Characterization of Ferritic Steels with 17 % Chromium for High Temperature Application

A study of the precipitation behavior of three ferritic steels containing 17 % Chromium and different amounts of Tungsten, Niobium, Boron and Nickel

Karl Bernhard Bolz

Institut für Eisenhüttenkunde, RWTH Aachen University (RWTH), 52072 Aachen, Germany

THESIS INFO

Contact:
Bernhard.Bolz@rwth-aachen.de

Submitted:
3.April 2017

Supervisor:
Dipl.-Ing. Jana Pöpperlová
Jana.Poepperlova@iehk.rwth-aachen.de

Keywords:
High Cr ferritic steel
Precipitation
Laves Phase
Creep Strength

ABSTRACT:

Due to their superior creep strength and steam oxidation resistance, high Chromium ferritic steels can be applied in thermal power plants above 600 °C. In this study the precipitation behavior and the mechanical properties of three ferritic steels, which contained 17 % Chromium, after a thermo-mechanical treatment were investigated.

A homogenous precipitation of fine Laves phase particles, both on the grain boundaries and in the grain interior, is indispensable in order to stabilize the microstructure and to reach sufficient creep strength. In comparison to the heat treated specimens, the microscopy images show a much more homogenous distribution of fine Laves-Phase particles of the hot deformed specimens, especially on deformation temperature of 800 °C. Thermo-mechanical treatment induces dislocations, deformation bands and subgrain boundaries into the microstructure, which serve as nucleation sites for the Laves phase. The higher amounts of Niobium and Tungsten led to a significantly higher amount of Laves-Phase and consequently to a higher hardness. After thermo-mechanical treatment a great increase of the precipitation kinetics for the Boron and Nickel alloyed steels was observed.