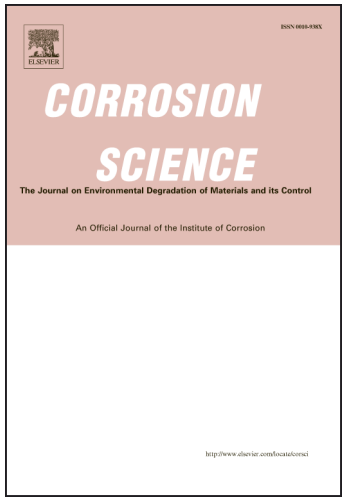

Evolution of carbides and chromium depletion profiles during oxidation of Alloy 602

R. Pillai, H. Ackermann, H. Hattendorf, S. Richter

PII: S0010-938X(13)00215-1
DOI: http://dx.doi.org/10.1016/j.corsci.2013.05.013
Reference: CS 5377

To appear in: *Corrosion Science*

Received Date: 15 March 2013
Accepted Date: 15 May 2013

Please cite this article as: R. Pillai, H. Ackermann, H. Hattendorf, S. Richter, Evolution of carbides and chromium depletion profiles during oxidation of Alloy 602, *Corrosion Science* (2013), doi: http://dx.doi.org/10.1016/j.corsci.2013.05.013

Evolution of carbides and chromium depletion profiles during oxidation of Alloy 602

R. Pillai[a)], H. Ackermann[a)*], H. Hattendorf [b)], S. Richter [c)]

[a)] Oel Waerme Institut GmbH, Affiliated to RWTH Aachen, Kaiserstrasse 100, 52134 Herzogenrath, Germany

[b)] Outokumpu VDM GmbH, Kleffstraße 23, 58762 Altena, Germany

[c)] Central Facility for Electron Microscopy, RWTH Aachen, Ahornstraße 55, 52074 Aachen, Germany

*Corresponding author, Address:Oel Waerme Institut GmbH, Affiliated to RWTH Aachen, Kaiserstrasse 100, 52134, Herzogenrath, Germany. Tel: +49 2407 9518140; Fax: +49 2407 9518118
Email address: h.ackermann@owi-aachen.de

Abstract

The microstructure evolution in carbide strengthened Alloy 602 during exposure to a synthetic flue gas (N_2-2.5%O_2-8.6%H_2O-16.4%CO_2) at 1100 °C has been studied. The chromium and aluminium loss resulted in a chromium depleted alloy subsurface area and the dissolution of the carbides within this area. An increase of the carbide fraction in the sample core was observed and quantified. Phase equilibria calculations revealed that the depletion of aluminium as well as that of chromium triggers carbon to leave the depleted area. The overall carbon depletion in that area corresponded to the observed increase in carbide fraction in the sample core.

Key words: superalloys, EPMA, high temperature corrosion

Introduction

Many austenitic high temperature alloys rely on the formation of a protective Cr_2O_3 scale and a variety of strengthening mechanisms. For wrought superalloys a beneficial effect of a discrete distribution of globular grain-boundary carbides on creep-rupture properties was reported [1]. The carbides at the grain boundaries provide a limited strengthening by stabilizing the grain boundary against sliding in creep. In the alloys with carbon content exceeding about 0.04 wt% carbides - normally chromium-rich $M_{23}C_6$ - are precipitated [2].

The high temperature wrought Ni-alloy 602 which is used for furnace and heat treatment equipment and in chemical facilities derives some of its stress-rupture-strength from primarily precipitated chromium carbides. The microstructure of this alloy has been studied experimentally for carbon content between 0.06 and 0.37 wt% by Brill [3]. From a research of earlier studies Brill found in summary that in Ni-Cr and Ni-Cr-Fe alloys with chromium concentration below 30 wt% the carbon solubility decreases with increasing chromium content and increases with temperature. The