

AP1-4

Field and Voltage transient behavior in REBCO HTS coils using single tape or two bundled tapes: Comparison between Experiment and Modelling

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The development of practical REBCO HTS coils (Rare-EarthBiCaCuO High Temperature Superconductor) for very high field face two issues. The first is destructive thermal runaway induced by local dissipative zones, and the second is dynamic field homogeneity. These two problems are due to the specificities of REBCO Coated Conductors. They have significant critical current variations along the length which engender local dissipative zones with slow propagation, and their wide and thin tape structure enable the development of large shielding current loops. The first issue, thermal runaway, may be solved by using a non-insulation or partial insulation technique. These techniques however affect negatively the second issue as shielding current loops may appear both in the tape surface and across coil turns. We observed, as other groups, that an early detection of dissipating voltages makes it possible to discharge isolated coils before a dangerous thermal runaway can occur. However, the dissipating voltage that must be detected is very low, comparable in amplitude to the transient voltage due to magneto-electric effects. These must thus be understood and considered in the detection scheme.

We report results obtained on pancakes wound with single 12 mm tape, in terms of transient voltages and magnetic field evolution. They are compared with simulation results obtained using a recently developed model. It shows that these transient behaviors can be accurately predicted by the model and that transient voltage measurement can be a good tool to study shielding current variations.

Even though early detection makes the practical use of isolated REBCO coils possible, the maximum operating current remains limited by the weakest conductor defect. We investigated the possibility of using two co-wound tapes to average the tapes properties. Results obtained on pancakes wound with such conductors are reported both in terms of transient voltages and field evolution. The behavior is qualitatively similar to single tape pancakes, with comparatively weaker hysteresis.

Simulation results obtained using various simplifying assumptions for the conductor structure are presented for comparison, showing the interest of the two bundled concept and the need for further model refinement to represent accurately such conductors.

Keywords: REBCO coil, Field homogeneity, Very high field