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Defect-Irrelevant Behavior of No-Insulation REBCO Coils at 4.2 K

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High temperature superconductors (HTS) have become a viable option for high field magnets, mainly due to its superior in-field current carrying capacity at greater than 20 T. However, the price of HTS conductors is still high and impedes widespread use. Provided that the need for a defect-free "long" piecelength of HTS conductor is a primary cost driver for most applications. Results previously reported from our defect irrelevant winding (DIW) technique of a no-insulation (NI) pancake coil wound with REBCO tapes containing multiple "defects" was subjected to a temperature of 77 K. A defect is defined as a section of the tape of which the average critical current is less than 80 percent of the lengthwise average over the entire length. The DIW coil performance, such as critical current, field constant, and coil voltage, was barely discernible from that of its "healthy" counterpart. Demonstrating a potential of the DIW technique for significant cost reduction of REBCO devices that may be operated at low current and high operating temperature. This study is to further investigate the validity of the DIW technique in 4.2 K. New pancake coils were wound with REBCO tapes containing multiple defects and tested in a bath of liquid helium at 4.2 K. Key parameters of each coil were measured and compared with simulations by the use of our lumped circuit model containing critical current data of a "healthy" portion of the tape used to build the DIW coils. The DIW coils underperformed at 4.2 K, i.e., the coil critical current was measured to be 60 – 70 percent of that of its healthy counterpart.
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