Critical Current Measurement at 4.2 K up to 20 T of High-Temperature Superconducting Magnet Cables

D.C. van der Laan (Advanced Conductor Technologies and the University of Colorado); H. Weijers (FSU-NHMFL); P. Noyes (FSU-NHMFL); G. Miller (FSU-NHMFL); G.P. Willering (CERN)

Introduction

The next generation of high-field magnets requires operating fields exceeding 20 T and that cannot be reached with low-temperature superconductors, such as NbTi or Nb_3Sn and high-temperature superconductors (HTS), such as $REBa_2Cu_3O_{7-\delta}$ (REBCO) coated conductors, are the only option. We've introduced a new cabling method that enables the construction of conductor on round core (CORC) cables that meet the requirements for high-field magnets [1,2] and performed cable tests at 4.2 K at magnetic fields up to 20 T at the user facility of the NHMFL.

Experimental

Several REBCO coated conductors cables were constructed using the method as outlined in Ref. [1]. One of the cables was wound into a 12-turn, double layer magnet (see Fig. 1a. The critical current (I_c) of the cables and the magnet will be measured at 4.2 K, at magnetic fields of up to 20 T.

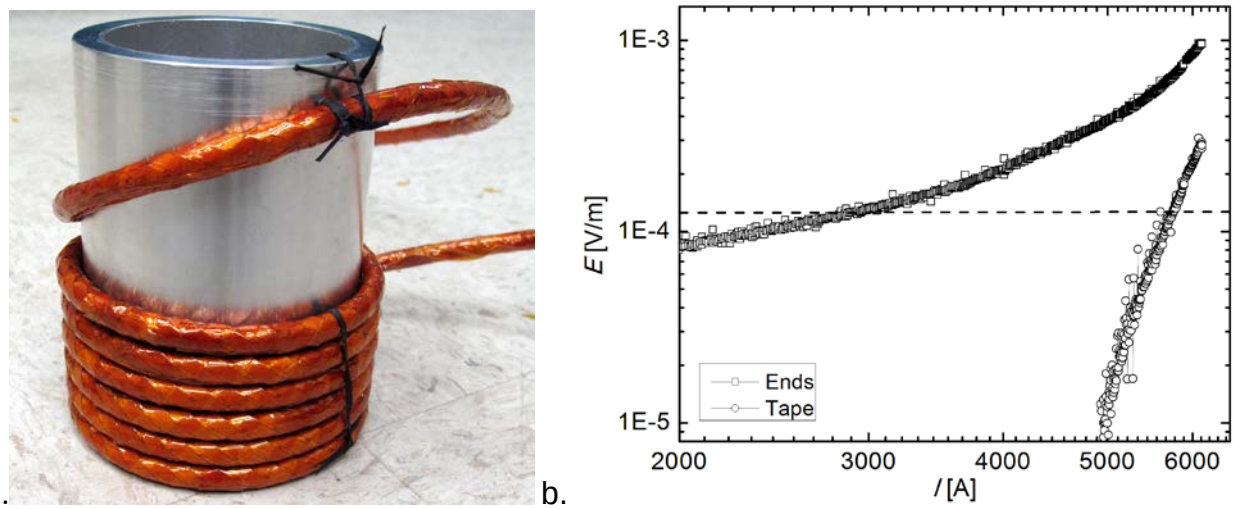

Figure 1. a) Magnet from CORC cable. b) Electric field vs. current at 4.2 K of record CORC cable at 19 T.

Results and Discussion

The magnet shown in **Figure 1a** has an I_c of about 2 kA in a total field of 20 T. With another cable, we set a new record for a superconducting critical current at 4.2 K in a background field of 19 T, namely 5021 A. The superconducting transition is shown in **Figure 1b**. We've also measured the response of this particular cable to high current ramp rates of up to 68 kA/s to 120 % of I_c at 19 T. No effect on the superconducting transition was found.

Conclusions

We successfully performed several measurements of an HTS cables at a field of 20 T. The results show the feasibility of CORC cables for high-field magnets that are operated at high current ramp rates.

Acknowledgements

This work was supported in part by the U.S. Department of Energy, under award numbers DE-AI05-98OR22652, DE-SC0007891, and DE-SC0007660.

References

[1] van der Laan, D.C., *et al*., Supercond. Sci. Technol. **24**, 042001 (2011).
[2] van der Laan, D.C., *et al*., Supercond. Sci. Technol. **25**, 014003 (2012).