CONTEMPORARY METALLIC MATERIALS

Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim

IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

CONTEMPORARY METALLIC MATERIALS

Edited by:

Md Abdul Maleque

Iskandar Idris Yaacob

Zahurin Halim

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ISBN: 978-967-418-164-2

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

Table of Content

Chapter 020

Surface Oxygen Potential on the Oxide Scale during High Temperature Oxidation of Fe-Cr Alloys at 1073 K

Mohd Hanafi Bin Ani and Raihan Othman
Faculty of Engineering – International Islamic University Malaysia
✉ : mhanafi@iium.edu.my

Keywords: Surface oxygen potential, CSZ oxygen sensor, High temperature oxidation.

Abstract: The surface oxygen potential on oxide scale during the high temperature oxidation at 1073 K has been measured using CSZ oxygen sensor. Formation of protective Cr_2O_3 scale gives surface oxygen potential almost identical with oxygen potential in oxidizing atmosphere. While the formation of non-protective iron oxides decrease the surface oxygen potential by few magnitude orders. It is successfully demonstrated that monitoring surface oxygen potential is beneficial to predict the formation of protective or non-protective oxide scale during the oxidation process.

Introduction

Boiler, super heater, reheater etc in fossil fuel steam power plant are exposed in severe oxidizing environments. It is common knowledge that the presence of water vapour accelerates the oxidation rate in those environments. Ferritic Fe-9 to 12 wt% Cr alloys is preferred materials for thick wall tube in power plant, due to their good rupture strength and thermal expansion. However, their oxidation behaviour in such environment is not well understood. Hanafi [1] has quantitatively clarified that the presence of water vapour increase the critical Cr concentration required in Fe-Cr alloy to establish protective Cr_2O_3 scale. Figure 20.1 shows the formation of internal oxide, external oxide (protective scale) and transition scale (mixed internal + external oxides) in dry and water vapour environment. The change of Cr concentration to form protective scale in dry and humid environments is probably due the change of surface oxygen potential. In this paper, calcia stabilized zirconia (CSZ) was applied as a solid electrolyte of high temperature oxygen sensor to monitor the oxygen potential during the oxidation process.

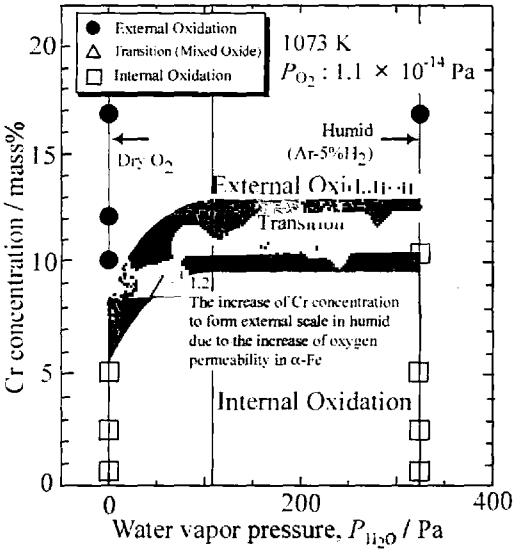

Figure 20.1: The type of oxide scale that forms on various Fe-Cr alloys at 1073 K [1].