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Electromagnetic and thermal modeling of small coil made from HTS round cable

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Placing of tapes in helical manner on a round core represents one of possible ways to accomplish high-current cables from the 2nd generation of high-temperature conductors. We follow the concept similar to that of the Conductor On Round Core (CORC) however with a metallic tube utilized as the core allowing a coolant to flow through the central channel of such Conductor On Round Tube (CORT).
We present the results of experiments and modeling of the coil with 140 mm inner diameter wound from the hand-made CORT 4 meters long. This cable was used to wind the coil with 8 turns on 14 cm diameter. First the coil was tested in liquid nitrogen bath. Afterwards the layers of commercial aerogel and polyurethane foam were applied to provide a vacuum-less thermal insulation and a simple circuit arranged for its cooling by the flow of 77.3 K cold liquid nitrogen at DC tests.
Electromagnetic modeling based on the Jc(B, ⊠) data has been performed assuming two limiting cases of current sharing between tapes. Comparison with experimental data obtained in nitrogen bath indicated that the tapes did not experience any damage during cabling nor coil winding, and also pointed to certain amount of DC current migration between tapes in the cable.
Numerical modeling for the regime of flow cooling revealed an imperfection in cable manufacturing: in order to reach the temperature distribution observed in the experiment we had to introduce an additional thermal resistance between the copper tube and the tapes. This indicates that either the surfaces of tube and tapes were not clean enough or that the tapes did not adhere perfectly to the cylindrical surface of cooling tube.

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