Bi-2212 Canted-Cosine-Theta Coils for High-Field Accelerator Magnets

A. Godeke, L. N. Brouwer, S. Caspi, D. R. Dietderich, S. A. Gourlay,
R. R. Hafalia, N. I. Heys, H. C. Higley, T. M. Lipton,
M. A. Reynolds, and J. H. Swanson

Lawrence Berkeley National Laboratory, 1 Cyclotron Rd.,
Berkeley, CA 94720, USA

Email: agodeke@magnet.fsu.edu

Abstract — We report on the test of two-layer Bi-2212 insert coils that were fabricated using a Canted-Cosine-Theta (CCT) coil technology. In the CCT technology, a conductor is wound into canted helical channels that are machined into cylindrical coil winding mandrels, thereby creating a cosine-theta current distribution and providing stress support at the conductor level. The prevention of stress accumulations by the internal structure of winding mandrels is considered an enabling technology for high field Bi-2212 insert coils that target the 20 T magnetic field range. We report on proof-of-principle coils that use insulated 0.8 mm diameter wires and machined Inconel 600 coil winding mandrels that have an outer diameter of 50 mm and a clear bore of 35 mm for a two-layer coil set. The coils are designed to demonstrate the feasibility of the fabrication, reaction, and impregnation in Bi-2212 CCT technology, and provide a baseline for 6-around-1 cable-wound coils. These latter coils are designed to test the high field performance of CCT Bi-2212 inserts using simplified cable geometry. Eventually, we plan to fabricate a four-layer, cable-wound insert-coil set with optimized current density in the windings, to enable the construction of a 19 T Nb_3Sn – Bi-2212 hybrid dipole magnet.

Keywords (Index Terms) — accelerator magnet, Bi-2212, high temperature superconductor, high magnetic field