

## Quantitative Textures of porous YBaCuO bulk prepared by infiltration and melt growth process

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For various applications such as Fault Current Limiter, motor flywheel or bearing, ... the core of bulk superconductors need to be fully oxygenated and some defects like cracks, pores and voids suppressed, in order that the material can carry high current densities. In order to study and minimise the above defects, we have developed a new elaboration technique.  $\text{YBa}_2\text{Cu}_3\text{O}_y$  (Y123) bulks have been prepared by combining liquid infiltration and top seed growth (ITSG) process [1-3]. This process involves negligible shrinkage and an uniform distribution of Y211 inclusions. In addition, we prepare a regular perforation of the Y123 sample in view to magnify the specific surface and by then increase oxygen diffusion into the core of the material.

In this study, neutron texture analysis is used to demonstrate the non-perturbative effect of the holes in the bulk from the orientation point of view.

Figure 1a shows an optical macrograph of the top view of a 15 mm diameter pellet, with 0.8 mm diameter holes. At high magnification (Figure 1b), the average size of the Y211 inclusions is determined to be 2  $\mu\text{m}$  and homogeneously distributed into the Y123 matrix, this latter being free of macrocracks. The small size of Y211 particles obtained without any dopant addition is clearly one of the advantages of the ITSG method. This refinement of Y211 inclusions is considered for inducing a good flux pinning and high critical current density ( $J_c$ ).

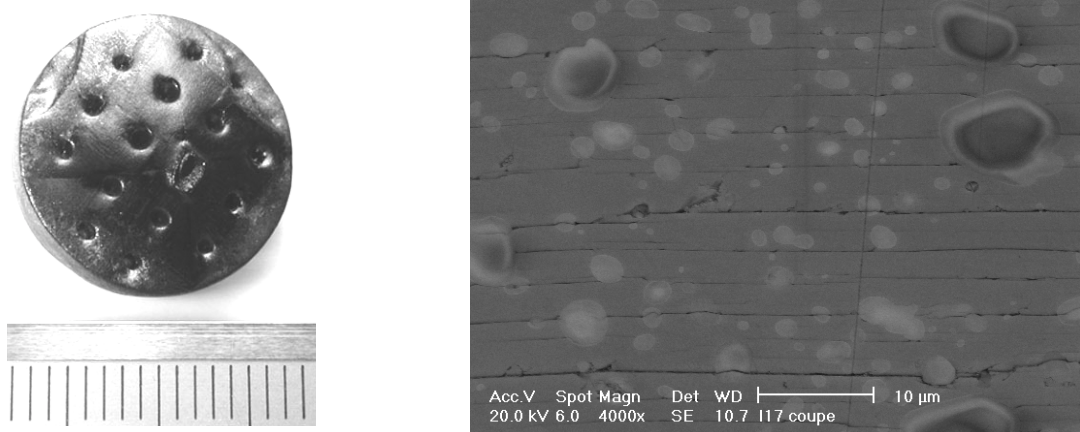


Figure 1 : (a) Textured Y123 as-processed and (b) microstructure showing the refined Y211 particles into the Y123 matrix.

Quantitative texture analysis was performed on the perforated sample in order to check for eventual orientation perturbation. The whole sample volume was probed using the D1B beamline. Complete pole figures were measured using a procedure described elsewhere [4]. We used the combined approach to extract pole figures from diffraction spectra and calculate the orientation distribution function, this latter enabling calculation of the {003} and {100} pole figures shown in Figure 2 [5, 6]. These pole figures clearly illustrate the presence of only one domain present in the sample, with c-axes aligned parallel with the hole axis, and a-axes perpendicular to it. The texture is single-crystal like, with pole dispersions within 5° to 10° of dispersion, at the limit of the refinability of the orientation distribution using our scanning resolution (5°x5° grid). Since no other domains are present, we can conclude that no significant orientational perturbation is introduced using the perforation process. The cell parameters of the two phases were refined from the diagram summed over the 1368 spectra corresponding to as many measured sample orientations. We obtained after refinement  $a = 3.8532(7)$  Å,  $b = 3.8554(3)$  Å and  $c = 11.8230(9)$  Å for Y123,  $a = 12.169(1)$  Å,  $b = 5.6526(7)$  Å and  $c = 7.1237(8)$  Å for Y211, with a reliability factor of  $R_w = 4.2$  % corresponding to the refinement illustrated on Figure 2. The Y123 phase is then poorly oxygenated, as expected for an as synthesised sample.

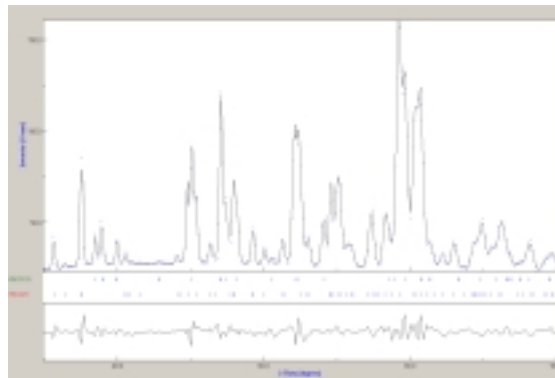


Figure 2 : Rietveld refinement of the sum of the 1368 measured diagrams (top), allowing phase, cell parameters quantitative determinations, for one of the measured samples and {003} and {100} pole figures (bottom) showing the strong orientation of the Y123 phase with one single domain.

A  $J_c(0T, 77K) \approx 23 \text{ kA/cm}^2$  is obtained from magnetic measurements on this sample. This value is similar to those of single domain bulks with non-optimized Y211 content and size distribution. There is now a lot of scope for further improvement of  $J_c$  in the ITSG-Y123-perforated by refining the Y211 distribution and their microstructure using e.g. doping methods known from bulk materials processing [7].

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