# THE INFLUENCE OF COILING TEMPERATURE ON THE FRACTURE SURFACE OF INTERSTITIAL-FREE STEELS

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## Introduction

The steels, although constitute one of the oldest kind of materials, still allow an introduction of considerable advantages through chemical composition changes and processing improvements that recompense the investment in research and development. Among several steels of new generation arise the interstitial-free steels which are ultra-low carbon steels with very low concentration of interstitial elements like carbon and nitrogen. They are part of a research and development trend in ultra-clean steels and have characteristics of high formability, high superficial quality and good homogeneity of final product, being very attractive for applications in cold forming components.

## Experimental Procedures

It was discussed in this work the coiling temperature influence on the fracture surface characteristics. A thermomechanical processing was carried out using a 1250°C slab reheating temperature (SRT), 900°C finishing temperature (FT) and two different coiling temperatures (CT): 700°C and 550°C. The material was hot rolled to 6.35mm in a 74.6% reduction. After the coiling temperature treatments the steel was cold rolled to 1.3mm to obtain a cold reduction ratio of 80%. Finally the steel was continuous annealed at 850°C during 40s.

## Results and Discussion

The coiling temperature effect on the microstructure was analyzed by optical microscopy and is summarized in figures 1 and 2. They showed a strong modification on the carbide morphology. The microstructure of the sample coiled at 550°C (fig.1) showed spheroidal-type precipitates, denser in dispersion and finer in size than those observed at 700°C CT. In this temperature a precipitates coalescence occurred and they become coarser in size showing a sparse dispersion (fig.2).

The fracture surface analysis was carried out with a scanning electron microscope (SEM) and showed a ductile fracture microscopically characterized by equiaxed dimples presence in both conditions: 700°C and 550°C. In the fracture surface the spacement among adjacent microavoids was directly correlated with the distance among the present precipitates such as the difference in the dimples size can be associated with precipitates sizes or precipitates different types in interstitial-free steels.

The figure 3 shows the presence of large dimples in the 700°C CT condition, however in minor quantities when compared with the 550°C condition. In this last situation (fig.4) the dimples appeared in larger quantities but in a small size. It can be explained and correlated by the coarser and sparsed precipitates presence caused by the application of higher coiling temperature in the thermomechanical processing.

Brittle fracture or clivage process was not found on the analysis of fracture surfaces of interstitial-free steels.

References

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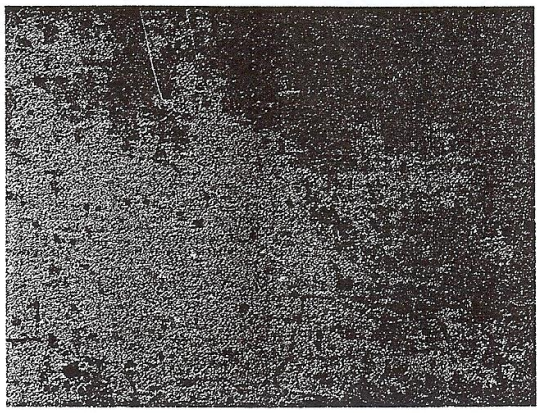

Figure 1. Microstructure of hot-rolled interstitial-free steel.
Coiling temperature - 550°C. Etching: picral. Magnification - 500X.

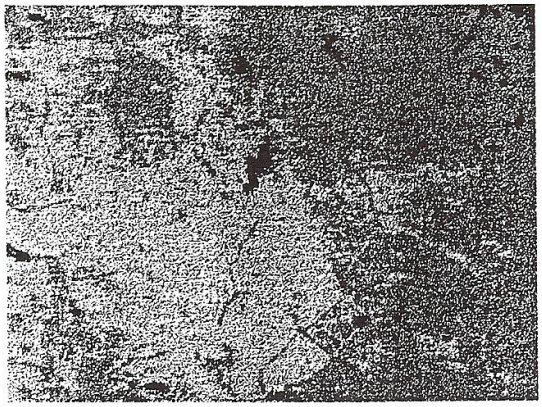

Figure 2. Microstructure of hot-rolled interstitial-free steel.
Coiling temperature - 700°C . Etching: picral. Magnification - 500X.

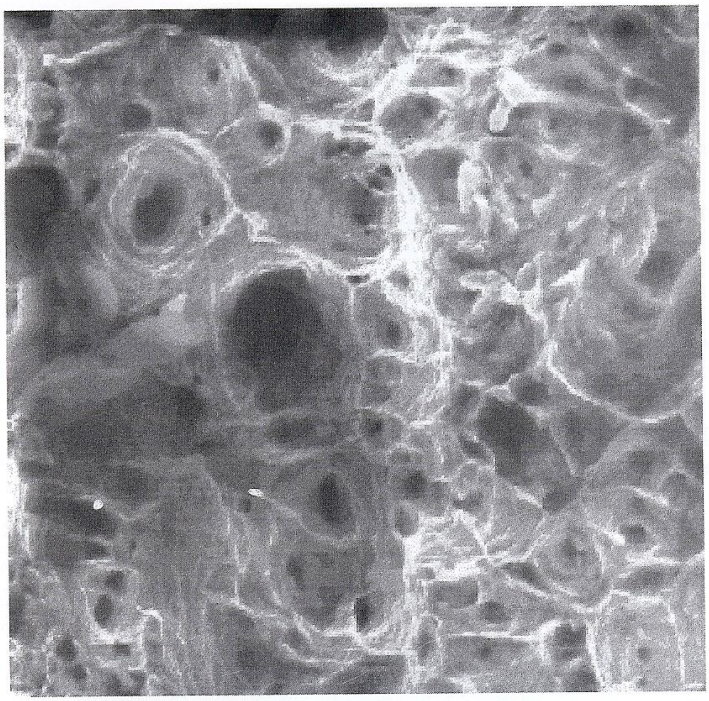

Figure 3. Interstitial-Free steel fracture surface. Coiling temperature - 700°C. Magnification - 1000x (SEM).

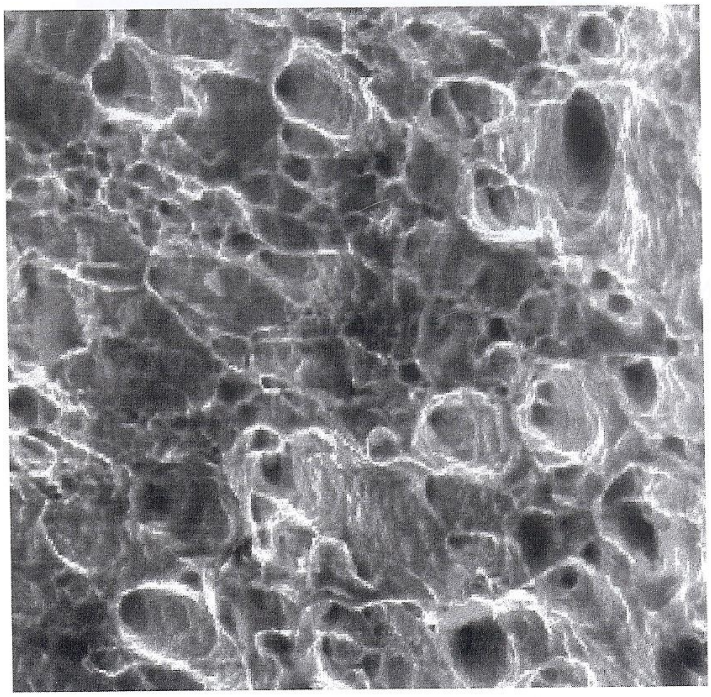

Figure 4. Interstitial-Free steel fracture surface. Coiling temperature - 550°C. Magnification - 1000x (SEM).