

# CONTEMPORARY METALLIC MATERIALS

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INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Edited by:

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

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**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  $\text{Cr}_2\text{O}_3$  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  $\text{Cr}_2\text{O}_3$

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.

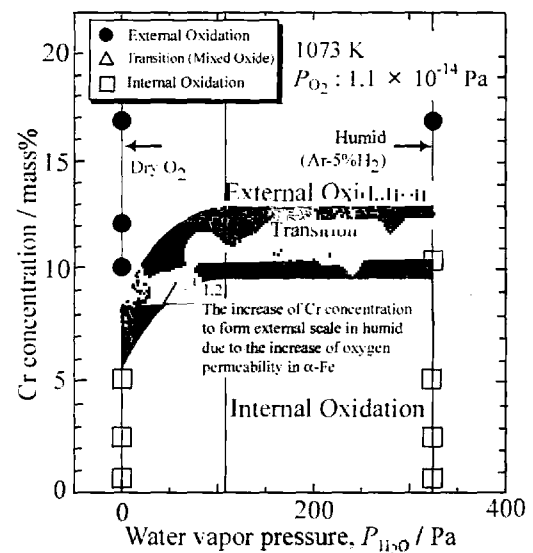


Figure 20.1: The type of oxide scale that forms on various Fe-Cr alloys at 1073 K [1].