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Electromagnetic characteristics of two-tape co-winding REBCO coil including local defects

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REBCO tapes have good critical current characteristics under high magnetic fields. Their application to superconducting magnets generating above 25 T is under active study. However, performance inhomogeneity along their length can cause damaging hotspots. Adapted winding technologies are needed to mitigate this phenomenon. One of such winding techniques is the two-tape bundle co-winding method, where two REBCO tapes are co-wound along with an isolating tape to form the conductor. To test this solution, a double pancake coil was wound with an artificially degraded short section on one of the tapes. We previously reported its current-carrying capability, showing the gain in reliability. We now study its behavior in terms of field hysteresis and dynamic, at various temperatures (20-65 K).

In two-tape co-winding HTS coil, in addition to the shielding current flowing in the width of the tape, there are coupling current flowing between the two tapes. The axial field contribution of screening currents is in opposition to the field generated by the coil driving current, while the coupling current contribution is in the same direction. These two phenomena are thus in competition, the resulting overall field hysteresis depending on their relative amplitude and their decay dynamics.

For our test coil, the hysteresis behavior is strongly dominated by coupling effect during continuous ramping at all temperatures, contrary to other similar experiments conducted previously. This is due to the face-to-back configuration used for this co-wound conductor, which increase the distance between the REBCO layers and thus the coupling current flow path. The field transient at plateau show the decay of coupling currents, the field hysteresis being then dominated by screening current effect. The electromagnetic dynamic properties of this coil are presented with the temperature influence and compared with 2D axisymmetric modelling.

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