

# APPLICATION OF THERMODYNAMIC CALCULATIONS FOR THE DEVELOPMENT OF NEW FERRITIC STEELS FOR POWER PLANTS

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An overview of current activities for the development of new ferritic steels for power plants is given. The focus is on martensitic 9% and 12% Cr-steels for power plants with advanced steam parameters.

Increasing the application temperature up to 650 °C involves materials with complex microstructures in order to reach a sufficient creep strength. Calculations of phase equilibria of such complex systems are necessary to define new directions of alloy concepts and heat treatment parameters.

Examples on thermodynamic calculations using Thermo-Calc and DICTRA simulations of precipitation reactions in 12%Cr steels with carbides and intermetallic phases are given in this paper.

There are some important aspects which cannot yet be treated by computational thermodynamics. For instance, relatively high amounts of boron lead to “improved microstructures” and thus to promising creep properties, but the solubility of B in the  $M_{23}C_6$  carbide is not added to the thermodynamic description of this phase. Some material development concepts are based on a mixture of carbides, carbo-nitrides and intermetallic phases (Laves phase), but the accuracy of the thermodynamic description of some intermetallic phases is questionable. The so-called Z-Phase containing Cr, Fe, Nb, V, Mo, and N plays a detrimental role during long-term service of some ferritic steels. For the development of steels strengthened by carbo-nitrides it is important to be able to predict the competing processes such as growth of Z-phase and dissolution of N-containing phases.