

EXPERIMENTAL REPORT

EXPERIMENT N°CRG-262

INSTRUMENT: D1B

DATES OF EXPERIMENT: 8-15 JUL 98

TITLE

Texture investigation of large top seeded bulk YBCO samples and its correlation to magnetic levitation

EXPERIMENTAL TEAM (names and affiliation)

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The processing of large bulk $\text{YBa}_2\text{Cu}_3\text{O}_{7-d}$ (Y123) is developed mainly in view of levitation applications. The levitation forces are proportional to the product of the field gradient by the magnetization, which is related to the size of the current loops and to the critical current of the Y123 phase grains, since grain boundaries are limiting the current flows through the basal (**a,b**) planes. Then, the samples must exhibit large grains oriented with **c** along the magnetization direction.

Various methods are used to induce a preferred alignment of the Y123 (or Nd123) crystallites in order to get the optimum properties: we choose in this work a melt texturing with application, or without, of a magnetic field $\mathbf{H} = 8\text{T}$, and assisted by a single crystal top seed of $\text{SmBa}_2\text{Cu}_3\text{O}_7$ (Sm123). We have chosen this method of alignment for the elaboration of our samples, in order to test the effect of the application of a magnetic field during the growth, and to reveal orientations dispersions within the bulk as well as orientation correlation between the two main phases.

The neutron texture analysis was performed using the position sensitive detector of the D1B line by a previously described procedure [1].

The samples result in large domains with the main $\text{YBa}_2\text{Cu}_3\text{O}_7$ (Y123) phase, a main secondary phase Y_2BaCuO_5 (Y211), and porosity. Thanks to the control of the orientation by the seed, the Y123 phase shows a very high degree of preferred orientation with **c** axes parallel to the magnetic field, and are then particularly suitable for levitation application since the current can flow within the (**a,b**) planes on the grain scale (Figure 1). However, even in that case, the critical current remains sensitive to the perfection of the alignment. Some local perturbations induce orientation distributions (OD). We first controlled the variation of the OD of the Y123 domains versus the distance from the center of the former 44 mm diameter samples. We measured one sample with \mathbf{H} applied (1), and one without (2), and for three locations at the sample: at the center (a), at the edge along the **a**-axes (b), at the edge along the $\langle 110 \rangle$ directions (c).

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Figure 1 shows the $\{100\}$ and $\{001\}$ pole figures of these 6 samples recalculated from the OD. The 6 first pole figures are for the sample elaborated with a magnetic field. The density scale shows a maximum of 100m.r.d. for the sample without magnetic field applied, while always lower with (1).

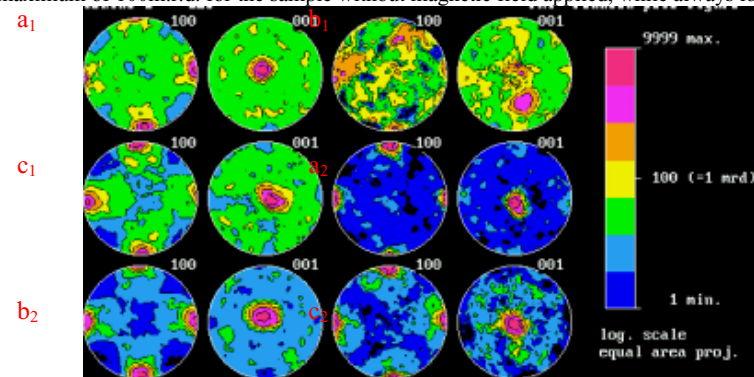


Figure 1

Also sample (1) is showing strong alignment perturbations on the edge, and the all series of textures correlates well with the magnetic levitation experiments, with maximum forces of 4.7N, 1.2N, 4.2N, 4.6N, 2.7N and 3.6N with respect to a_1 , b_1 , c_1 , a_2 , b_2 and c_2 respectively. For both samples, we correlated the Y211 to the Y123 textures. Results (Figure 2) show a low texture degree for Y211 with a maximum density around 2 m.r.d., with however a tendency to an epitaxial-like relationship between Y211 and Y123.

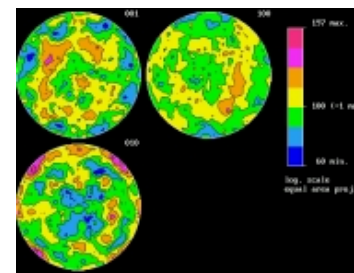


Figure 2

This epitaxial-like relationship corresponds to an alignment of the **b**-axes of the Y211 phase with the $\langle 110 \rangle$ directions of the Y123 phase. This is the first time to our knowledge that a full quantitative texture analysis is achieved on such complex multiphase materials, including a correlation between texture and physical properties.

[1]: D. Chateigner, H.-R. Wenk & M. Pernet: J. Appl. Cryst. 30, 1997, 43-48.

This work has been published :

D. Chateigner, J. Ricote, X. Chaud, P. Gautier-Picard, E. Beaugnon, J.-L. Soubeyrou, C. Leblond & I. Monot: Levitation force to texture correlation in bulk Y-Ba-Cu-O. In "Textures of Materials" (Ed J.A.