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Abstract: The REBCO (RE = Rare Earth) powder materials have a great application on industries, especially used as fault current limiters, current leads and levitators for electrical enhances and generators. In this work is presented an efficient process and results that may contribute to improve superconducting materials of optimum quality to Melt-Textured-Growth (MTG), which are suitable for many applications.

Polycrystalline bulk samples of $Y_{(1-x)}Nd_xBa_2Cu_3O_{7-\delta}$ were obtained by a wet-chemical acetate method with $x = 0, 0.1, 0.2, 0.5$ and 1.0 as well as change the Yttrium for the rare earth Neodymium until full replacements i.e., from YBCO to NdBCO. The acetate route consists of a wet chemical procedure reaction with the powder Y_2O_3 , Nd_2O_3 , $BaCO_3$ and CuO (99,9% purity) into a solution of 50% glacial acetic acid. This method improves the grain growth, is shorter than conventional solid state method without any degradation in sample parameters.

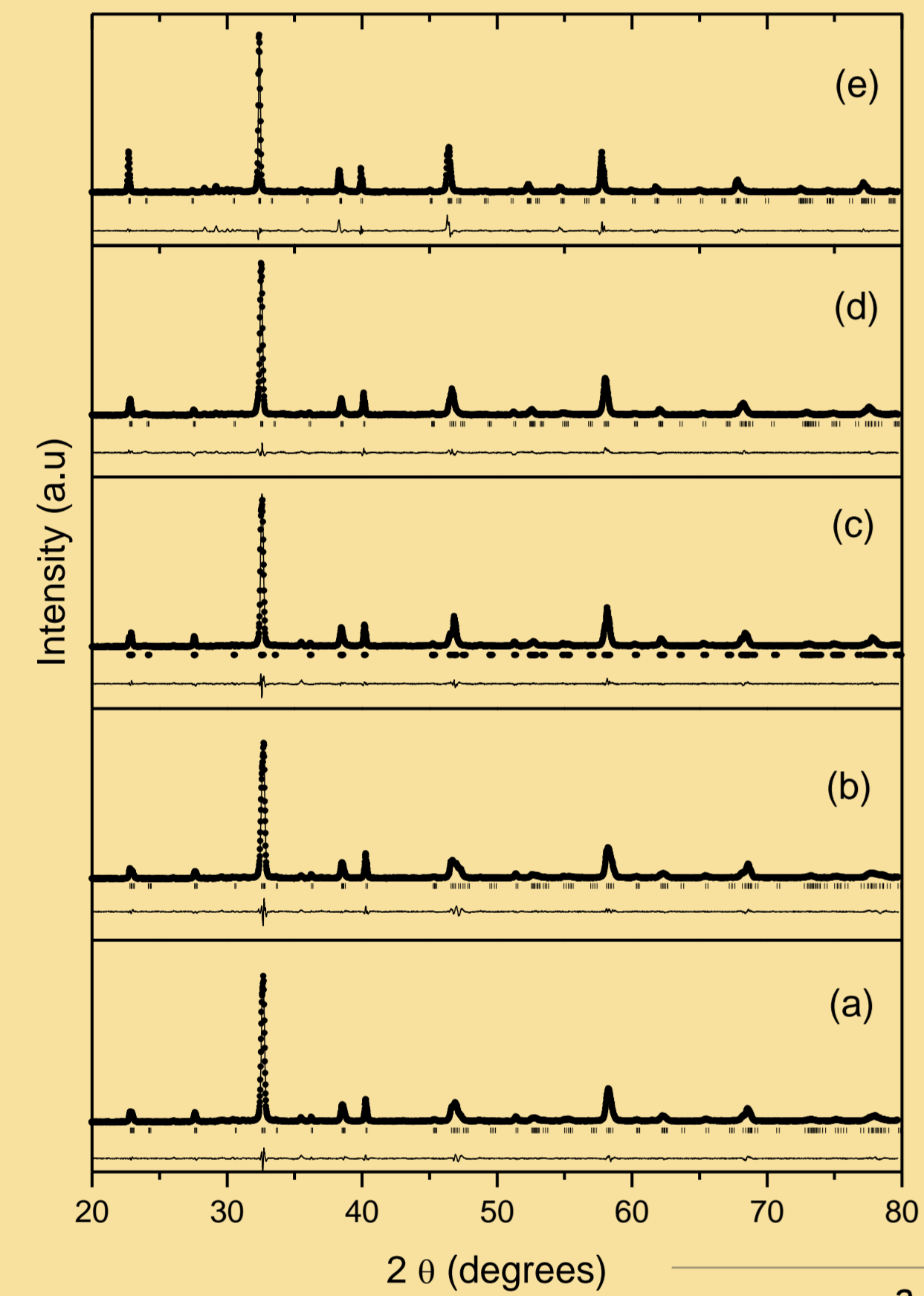
The samples were submitted to X-ray powder diffraction (XRD) and the spectra obtained were fitted using Rietveld method, orthorhombic space group $Pmmm$ was assumed, the result showed that the unitary cell average volume increases with the Neodymium doping quantity.

The porosity of the samples was calculated with densities from the sample and XRD data, and the values are from 11% up to 23%, resulting into a high degree of granularity in those samples. Those result shows that are fewer necks on the samples than expected by conventional method synthesis, confirmed by SEM images of cross section and superficial surfaces. It also provides information of the grains size and homogeneity.

AC electrical resistance as a function of temperature measurements and DC magnetization measurements showed that all samples had superconducting transition with $T_c > 77$ K, and in absence of Neodymium, the critical temperature reaches 91K. From the analysis of the results we conclude that this method is promising for obtaining optimal high temperature superconducting cuprates in order to be used for MTG.

Introduction

The $YBa_2Cu_3O_{7-\delta}$ compound was synthesized in 1987, and was the first superconductor which showed a critical temperature above the boiling point temperature of nitrogen. In its composition, Yttrium (Y) can be replaced by various rare earth ions, which exhibit similar properties. Samples of $YBa_2Cu_3O_{7-\delta}$ (Y-123) and $NdBa_2Cu_3O_{7-\delta}$ (Nd-123) were obtained by a liquid route of acetic acid solution in distilled water.



X-Ray Diffraction

The X-ray diffractogram (after a Rietveld refinement) for samples of $YBa_2Cu_3O_{7-\delta}$ and $NdBa_2Cu_3O_{7-\delta}$, showed orthorhombic crystal system and space group $P m m m$.

Fig.1 – X-ray diffratogram after adjustment by Rietveld refinement of the samples.

x	a (Å)	b (Å)	c (Å)	V (Å³)
0	3.858435	3.877067	11.679653	174.721
0.1	3.852419	3.879487	11.687979	174.682
0.2	3.872143	3.879525	11.705256	175.830
0.5	3.880576	3.891899	11.705530	176.786
1	3.901839	3.914003	11.725516	179.070

Table 1 – Lattice parameters and unitary cell volume of the samples.

Resistivity Measurements

The resistivity versus temperature curves of AC for the samples Y-123 (a) and Nd-123 (b) are shown in Figure 2.

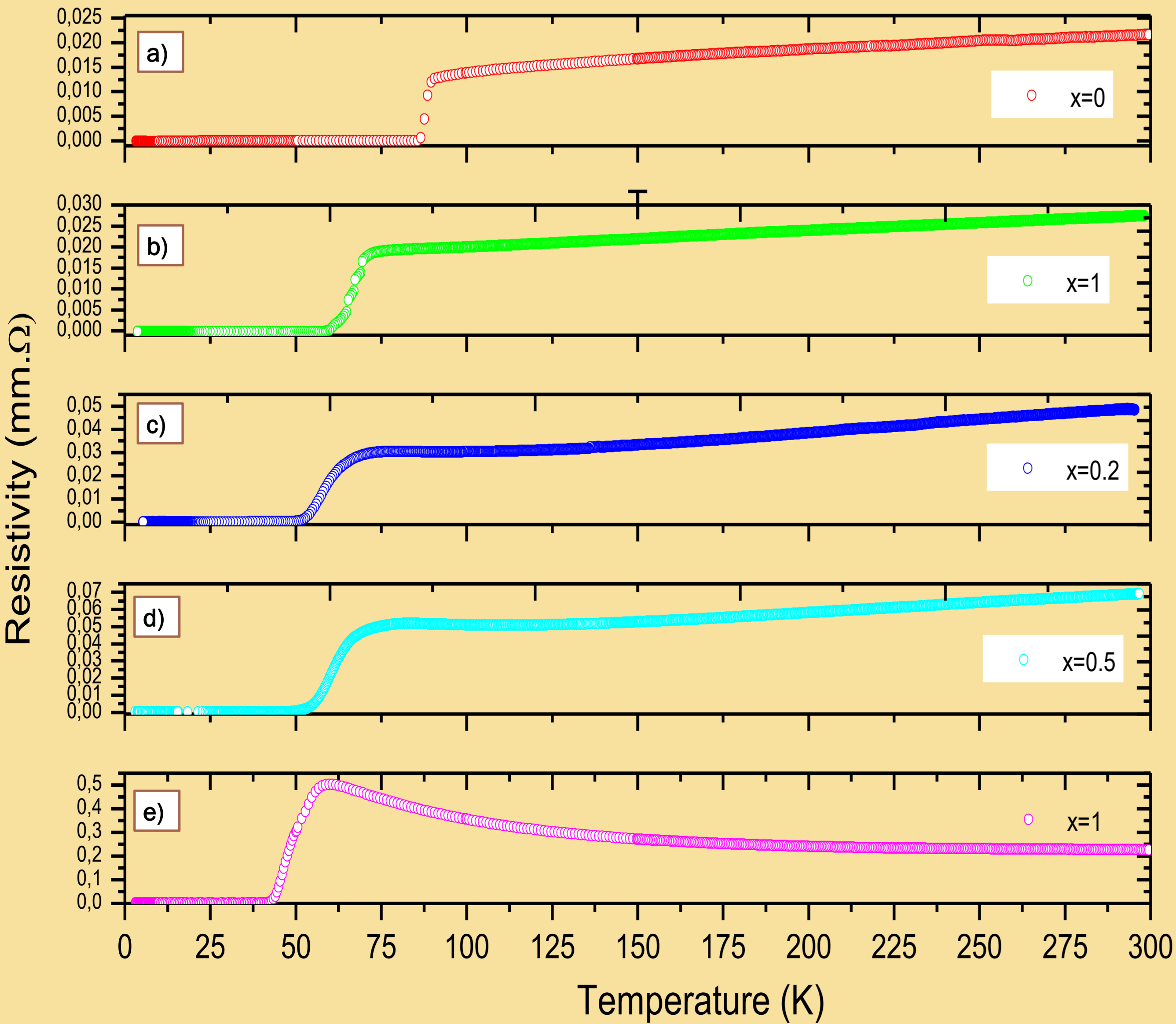


Fig.2 – Resistivity versus temperature of the samples $Y_{(1-x)}Nd_xBa_2Cu_3O_{7-\delta}$: a) $x=0$; b) $x=0.1$; c) $x=0.2$ d) $x=0.5$ and e) $x=1$

Magnetic Measurements

The magnetic moment analysis performed in two steps obtained irreversibility temperatures in ZFC and FC curves for the samples. These measurements confirmed the diamagnetic property of all compounds obtained over the temperature range.

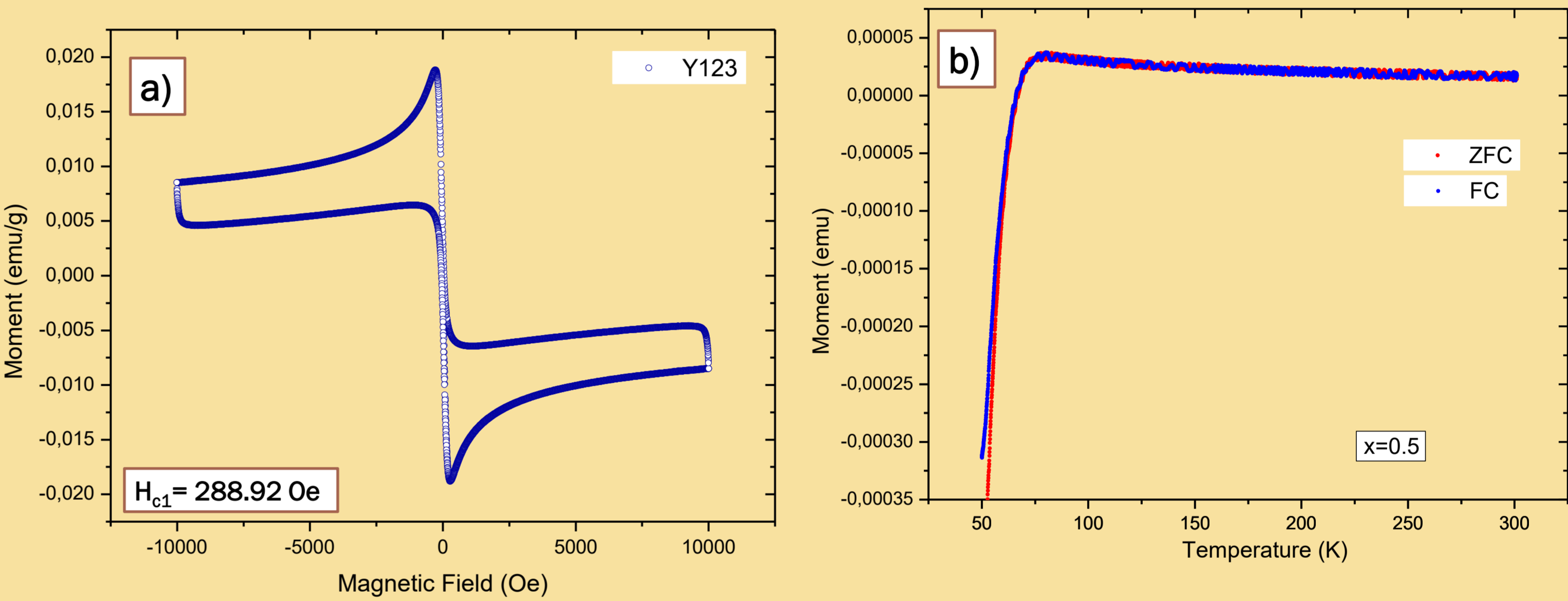


Fig.3 – a) Hysteresis Loop of Y123 (absence of Nd); b) Magnetization measurements versus temperature of the samples $Y_{0.5}Nd_{0.5}Ba_2Cu_3O_{7-\delta}$.

SEM Images

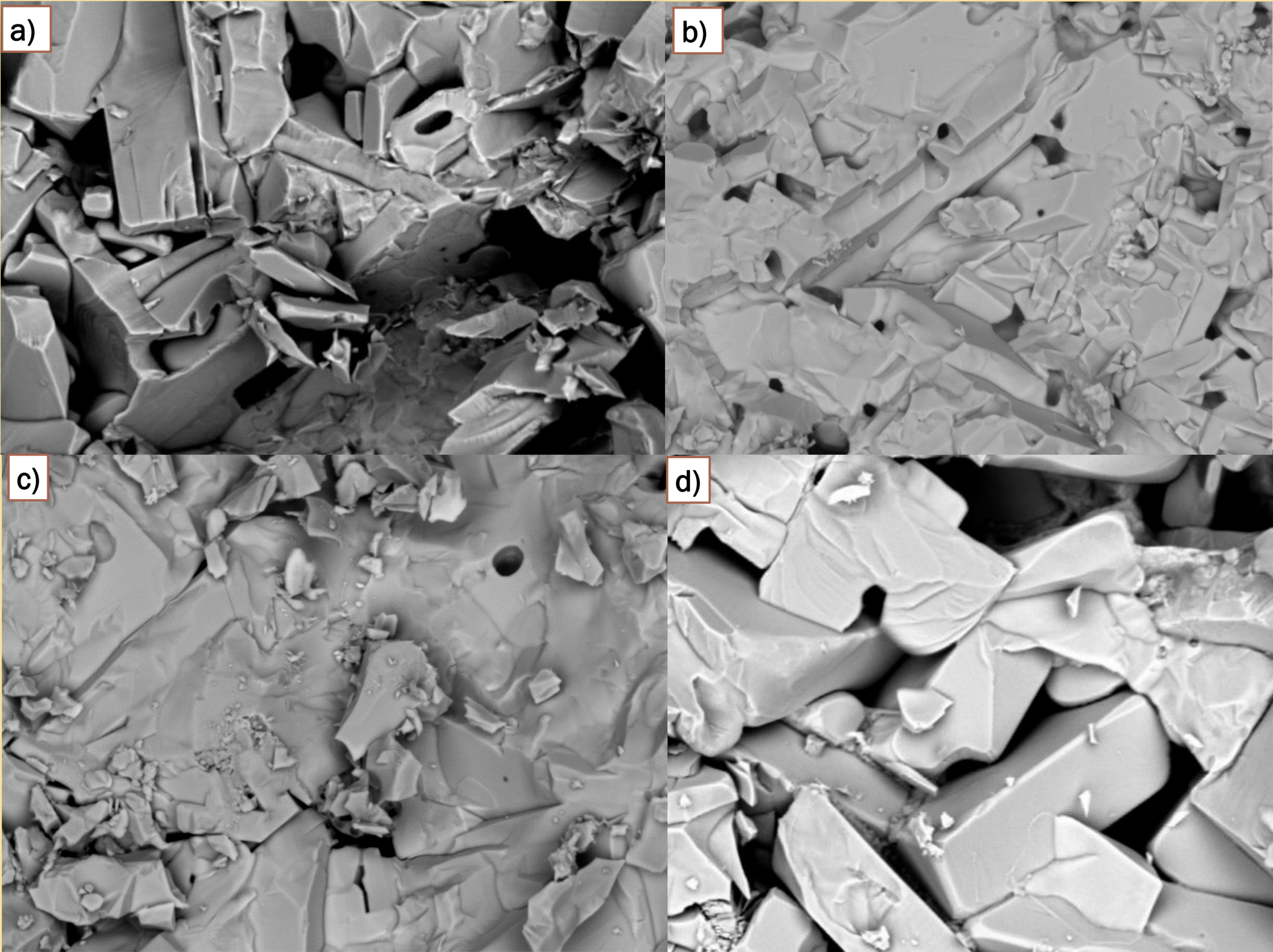


Fig. 4 – Amplification of 2500x the straight section of the samples $Y_{(1-x)}Nd_xBa_2Cu_3O_{7-\delta}$: a) $x=0$; b) $x=0.1$; c) $x=0.5$ and d) $x=1$.

Conclusions

The results allow one to conclude that the method of wet synthesis of acetate proposed is promising for obtaining high quality powders of superconducting RE123 system, usable as starting materials to obtain sputtering targets to thin or thick superconducting films as well for the production of bulk pieces for use as levitators or current leads.

Acknowledgments

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