Low Temperature High Field Continuous Measurement of YBCO Coated Conductor

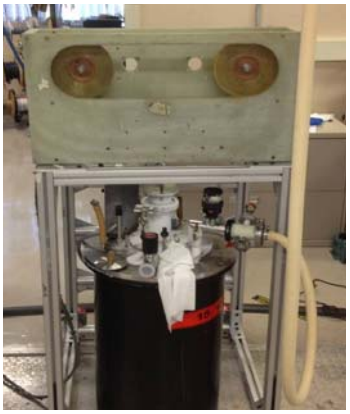
A. Stangl, J. Coulter, X. Hu, M. Santos, J. Sinclair, J. Jaroszynski, D.C. Larbalestier (NHMFL)

Introduction

Flat tapes containing thin films of the high-Tc superconductor, YBCO, are now commercially available in hundred-meter lengths, but must be carefully validated via detailed quality control before being committed for use in construction of superconducting magnets. We have developed a method of continuous measurement of such tapes down to liquid helium temperatures of 4.2K. Development of this unique quality control capability was made necessary by the MagLab's construction of a first-of-a kind, all-superconducting, 32 T magnet for its user program, a magnet that will increase the magnetic field available to superconducting magnet users by more than fifty percent.

Experimental

The tape moves from room temperature to a liquid helium cryostat through a 15 T magnet as shown. An array of Hall probes measures the remnant field profile induced by supercurrents flowing in the tape that have been induced by the strong magnetic fields.



Top: Reel-to-reel measurement in a 15T superconducting magnet. Right: critical current assessed at various magnetic fields at T = 4.2 K as a function of position. Evolution of the characteristic features with magnetic field is highlighted in two regions.

Results and Discussion

Figure shows several traces of magnetization at 4.2 K measured in 2 meter long sections at various magnetic fields. An evolution of magnetization pattern with increasing magnetic field is clearly seen. Strikingly, at some regions, minima observed at low current become maxima at higher fields and vice versa, signaling interplay between pinning and grain boundary effects on supercurrents.

Conclusions

The method that we have developed and implemented makes it possible to separate intrinsic properties like the vortex pinning mechanisms from mistakes and faults in the manufacturing process of the superconducting tape.

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References

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