

CRYSTALLOGRAPHIC ANALYSIS OF Fe-27%Ni ALLOY

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Many factors such as crystallography of parent phase, heat treatment temperature and chemical composition affect considerably martensitic transformation and martensite morphology.

During the austenite to martensite phase transformation from a single austenite grain varying numbers of martensite grains with different crystallographic orientations can be obtained. The crystallographic orientations of the martensite crystals are related to the austenite crystals, which can be expressed either by a specific axis angle pair or by indicating the corresponding lattice planes and directions of the parent and product crystals. In steels the most frequently observed crystallographic orientation relations are the ones proposed by Kurdjumov-Sachs (K-S) and Nishiyama-Wasserman (N-W) and twin boundaries in parent and product phase [2].

The aim of this study was to revisit martensitic transformation and orientation relations proposed for martensitic transformation measured by EBSD technique seeking to investigate it experimental and theoretically. In order to obtain two different analysis conditions, thermomechanical treatments were done in Fe-27%Ni alloy, consisting of an hot rolling at 1100°C with 55% thickness reduction following by a thermal treatment at two different dwell temperatures (800°C and 1100°C) for 60 minutes followed by liquid nitrogen quenched.

Based on the dual phase microstructural state of the samples, the EBSD (data acquisition control) was set to interpret the bcc (body center cubic) and fcc (face center cubic) phase diffraction patterns. The EBSD files (type “.ang”) register for each diffraction point a position (coordinates x and y) with related with Euler angles, IQ (index quality), IC (index confidence) and the respective crystallographic phase. The EBSD data were analyzed by a group of programs developed in FORTRAN language. For characterize experimentally the orientation relation in austenite-martensite interface, the programs calculated the rotation pairs axis-angle for to obtain the orientation coincidence when two neighboring orientation with different crystallographic phase. Additionally, a similar routine was used exclusively to characterize pairs of points with orientation difference inside the martensite originated from accommodation twin existent in this phase. The simulated results, from the EBSD data [3], showed that the most frequent orientations in bcc/fcc interface region were (0 -4 1)[-1 1 4], (-2 -6 1)[-1 1 4]. The (5 1 1)[-1 -2 7] orientation, 60° angle - twins, was the most frequent inside the martensite phase for the both samples. The (0 0 1)[-1 1 0] and (-1 -1 -1)[1 1 2] orientations were the most frequent orientation between the bcc and fcc phases.

References:

[1] J. R. Guimarães, C. B. Eckstein. *Metalurgia-ABM*, Vol. 39, (1983) 307.

[2] J. J. Jonas, M. P. Butrón-Guillén, C. S. C. Viana. *Textures and Microstructures*, Vol. 26-27, (1996) 599.

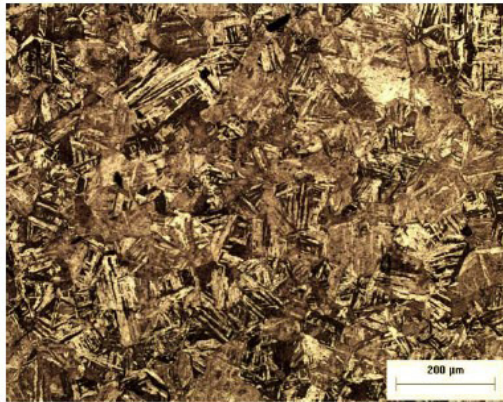
[3] Y. Minamino, N. Tsuji, M. Ueda, R. Ueji, H. Kitahara, *Mat. Charact.* 54, (2005) 378.

(a) (b)

Figure 1 – (a) Optical micrography (b) EBSD data orientation for bcc (left side) and fcc (right side) phase of the Fe-27%Ni alloy (800oC).

(a) (b)

Figure 2 – (a) Optical micrography (b) EBSD data orientation for bcc (left side) and fcc (right side) phase of the Fe-27%Ni alloy (1100oC).



(a)800N

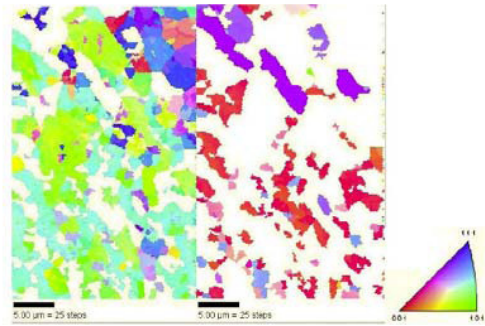
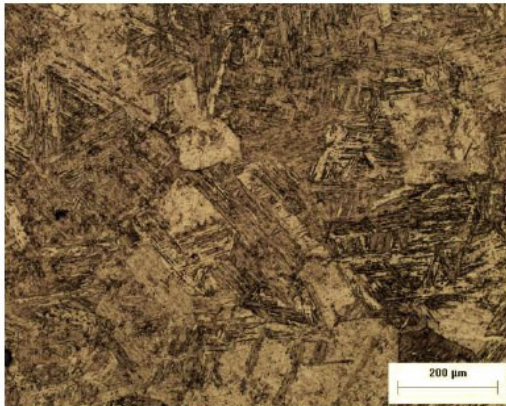


Figure 1 – (a) Optical micrograph (b) EBSD data orientation for bcc (left side) and fcc (right side) phase of the Fe-27%Ni alloy (800oC).



(b)1100N

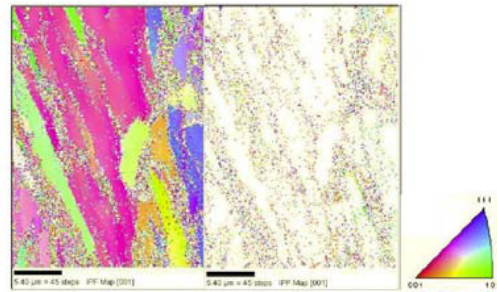


Figure 2 – (a) Optical micrograph (b) EBSD data orientation for bcc (left side) and fcc (right side) phase of the Fe-27%Ni alloy (1100oC).