Research Progress in Joint and Cooling Techniques for a Remountable High-Temperature Superconducting Magnet

(3) Evaluation of Shear Strength of Mechanical Joint

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The shear strength and resistance of the mechanical joints is important factor to design the remountable high-temperature superconducting magnet. This presentation addresses analysis of the shear strength and the change in resistance of a mechanical lap-joint of REBCO coated conductors with an indium foil as an interlayer material.

Keywords: Superconducting Magnet, High-temperature Superconductor, Mechanical Joint.

1. Introduction

Remountable and joint-winding high-temperature superconducting (HTS) magnets have been proposed for segmented-magnet designs such as the helical fusion reactor FFHR-d1. Mechanical lap-joint (MLJ) of HTS coated conductors (CC) is a joint method candidate for such magnet designs. Previous tensile tests on MLJ of HTS CCs having Cu stabilizer with and without applied joint pressure revealed linear tendency between MLJ shear strength and contact conductivity. However, change in voltage drop due to sliding of the joint could not be observed due to HTS CCs reaching irreversible strain levels [1] for the case of applied joint pressure specimens. This study is an attend to clarify joint failure mechanism and the relationship between changes in joint resistance with respect to joint displacement of a MLJ of HTS CCs under joint pressure conditions.

2. Experimental set-up

HTS CCs reinforced with 0.8 mm thickness stainless steel bars where jointed with an indium film of 0.1 mm thickness as the joint interlayer material. Fabrication of the MLJ specimens with joint area 50 mm^2 was achieved using a special jig; the same one used to provide joint pressure during the experiment. Specimens were placed in a customized tensile test machine especially designed for HTS CCs. The whole equipment was submerged in liquid nitrogen (77 K) and a current of 50 A was applied. Measured parameters include load [N], potential drop [V] across the joint section and tensile strain of one HTS CC. A clip-on gauge was also used to measure total displacement of the whole set-up.

3. Results-Conclusion

Results revealed that by reinforcing the HTS CCs with stainless steel, irreversible strain [2] is avoided, leaving only the increase in potential difference across the joint section as can be seen in figure 1. Region (1) shows first sliding of the joint followed by re-attachment and strengthening of the joint at region (2). After reaching maximum load (1338 N), the joint starts continuous sliding. With the values of potential and further joint displacement measurement, we can evaluate the rate of change in joint resistance as the apparent area of contact decreases. More results on the day of the presentation.

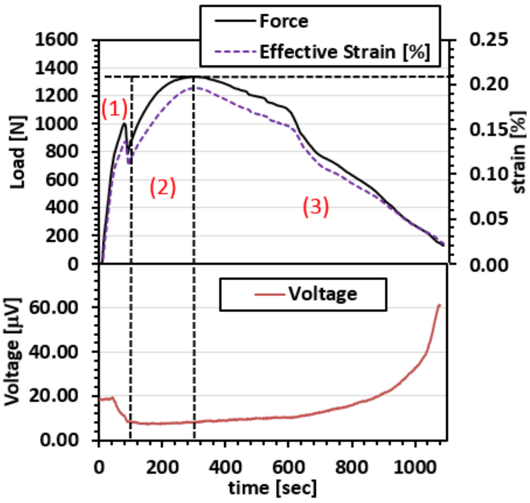

Fig. 1. Applied load and V_{drop} across joint section for 50 MPa and stainless steel-reinforced HTS CCs.

References

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