

Low-loss, High Current Density HTS Conductor and Coils for AC and Fast Ramp Systems

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Abstract

Higher field, much lighter-weight and more efficient ac and fast ramp magnets that can operate at affordably cooled temperatures above 12 K require HTS. Stator coils for example operate at above 100 Hz where HTS tapes cannot be used due to excessive induction - driven losses, requiring instead HTS as small cross-sectioned fine-filament, axially-twisted wires in transposed cable forms. An approach has now been developed to meet these requirements. As a first step, all required loss-reducing features are built into small diameter Bi2212 wires, consisting of non-merged, to order 10 μm filaments, twist pitch to 5 mm, and increased inter-filament resistances, while attaining Je levels by a low-cost reaction process that matches the best performance of Bi2212 magnet wires that do not include loss reducing features. In a second step, the fabrication of this wire has been scaled up to produce 3 km piece lengths. As a third step, a Rutherford cable design with all the required cable level loss reducing features, consisting of fully transposed strands, short cabling pitch and optimally increased interstrand resistances in long lengths has also been developed. As a fourth step, coil design features and wind – and – react fabrication methods were developed for this type of cable with focus on stators and ion beam medical systems and with tests demonstrating losses and performance that are in the range of application requirements while operating in the 15 to 25 K temperature range. Finally, the capability to fabricate reacted cables for react – and - wind utilization in larger bore coil types has also been demonstrated. Developments are continuing, coupled with prototype racetrack, saddle and solenoid test coils produced for performance and loss assessments at operating conditions of interest and for integration into next generation end user system developments.

Keywords: Bi2212, HTS, Coil, Cable, Wire, AC, Low Loss