**NANOSTRUCTURATION OF $YBa_2Cu_3O_{7-\delta}$ SUPERCONDUCTING THIN FILMS BY METAL ORGANIC DECOMPOSITION (MOD)**

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Since the discovery of the high temperature superconductivity the main objective has been to develop efficient methodologies to obtain superconducting wires capable of carrying current densities at least 100 times higher than the copper wires.
The principal difficulty to achieve this objective is the granularity of the superconducting materials, which impedes the pass of the superconducting current. The development of the second generation superconducting tapes has allowed to overcome this obstacle. These conductors consist on an epitaxial superconducting layer of $YBa_2Cu_3O_{7-\delta}$ (YBCO) deposited on textured buffer layers and finally the metallic tape. These superconducting tapes have a low angle grain boundary (disorientation lower than 4-6º) and therefore the current flow is not significantly affected.

The production of these tapes using chemical methodologies such as the Metal Organic Decomposition (MOD) is very promising due to its low cost compared with the physical methods [1]. At a temperature of 77K it has been obtained high current densities (Jc~3MA/cm$^2$) in thin films (~300nm).
Nowadays the research is focused on the maintaining of these properties in thicker films (1-2μm) and at high magnetic fields (3-5T). This would allow the displacement of the copper in applications requiring high magnetic fields such as motors, generators, magnets, energy storage, etc.

YBCO is a Type II superconductor; the magnetic field can partially penetrate in the material generating the so-called vortices. When an electrical current is applied in the material, the vortices moved and this produces a loss of energy. The consequence is that the critical current density is significantly reduced.
In order to prevent the vortices motion is necessary to anchor them by means of non-superconducting nanometric defects. This has been recently achieved by physical methods such as Pulsed Laser Deposition (PLD). [2]

The goal of the present work is to obtain textured nanoparticles of a non-superconducting second phase ($Y_2O_3$, $BaZrO_3$,) in the YBCO matrix using the Metal Organic Decomposition.

The general principle of the MOD process is the decomposition of the metalorganic precursors in order to obtain the desired oxide phase. In our case, the precursor solution contains $Y(CF_3CO_2)_3$, $Ba(CF_3CO_2)_2$, and $Cu(CF_3CO_2)_2$ (0.25M, 0.50M and 0.75M respectively in MeOH). The use of the trifluoroacetate (TFA) anion avoids the formation $BaCO_3$ which is stable up to T~1000ºC and remains as an impurity in the YBCO phase, while $BaF_2$ can be decomposed in a humid atmosphere at lower temperature (T~550ºC).

By modifying the precursor solution we have succeeded in the growth of secondary phases. To obtain $Y_2O_3$ as a secondary phase, an excess of Y $(CF_3CO_2)_3$ is added in the precursor solution. The same strategy is followed for the $BaZrO_3$ case, adding an excess of $Ba(CF_3CO_2)_2$ and an equivalent amount of $Zr(C_5H_7O_2)_4$.

The texture analysis confirms that $BaZrO_3$ and $Y_2O_3$ phases are textured both in plane and out of plane.
Moreover we have observed, as a consequence of the presence of these nanometric defects in the YBCO film, an increase of the critical current density at high magnetic fields. Fig (1)

We are currently performing a high resolution TEM/EELS study of both, compositional and structural defects associated with the interaction of the non-superconducting nanoparticles and the YBCO matrix.

**References:**

[1] X.Obradors et al, Supercond. Sci. Technol., **17** (2004) 1055.
[2] J. L. MacManus-Driscoll et al, Nature Mat., **3** (2004) 439.

**Figures:**

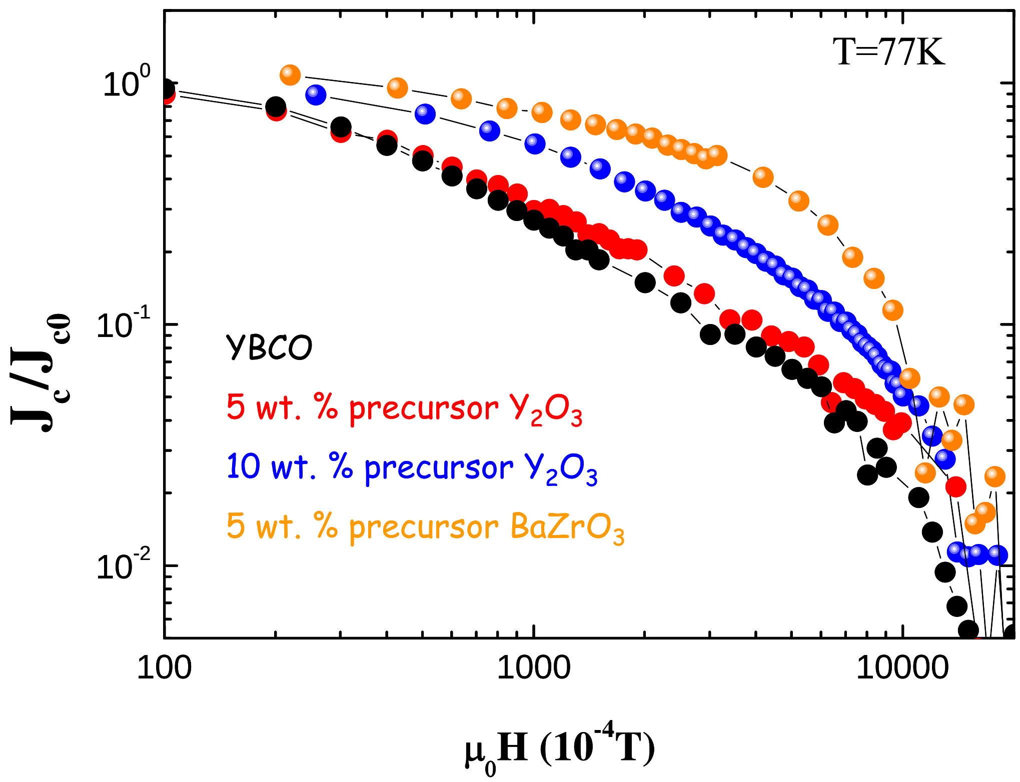


**Fig 1** Critical current density at 77K versus magnetic field applied parallel to the *c* axis for pure YBCO film, YBCO + $Y_2O_3$ films and YBCO + $BaZrO_3$ films.