capability. This paper is to presents an experimental study of thermo gravimetric and Fourier transform infrared analysis of Cr2O3 at 1073 K in dry and humid environment. Samples were used from commercially available Cr2O3 powder. It was cold-pressed into pellet shape of 12 mm diameter and 3 mm thick with hydraulic press for 40 min at 48 MPa. It then sintered at 1173 K in inert gas environment for 8 h. The samples are cooled and placed in 5 mm diameter platinum pan. It is subjected to reaction in dry and wet environment at 1073 K by applying 100%-Ar and Ar-5%H-2 gas. Each reaction period is 48 h utilizing Thermo Gravimetric Analyzer, TGA to quantify the mass changes. After the reaction, the samples then characterized with Fourier Transform Infrared Spectroscopy, FT-IR and Field Emission Electron Scanning Microscopy, FE-SEM. The TGA result shows mass decreasing ratio of Cr2O3 in wet (PH2O = 9.5x10(5) Pa) and dry environment is at a factor of 1.2 while parabolic rate at 1.4. FT-IR results confirmed that water vapor significantly broaden the peaks, thus promotes the volatilization of Cr2O3 in wet sample. FESEM shows mostly packed and intact in dry while in wet sample, slightly porous particle arrangement compare to dry. It is concluded that water vapor species decreased Cr2O3 protectiveness capability.

Keywords

KeyWords Plus: FE-CR ALLOYS; OXIDE SURFACE; TEMPERATURE; OXIDATION; CHROMIUM; ATMOSPHERES; EVAPORATION; STEELS; RATES

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Publisher

IOP PUBLISHING LTD, DIRAC HOUSE, TEMPLE BACK, BRISTOL BS1 6BE, ENGLAND

Categories / Classification

Research Areas: Engineering; Materials Science

Web of Science Categories: Engineering, Manufacturing; Engineering, Mechanical; Materials Science, Multidisciplinary

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1 of 1

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