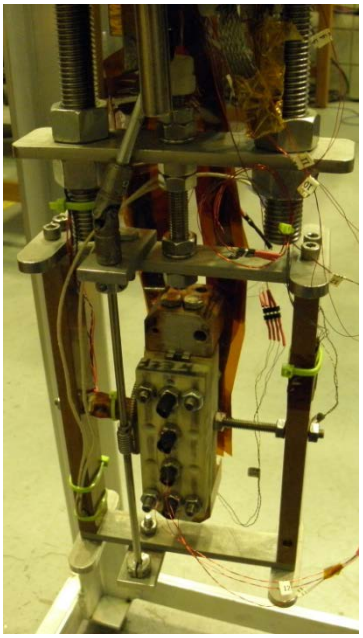
Bi-2223 Conductor Characterization for the HTS Current Leads for the NHMFL Series-Connected Hybrid Magnet

Patrick D. Noyes, W. Scott Marshall, Sarah E. Napier, Steven Carter, Iain R. Dixon, Mark D. Bird (NHMFL)

Introduction

The performance characteristics of the HTS conductor used in the binary leads for the Series-Connected Hybrid Magnet (SCH) must be well understood. A series of measurements were made on multiple samples of single tape conductor and a stack. The tapes will be in a high background field of varying angles and at temperature above 77K. This data is essential for engineering margins and quench behavior.



Development activities

Testing

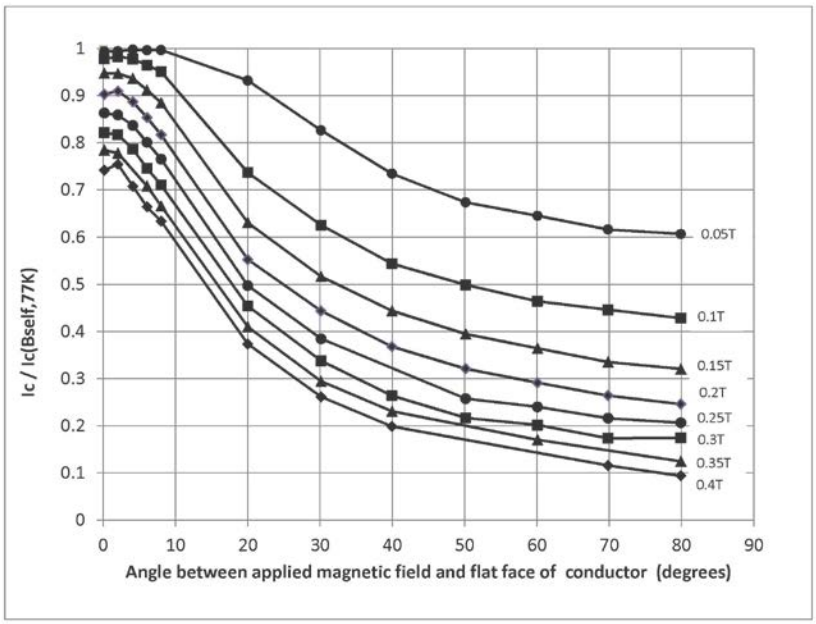
A probe was designed and built specifically for these tests in the wide bore resistive magnet in Cell 4. The large bore of this magnet was necessary as the samples were rotated from I parallel to B to I perpendicular to B. Additionally, the use of the resistive magnet assisted greatly in its ability to withstand very high ramp rates when compared to a similar bore superconducting magnet. The probe itself could be rotated from an external control.

In order to make measurements at different temperatures, the pressure on the bath was changed. This was done with a large vacuum pump and a regulator, or a pressurized gas bottle and cartridge heaters depending on whether the desired point was above or below 77.4K.

Comments on Results

I_c data was taken at 10 different field points, 10 different angles, and up to 6 different temperatures for a total of up to 600 data points for a single tape. Where this data set overlaps other datasets taken outside the lab, there is agreement, but the bulk of this data covers conditions not measured before. A total of 1 YBCO tape, 3 Bi-2223 tapes, and a stack of 6 Bi-2223 tapes were measured.

Bath temperature was measured with two calibrated platinum sensors from Lakeshore. Angle and field were measured with a pair of calibrated hall sensors that were orthogonal to each other. This allowed for a high precision in the angle measurement. The YBCO tape measured assisted in correction a minor systematic angle error.



Conclusion

The Bi-2223 tapes, as measured, will give the leads a comfortable margin in normal operation. The stack of tapes has a measured reduction in current density comparable to the reduction measured at CERN, roughly 30%.