Irreversibility Field, Connectivity and Filament Bridging of Bi-2212 Round Wire


Introduction

Bi-2212 round wire is highly desirable for high field magnets due to its long length, round shape and high engineering current density up to at least 45 T at 4.2K. But present Jc for Bi-2212 is about half of our goal. Understanding what limits Jc is essential to developing strategies for raising Jc by improved processing and alternate processing routes. We have studied the irreversibility field, the connectivity, and the effects of filament bridging of the Bi-2212 round wires

Experimental

It is observed that the Bi-2212 filaments are connected transversely due to the formation of filament bridging. In order to understand the roles of the filament bridging a 27x7 filament wire was made in collaboration with Oxford Superconducting Technology by replacing 58 of the 85 filaments with silver in the standard 85x7 filament wire, so that the filaments do not bridge and remain separated. The critical state irreversibility field Hk and connectivity for a variety of Bi-2212 round wire samples was measured by using a 14T Oxford VSM and fitting the flux pinning force curves. We did the connectivity analysis for Bi-2212 conductor by measuring the remnant fields at different temperatures with a Quantum Design SQUID.

Results and Conclusions

We found that Hk of 2212 round wire is about 100 T at 4.2 K with field perpendicular to wire by fitting the flux pinning force curves. As seen in Fig. 1, the high Jc wire shows higher intergrain derivative mR peak, implying the better connectivity. We are finding that two-fold variations in Jc produce little change in Kramer field Hk, leading us to conclude that the connectivity is the main controlling factor for Jc in present Bi-2212 conductors. It was found that Jc of 27x7 filament wire was only a third of 85x7 wire and that the flux pinning for 85x7 wire was obviously stronger. The remnant field analysis suggests that the filament bridging improves the connectivity. It is believed that the filament bridging contributes to both the better connectivity and stronger flux pinning, and that encouraged good bridging by optimizing the filament configuration could be an important way to improve Jc of Bi-2212 round wire.

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Figure 1: (a) Remnant magnetization (mR) as a function of the maximum applied field at 5K with field parallel to wire direction for short high Jc 85x7 filament sample (W521-3) and test coil (TC-2007-012-coil). (b) Derivative mR at 5K. The lower field peak in the derivative mR curves corresponds to the intergrain current (I), and the higher field peak to the intragrain current (G). (c) Comparison between 85x7 filament and 27x7 filament wires.