**HTS REBCO Twisted Stacked-Tape Cable Test at High Fields**

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**Introduction**

HTS REBCO flat tape cables made using the Twisted, Stacked-Tape Cabling (TSTC) method have been tested. The TSTC method allows developments of high current, compact conductors for various applications such as power transmission cables and high field magnets. In 2015, we fabricated and tested two pentagonal-shape TSTC coils.

**Experimental**

Two samples were made of a stacked-tape conductor composed of 40 REBCO tapes (SuperPower SCS 4050-AP, 4 mm width, 0.1 mm thickness). The cable of each sample was wound in a groove on a 165 mm diameter pentagonal cylinder made of G10 using the Stacked-Tape Twist-Wind technique. They were tested in liquid helium in Cell 4 using the 17 T, 195 mm warm bore Bitter magnet. Sample current for the first sample was provided using a 20 kA, 10 MW Bitter magnet DC power supply through a 4.7 m-Ohm stainless-steel tube resistor of Cell 4 connected in series with the test sample, on the other hand the second sample was charged by several DC power supplies, with current ratings between 1 kA to 2.4 kA, connected in parallel.



**Results and Discussion**

The first sample was tested in May, but unfortunately, the cable was damaged at 6 T and at about 10 kA, when an accidental manual dump of the 20 kA sample current power supply was performed after observing noisy signals. The cable might be damaged by an over current during dump as happened before.

The second sample was fabricated with a better cable support method using braided copper sleeve with soldering and Stycast to support Lorentz load applied inward during a high-field test, and the transition sections were reinforced with soldered copper tubes. This sample was tested in August using small DC power supplies in parallel instead of using the 20 kA power supply. Fig. 1 shows an I-V curve of 0.5 m voltage tap at the background fields of 14 T and 17 T at 4.2 K [1]. Fig. 2 shows a cyclic load test results of the critical current measured at the criterion 1 V/cm in liquid helium with background magnetic fields up to the maximum available field of 17 T.

As seen in the figure no cyclic load effect was observed. The critical currents between 10 T and 17 T were degraded by 16%, compared to the expected value from single tape critical currents measured in perpendicular field. From these results, a Lorentz load up to 102 kN/m (17 T x 6.0 kA) seems not to degrade the critical currents. The overall engineering critical-current density *Je* was 117 A/mm2 for the present conductor considering an overall averaged diameter of 8.1 mm, while that of the conductor cross-section of 4 mm x 4 mm is 375 A/mm2. The TSTC conductor test was successful.

**Conclusions**

The Twisted Stacked-Tape Cable will be very useful for high field, high current magnet applications. The conductor seemed to be very well supported, however the sample showed quenches similar in behavior to a thermal runaway after 200 V/m criterion. Origins of the quenches are under investigation. Further investigations of cable design and characterization will be required at a high magnetic field.

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**References**

[1] M. Takayasu, *et al*., 3rd HTS4Fusion Conductor Workshop, Italy, September, 11-12, 2015.