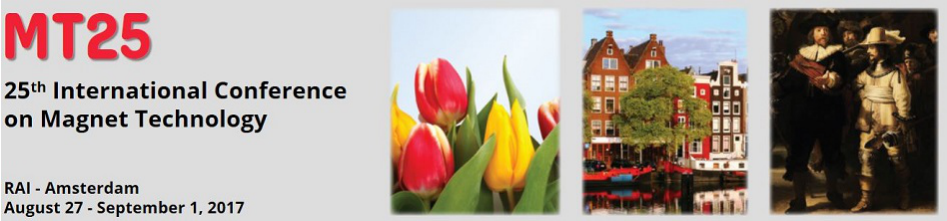

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Optimal Design Methodology of Multi-Width HTS Magnet

Monday, 28 August 2017 13:15 (1h 45m)

It is well known that critical current (Ic) of an high temperature superconductor (HTS) magnet comprising a stack of pancake coils is limited by that of "one" pancake, while the rest of the pancakes still have substantial margin to their own Ic. This unfavorable design issue is often mitigated by the so-called multi-width (MW) technique, where pancake coils wound with the narrowest tapes were placed at and near the magnet center and those with progressively wider tapes toward the top and bottom of the magnet. To date, several MW HTS magnets were fabricated and successfully generated their target fields significantly larger than those of their single-width counterparts. Currently, the SuNAM provides MW tapes grading width of 4 –12 mm in every 1 mm. So far, critical currents of the previous MW magnets were mostly limited by the Ic of the top or bottom most pancake wound with the narrowest tape, chiefly due to the angular dependency of the tape' s Ic. Further grading of the tapes, say in every 0.5 mm, may be beneficial in terms of mitigating the tape' s angular dependency in the magnet. This paper investigates an optimal design methodology for MW HTS magnets. For a given design target of field strength and winding bore, input parameters include tape width, number of grading tapes, and number of pancakes coils for each tape, while the main objective is to minimize the magnet volume, i.e., essentially the stored energy and thus the cost. A magnet with a single-width tape is also designed as a control sample for comparison. The results are expected to be beneficial to determine the practical level of HTS tape grading and estimate a volume of an MW magnet.
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