MT 26
International Conference
on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **1588** Type: **Poster Presentation**

Wed-Af-Po3.20-02 [55]: No Insulation CCT Coils for Superconducting Accelerator Magnets

Wednesday, 25 September 2019 14:00 (2 hours)

The Canted Cosine Theta (CCT) magnet design is typically fabricated by winding individual turns into grooves machined into a metallic mandrel. This allows for precise placement of the conductor for field quality and also provides mechanical support against the Lorentz forces on an individual turn level. A new concept is explored in which the electrical continuity between adjacent turns is broken by means of a gap in the winding mandrel. In this case, no isolation of the turns to the winding mandrel is necessary, eliminating the need for turn to mandrel insulation. Insulation systems for Nb3Sn CCT magnets have so far consisted of a glass sleeve or braid over the conductor which is then vacuum impregnated with epoxy resin post reaction. With the new concept, the conductor can be wound into a mandrel without insulation, reacted, and then impregnated with a conducting material (for example with a low melting point metal). This new approach will be evaluated with respect to the previous glass and resin insulation system with a focus on: (1) improved efficiency due to elimination of the glass, (2) reduction in the quench disturbance spectrum by removal of the brittle resin, (3) improved cleanliness of the reaction process by removal of the glass and sizing, and (4) increased thermal stability of the coil due to being in close contact with conductive material. The reduction of mandrel stiffness due to the gaps will be studied using finite element modeling with possible stiffening mechanisms proposed where necessary. Finally, an initial study of the fabrication steps for such a coil will also be presented with a focus on manufacturing of the winding mandrel.

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Session Classification: Wed-Af-Po3.20 - CCT Magnets and Field Quality of Accelerator Magnets