Crystallographic considerations on phase transition materials and their applications to the reconstruction of parent grains from EBSD data.

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1. Abstract

When phase-transition materials are fully constituted of daughter grains and when there is neither residual parent phase nor precipitation around the prior parent grains, the information about the parent grains seems to be lost. However, this information is of primary importance in many metallurgical problems. For example, the size of the prior-austenitic grains constitutes a key parameter in the mechanical models of the martensitic steels. In this study, we present a method to reconstruct the parent grains from the EBSD maps.

The daughter crystals inherited from a parent crystal (the variants) and the specific misorientations between them (the operators) form an algebraic structure called groupoid [1]. A program, called GenOVa (Generation of Orientational Variants) has been written to generate the variants (an example is given in Fig. 1) and the groupoid structure [2]. The composition table determined by GenOVa is then used in other program to automatically reconstruct the parent grains from EBSD [3, 4]. The reconstruction programe is called ARPaGE (Automatic Reconstruction of Parent Grains from EBSD data). The algorithms do not imply any equation resolution; it is fast, robust and well adapted to highly deformed materials. It has been implemented in a home-made program written in Python language. The parent grains (morphology and orientation) are reconstructed and the possible variant selection mechanisms are quantified.

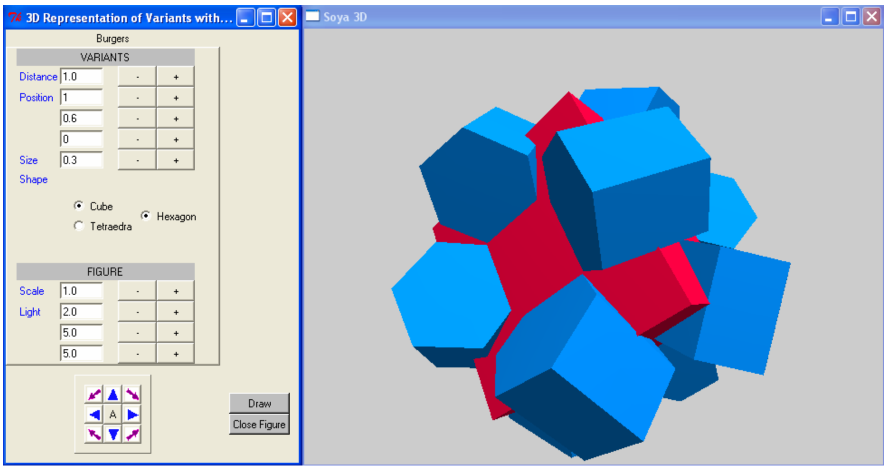

***Figure 1** – Burgers transition: Hexagonal α variants in orientation relationship with their cubic β parent crystal.*

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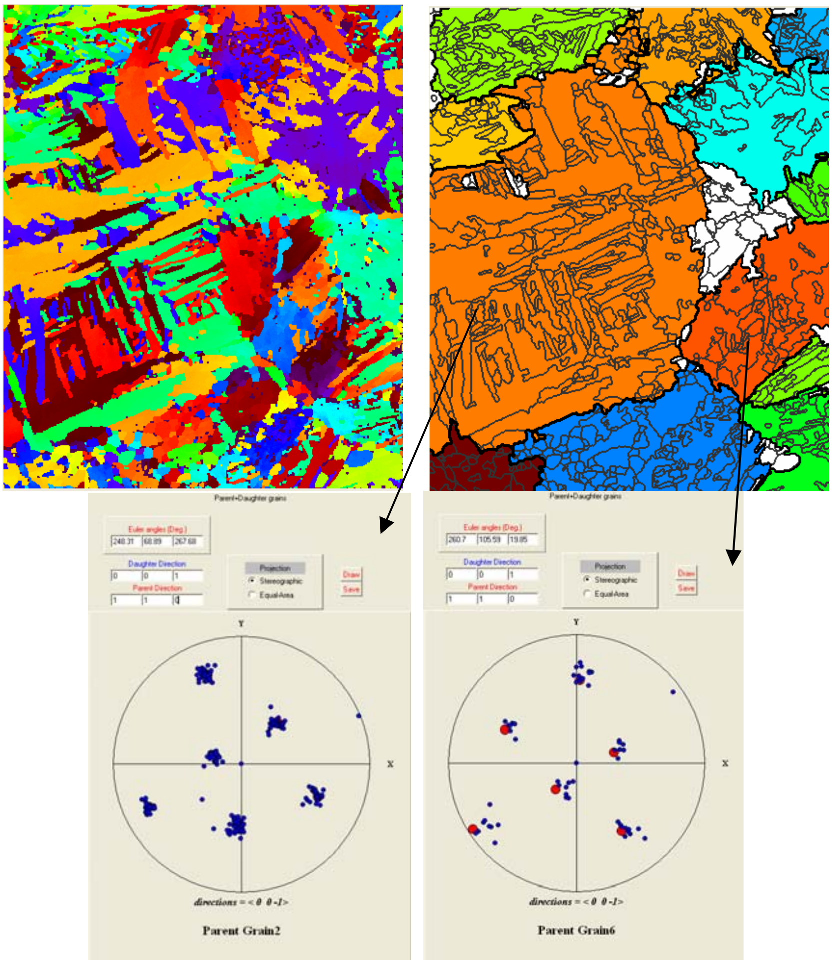

Figure 2 *– EBSD Maps on a titanium alloy (Ti-6Al-V alloy) before and after the reconstruction. One can check that the reconstruction works by looking at the pole figures of the reconstructed grains. These ones are in perfect agreement with simulations (here one can also check that the Burgers orientation is fulfilled, ie <100>α (experimental in blue) // <111>β (reconstructed, in red).*

2. Références

[1] C. Cayron, Acta Cryst. A62, 21-40, (2006).

[2] C. Cayron, submitted to J. Appl. Cryst.

[3] C. Cayron, B. Artaud and L. Briottet, Mater. Charac. 57, 386-401, (2006).

[4] C. Cayron, in preparation for J. Appl. Cryst.