ICAM2009
11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25

# Microstructural evolution of cold-rolled Dual Phase steel with different initial microstructure

F. Castro[(1)]*, A. Monsalve[(1)], B: Schulz[(1)], A. Artigas[(1)], Y. Houbaert[(2)] and D. Cabello[(1)]

(1) Departamento de Ingeniería Metalúrgica, Universidad de Santiago de Chile, av. L. B. O´higgins 3363, Santiago de Chile, felipe.castro.cerda@gmail.com
(2) Department of Materials Science and Engineering, Ghent University, Technologiepark 9, B-9052, Ghent-Zwijnaarde, Belgium.
* Corresponding author.

**Abstract** – Dual Phase (DP) steel was generated by isothermal annealing after cold reduction of the same steel sheet with ferrite-pearlite (HR) and ferrite-martensite (FM) microstructure. The evolution of resulting microstructure at different stages was evaluated and followed by means of optical, scanning and atomic force microscopy. Mechanical properties were also evaluated and compared with microhardness testings. The aim of this work is to study the mechanical response of two different initial microstructures with the same heat treatment path and how that is related with austenite transformation and ferritic grain growth.

A comercial 0,1%C-1,5%Mn-0,8%Si steel slab was hot rolled to 3 mm in thickness, and control cooled to produce a ferrite-pearlite microstructure. In order to obtain a microstructure with around 50% of martensite, half of the hot rolled sheet was intercritically annealed and water quenched. Cold rolling was performed to give 70% of reduction on both microstructures. Samples of both microstructures were heat treated according to the cycle shown in fig. 1. The microstructural observation and microhardness test was made on the thickness plane in the rolling direction (RD). Tensile test were also performed to evaluate mechanical properties.

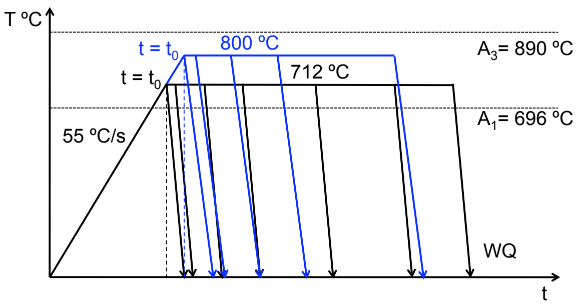


**Figure 1:** Heat treatment scheme showing isotherms and critical temperatures.

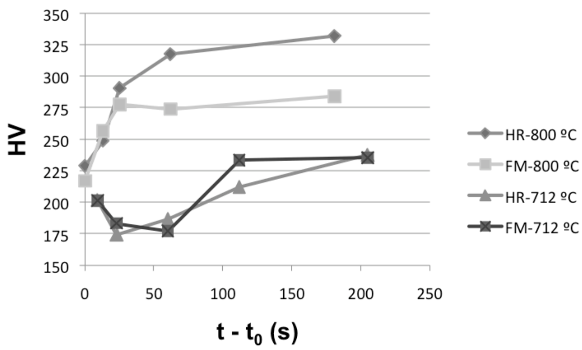


**Figure 2:** Time and temperature-dependence of hardness value.

Most of the interest on DP steel are focused on the mechanical behaviour related to martensite volume fraction and its nominal carbon content. One should also consider the phase distribution related to the initial microstructure, which play an important role on kinetics of austenite grain growth and becomes a matter of interest if the strength of DP steel is studied.

One interesting feature found on FM samples is ferrite recrystalization of martensite, which nucleate on ferrite/martensite interface and grows preferentially into martensite, showing a carbide structure inside new ferrite grains. The lower microhardness at 800 ºC (figure 2) seems to be related with this recrystalization structure and distribution of the carbon in austenite during intercritical annealing.

In both HR and FM samples treated at 712 ºC, hardness test showed a softening period before hardness value start to increase, possibly related with ferrite recrystalization. Subsequent hardening is due to martensite formation. In general, most of banding was not observed in FM samples. Martensite zones has an homogeneous distribution in ferrite matrix and smaller size than HR. Ferritic grain size was also smaller in FM samples, probably due to interaction with tempered martensite carbides [1].

**References**

[1] R. Petrov, L. Kestens, Y. Houbaert, ISIJ vol. 41 (2001) 883-890.