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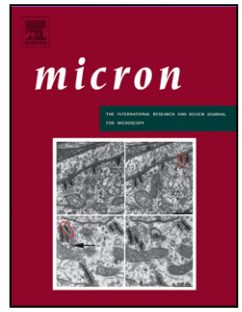

Title: Microstructure Evolution and Dislocation Behaviour in High Chromium, Fully Ferritic Steels Strengthened by Intermetallic Laves Phases

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Microstructure Evolution and Dislocation Behaviour in High Chromium, Fully Ferritic Steels Strengthened by Intermetallic Laves Phases

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Highlights:

- Fully ferritic steels as new idea to improve creep resistance.
- Focus on sub-grain structure, dislocation and particle-free zone evolution.
- Microstructure and particle evolution in fully ferritic steels.
- In-depth investigations of dislocation behaviour and its possible effect on the mechanical response.

Abstract

In the present study a stainless, high strength, ferritic (non- martensitic) steel was analysed regarding microstructure and particle evolution. The preceding hot-rolling process of the steel results in the formation of sub-grain structures, which disappear over time at high temperature. Besides that the formation of particle-free zones was observed. The pronounced formation of these zones preferentially appears close to high angle grain boundaries and is considered to be responsible for long-term material failure under creep conditions. The reasons for this are lacking particle hardening and thus a concentration and accumulation of deformation in the particle free areas close to the grain boundaries. Accordingly in-depth investigations were performed by electron microscopy to analyse dislocation behaviour and its possible effect on the mechanical response of these weak areas.

KEYWORDS: Laves phase, Microstructure, Intermetallic particles, Ferritic steel, Advanced Ultra Supercritical (AUSC) power plants, Dislocations, Particle-free zones

Introduction

Present investigations focus on a new concept of fully ferritic, stainless steels free of martensitic transformation for the application in high temperature energy conversion systems. The presented trial alloy 2.5W0.57Nb0Ti was produced in the framework of Crofer® 22 H development (commercially available from VDM Metals GmbH, Germany), where more than 50 trial alloys were designed. Crofer® 22 H was designed as an interconnect material for **s**olid **o**xide **f**uel **c**ells (SOFCs) for operation temperatures of about 800 °C. In general such steels show promising steam oxidation resistance in the temperature range from 600 °C to 650 °C due to their high chromium content (18 - 23 wt.%) (Kuhn et al., 2014). In comparison the oxidation resistance of state of the art 9 – 12 % Cr **C**reep **S**trength **E**nhanced **F**erritic (CSEF) steels, e.g. P/T91 and P/T92, is limited to temperatures up to

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