Strong Vortex Pinning in Sm-doped $YBa_2Cu_3O_{7-x}$ Films Made by MOCVD

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Introduction

Metal organic chemical vapor deposition (MOCVD) has been shown to produce high critical current density (J_c >3 MA/cm2) in a 2.1 μm thick YBCO coated conductor (CC) with 10% Sm substitution. Pursuing pinning studies up to 33T greatly extend our knowledge of vortex pinning behaviors near the irreversibility field (H_{irr}) over a wide temperature range.

Experimental

The MOCVD CC was grown on an IBAD grown MgO_2 texture template at SuperPower Inc [1]. A 50 μm wide by 500 μm long link was cut with a Nd-doped yttrium aluminium garnet laser to restrict I_c to < 5 A. Four-point transport *V-I* characteristics were performed in a 33 T NHMFL Bitter magnet and a 16 T PPMS system down to 10 K. J_c values were determined at 1 μV/cm electric field criterion.

Results and Discussion

Figure 1 presents $H_{irr}(T)$ along *c-axis* and *ab-planes*. H_{irr} values are at least 30% greater than single-crystal bulk YBCO or PLD grown science YBCO films [2], indicating that pinning is largely enhanced over a wide temperature range due to the strong interactions between the vortex lines and the nano-particle pinning centers [3]. Figure 2 shows $J_c(H)$ for T = 4.2 K for both *H//c-axis* and *H//ab-plane*. J_c(0T, 4.2K) reaches 34.9 MA/cm^2, which is ~11 times that of 77 K. Even along the disfavored orientation *H//c-axis* and at a high field of 16 T is J_c(4.2K) ~3.8 MA/cm^2. Along *ab-planes*, the decrease of J_c with increasing *H* is much slower, with only a 25% J_c reduction from 0 to 16 T.

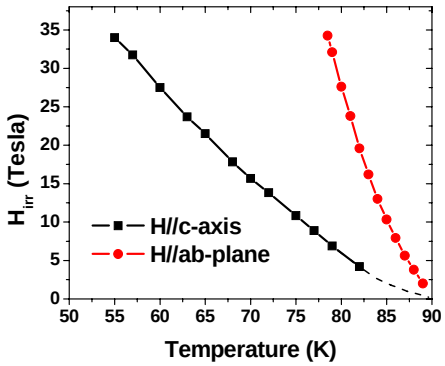

Fig. 1 H_{irr} as a function of T for H//*c-axis* and H//*ab-plane*

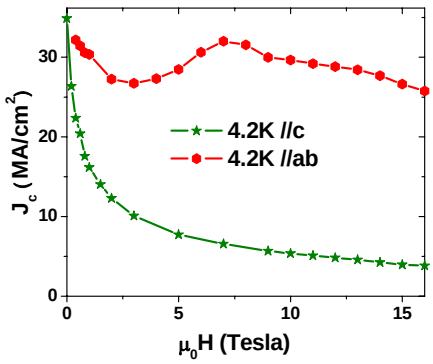

Fig. 2 J_c(H) at 4.2K for both H//*c-axis* and H//*ab-plane*

Conclusions

The high H_{irr} and J_c values of the Sm-doped MOCVD CC testified its capability of allowing the flow of large super-currents in high magnetic background fields, which makes this conductor a very promising candidate for high field magnet applications.

Acknowledgements

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References

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[2] Hanisch, J., *et al.*, Superconductor Science and Technology, **20** 228-231 (2007)
[3] Chen, Z., *et al.*, Superconductor Science and Technology, **20** S205-S210 (2007)