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Martensitic Transformation Characterization by Magnetic Properties of Austenitic Stainless Steel AISI 347

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Introduction

In the literature have several works in austenitic stainless steels (ASS) about the kinetics of martensitic transformation by cold rolling, but have a gap in Nb-stabilized AISI 347 stainless steel [1-4]. Buttler [5], verified the influence of solution treatment in the kinetics of ASS stabilized with Ti. This work provides reliable guidelines for the use of non-destructive characterization tools to assess susceptibility to martensitic transformation methodologies that can also be applied to compare other grades of austenitic stainless steel.

Objectives

The purpose of this work is to evaluate the martensitic transformation by cold rolling deformation in an AISI 347 stainless steel, at several solution treatment, by magnetic properties.

Methodology

For this study, niobium-stabilized austenitic stainless steel (ASS) plates were used to evaluate the phenomenon of martensitic transformation under different true strain, following prior solution treatment at 1100ºC and 1200ºC. Table 1 shows the material's composition.

Table 1. Material Composition

Weight Percentage									
Cr	Ni	Mn	Si	Nb	C	S	P	Mo	Ti
17,415	9,0109	1,9279	0,3841	0,4791	0,0424	0,0006	0,0308	0,0515	0,003
Al	Cu	Co	V	Pb	B	Sn	W	N	Nb ≥ 10C
0,0035	0,0451	0,1989	0,044	0,0022	0,0006	0,003	0,0178	0,0165	Ok.

Following the heat treatments, the samples were cold-rolled in the longitudinal direction with different values of true strain. In this study, 15 (fifteen) measurements were taken on each face in the central region of every sample, recording both the percentage of the ferromagnetic phase and the Ferrite Number (FN). The permeameter test was conducted with an amplitude of 5 V and a frequency of 10 Hz. The correction factor as suggested for [6] was applied during measurements by ferritoscope. Others measurements were made with Vibrating Sample Magnetometer

Results and Discussion

The ferritoscope measurement increases, reflecting the transformation of the austenitic phase into ferromagnetic martensite (α'), a process driven by the higher strain applied to the samples. A comparison reveals faster precipitation kinetics in samples solution treated at 1100°C.

During the initial stages of deformation, the aforementioned magnetic parameters exhibit a more pronounced change in the S1100 condition, this trend mirrors the results obtained via ferritoscopy.

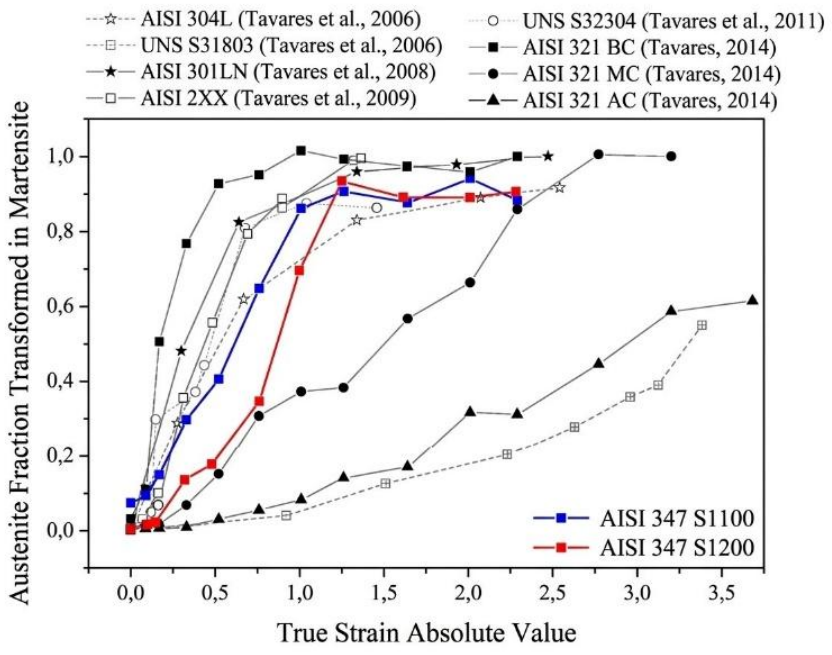


Figure 1. Fraction of austenite transformed into martensite versus true strain for different stainless steels.

Conclusions

This study leads to the following conclusions: Ferritoscope measurements reached a maximum value of 55% upon phase Transformation, the kinetics exhibited a sigmoidal behavior, similar to that observed in other metastable ASS grades, an acceleration in the kinetics of the martensitic transformation was detected in samples solution-treated at 1100°C compared to those treated at 1200°C. This is attributed to a smaller grain size, lower carbon solubility in the austenitic matrix, and the presence of a greater number and larger size of niobium carbide (NbC) precipitates.

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