Thermodynamic of third generation of Fe-Mn-Al-C steels with a duplex structure

Aurore MESTRALLET

Supervisor: Annie Antoni-Zdziobek

Tuesday, October 31st 10:00 am

Amphitheater André Rassat (UFR Chimie)

Abstract: A third generation of Fe-Mn-Al-C steels with a duplex structure, for Mn and Al contents less than 8%mass, could be a promising response to the 20% weight lightening of automotive vehicles, by keeping a high strength and a high formability.

The knowledge of the corresponding quaternary phase diagram serves as a roadmap for the choice of compositions and theoptimization of elaboration conditions. A reliable and precise thermodynamic database is therefore required. However, the literature data on the Fe-Mn-Al-C quaternary system in the targeted domains are limited.

This study is devoted to the establishment of phase equilibria involving ferrite-α, austenite-γ and carbide-κ(Fe,Mn)3AlC between 700 and 1000°C by a coupled approach of experiments and thermodynamic modeling. A kinetic model (DICTRA) is proposed to support the experimental evolution of phase fraction and composition. The kinetics of austenite formation as a function of the alloy composition and of the maintaining temperature in the intercritical domain have been calculated. The phases in equilibrium, characterized by XRD, SEM, EPMA, are represented as α/γ, γ/κ, α/γ/κ tie-linesin order to specify the stability fields of γ and κ. These data are used to refine the thermodynamic description of the quaternary system but it is necessary to revise the modeling of κ carbide.

Keywords: Fe-Mn-Al-C system, duplex steels, phase equilibria, microstructure, thermodynamic and kinetic modeling, EPMA