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Fri-Mo-Or5-02: Magnetic Penetration Fields and AC losses of helically wound ReBCO tape stacks

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ReBCO tapes and cables are of great interest high field magnets because of their high current carrying capability, high Tc, and high magnetic field tolerance. The magnetization and AC loss properties of ReBCO tapes are well known, however, for cables, especially the helically wound counterparts some interesting aspects remain. It is well known that for ReBCO tape the losses are strongly influenced by the ratio of the maximum applied field (Bmax) to the penetration field (Bp), and that Bp is proportional to tape thickness, rather than width, as it is for slabs or cylinders. It has also been shown that when tapes are stacked together, the penetration field tends back towards the stack width, and so the per tape loss can be suppressed if in so doing Bp increases above Bmax. In this work, we see that this effect is not directly translated for helically wrapped ReBCO tape stacks. Instead, changes in the AC loss per tape with increasing number of tapes is much more sluggish. We show measurements and analysis of the AC loss of helically wound ReBCO tapes as a function of increasing layer numbers to understand the behavior of effective penetration field. AC loss measurements were made on strips of 10 cm long ReBCO tapes helically wrapped around a non-conductive core. Measurements were made in a 0.55 T permanent magnetic test chamber up to frequencies of 120 Hz. The samples are placed in boiling nitrogen and the AC losses were measured using a calibrated nitrogen boil-off rate. We present a model for penetration field as a function of layer number and tape properties, and correlate the measured losses with the evolution of Bp with changes in layer number.
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