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Report

Effect of Ba_2YTaO_6 addition on the Irreversibility Line of $YBa_2Cu_3O_7$ films

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Introduction

The irreversibility field (H_{irr}) marks the upper limit of the magnetic field(**H**) - Temperature(T) region where superconductors are useful for power applications; thus increasing H_{irr} is of great technological interest. The generation of non-superconducting second phases and defects was shown to be effective to push H_{irr} up. The size, density and nature of the nanoparticles is critical to achieve the desired effect.[1] In this work we investigate the effect of Ba_2YTaO_6 (BYTO) addition into $YBa_2Cu_3O_7$ (YBCO) films on H_{irr} at different field orientations up to 65T.

Experimental

Epitaxial c-axis oriented YBCO and YBCO+ 6wt% BYTO nanocomposite films were grown on single-crystalline $LaAlO_3$ substrates, with the film's thickness of 250nm. Samples were prepared from metalorganic solutions with stoichiometric quantities of Y, Ba and Cu anhydrous trifluoroacetate, where Zr, Ta or Y salts were added to achieve the desired composition of the nanocomposites.[2] The superconducting transition temperature T_c for YBCO was T_c=91.8K while for the 6wt% BYTO was T_c=91.3K. A low AC current corresponding to 100 A/cm^2 with a frequency of 100 kHz was applied along the bridge in order to measure the electrical resistivity (ρ) with **J**⊥**H**.[2] For DC field studies (up to 9T) a rotational stage was used to change the orientation of the applied field **H** with respect to the c-axis of the films (Θ). For pulsed field experiments, Θ was varied by mounting the sample on fixed wedges. This introduces an error that is particularly relevant near the *ab* plane direction. Comparison with DC data allowed us to determine the orientation of the YBCO sample (for nominal **H**||ab) to be 87° not 90°**.** Thus the H_{irr} at **H**||ab for YBCO should be higher in order to compare with the other sample as seen in Fig. 1**a**. The H_{irr} were determined using a 0.01ρ*(95K)* criterion.

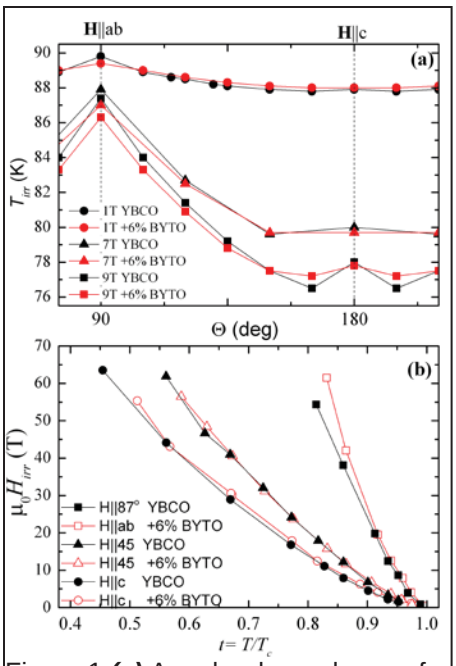

Figure 1.***(a)*** Angular dependence of T_{irr} at different DC fields.***(b)*** H_{irr} for **H**||*c*, 45^o and *ab*, for YBCO and YBCO+BYTO films.

Results and Discussion

Measurements in DC magnets were compared to the results from pulsed fields and showed very good agreement. We find that the addition of 6wt% BYTO nanoparticles enhances H_{irr} with respect to YBCO films only at low fields and high temperatures. Similarly to results for $BaZrO_3$ addition the effects are more important at intermediate angles.[3] The peak in H_{irr}(Θ) at **H**||c is also smaller, consistent with microscopy studies that show twin-boundaries being shorter and farther apart.[2] A decrease in H_{irr} was observed close to **H**||ab for YBCO+BYTO with respect to standard YBCO films most likely due to buckling of the *ab* planes.

Conclusions

We find that the addition of BYTO nanoparticles increases H_{irr} slightly in the high-temperature low-field region. Understanding the mixed pinning landscapes due to a combination of various dimensional disorders is critical to improve H_{irr}.

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[3] M. Miura *et al.* Applied Physics Letters **96**, 072506 (2000).