11th International Conference on Advanced Materials
ICAM 2009
Rio de Janeiro Brazil
September 20 - 25

Crystallographic orientation relationships between precipitate austenite and ferrite matrix in Casting Duplex Stainless Steels

A. M. Do Nascimento(1)*, V. OCELÍK(2), M. C. F. IERARDI(3) and J. TH. M DE HOSSON(2)

(1) Department of Metallurgy and Materials Engineering, Federal University of Ceará, Campus do Pici, Bl. 702, 60.455-760, Fortaleza-CE, Brazil, e-mail: **alexmn@metalmat.ufc.br**
(2) Department of Applied Physics, University of Groningen, The Netherlands
(3) Department of Materials Science, UNICAMP, Brazil
* Corresponding author.

Abstract – Casting Duplex Stainless Steels (CDSSs) have a structure composed by austenite and ferrite grains. The phase transformation between these two phases has been widely studied due to its importance in the processing of these alloys. One of the keys to understand the transformation is accurate characterization of the orientation relationship (OR) between two phases. This can be achieved through orientation mapping using Electron Back-Scattered Diffraction (EBSD) on sections of the alloys and comparing the results with theoretical models. Three different CDSSs were used in this study with aim to see which model is more common in this kind of alloys and it can be observed that the true OR is actually very close to two or more models. The identified boundary only shows the nearest ideal orientation relations. In this research, Greninger-Troiano, Kurdjumov-Sachs and Bain were found.

The crystallographic orientation relationships between two crystals of different structures play as key role in the nucleation and growth of second phases into the matrix [1]. Due to its technological importance, a lot studies have been carried out in the past few decades and many models have been proposed, based on experimental observations by X-ray or electron diffraction patterns [2]. In FCC/BCC systems, the most commonly cited orientation relationships are those proposed by Bain, Kurdjumov-Sachs, Nishiyama-Wassermann, Greninger-Troiano and Pitsch.

The EBSD technique has been established as an excellent tool to evaluate the complete range of steels like low carbon steel, duplex steel, martensitic steel, bainitic steel, etc. With EBSD technique, it is possible to measure the specific orientations of thousands of grains very rapidly with relatively high precision [3].

The purpose of this work is to investigate aspects of crystallographic orientation relations between precipitate austenite and parent ferrite in three cast duplex stainless steels.

Table 1: The chemical composition (in wt.%) of the three types of CDSSs: ASTM A890 grade 1A (free of nitrogen), ASTM A890 grade 3A (with nitrogen and without Cu) and ASTM A890 grade 6A (Super Duplex)

Alloy	C	Cr	Ni	Mn	Si	Mo	S	P	Cu	N	W
1A	0.04	25.01	5.53	0.78	0.99	2.11	0.006	0.026	3.10		
3A	0.03	25.33	5.38	0.84	0.90	2.13	0.005	0.025		0.19	
6A	0.02	25.96	7.93	0.83	0.97	3.63	0.008	0.024	0.82	0.24	0.78

All compositions are balanced to 100% by iron.

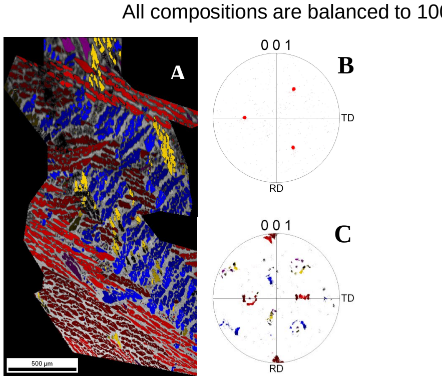

Figure 1: (a) Orientation of austenitic grains in relation to ferritic grain; (b) Pole figure of ferritic grain; (c) Pole figure of austenitic grain showing preferential orientations.

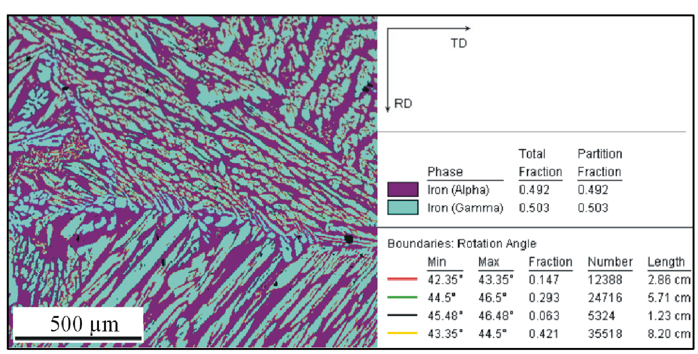

Figure 2: Image map obtained by EBSD technique to alloy 1A, showing the percentages found to each theoretical model with base on the misorientation between austenite and ferrite. G-T = 42.1 %, Bain = 23.0 %, K-S = 14.7 % and N-W = 6.3%.

[1] Bunge et al., Journal Applied Crystallography, 36, 2003, p. 137 – 140.
[2] He et al., Acta Materialia, 54, 2006, p. 1323-1334.
[3] Randle, V. and Engler, O., Amsterdam: Gordon and Breach, 2000, 388 p.