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Research progress in mechanical joint technique for remountable high-temperature superconducting magnet. (2) Improvement on interfacial shear strength of mechanical lap joint.

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1. Introduction

"Remountable" (demountable) high-temperature superconducting (HTS) magnet concept has been proposed for the segmented fabrication of the helical-type fusion reactor FFHR-d1 [1-4]. These magnets will allow for shortening of the fabrication time as well as reducing maintenance and repair costs by making access to inner components easier, and avoiding replacement of the whole magnet coil when damaged. Mechanical lap joint between HTS coated conductors (CCs) is one of the methods proposed for the joining of the magnet coil segments. This joint method consist of inserting an indium foil between two HTS tapes and then apply contact pressure to complete the assembly.

In order to verify the joint applicability, evaluation of its shear strength is essential since electromagnetic hoop and overturning forces will induce in-plane shear along the joint's width direction [3]. Consequently, fundamental tensile tests to apply shear stress to the lap joint was performed using rare-earth barium copper oxide (*RE*BCO) tapes [3]. Results revealed a proportional tendency between contact conductivity and the shear strength of the joint, and that the former will improve with higher contact pressure, directly improving the latter as a result. Thus, high and constant contact pressure is required in order to have sufficiently strong lap joints. However, having constant pressure at the joint sections in the actual magnet is unlikely since it would decrease after cooling the superconducting coils due to thermal strains. Therefore, this study focuses on the improvement of shear strength of mechanical lap joint by means of heat treatment process described in [5], and by changing the *RE*BCO tape stabilizer's surface treatment.

2. Method

For this study, *RE*BCO tapes were reinforced with stainless steel plates in order to avoid irreversible strain and reduce influence of the bending moment due to eccentricity of the tensile load. Figure 1 shows the experimental setup. Four specimens group were prepared as shown in Table 1, were one specimen fabrication method is heat treatment at 90 °C for 40 minutes while 100 MPa pre-load was applied as in [5], and the other corresponds to *RE*BCO tape's surface brushing direction.

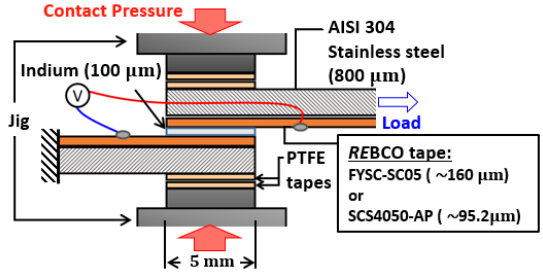

Fig. 1. Experimental setup.

Table 1. MLJ specimen group.

Specimen Group	Heat treatment [5]	Brushing direction
A	–	Longitudinal
B	X	Longitudinal
C	–	Width-wise
D	X	Width-wise

3. Results

Figure 1 shows results for group "A" and "B" using Fujikura ltd GdBCO tapes. Shear strength of specimens from group "B" was high even with low contact pressure in contrast with samples with high contact pressure (100 MPa) from group "A". Results including groups "C" and "D" are shown at the poster session.

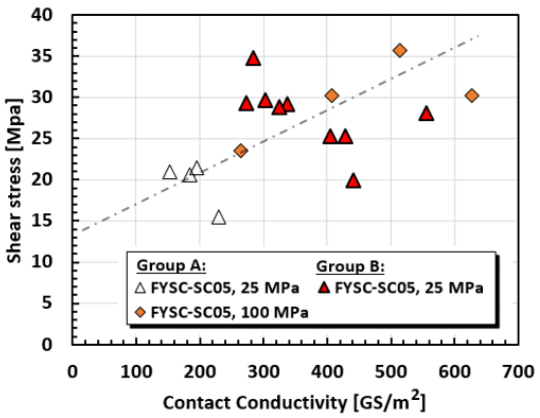

Fig. 2 Shear strength as a function of contact conductivity for MLJ of GdBCO CCs at 77 K.

4. Summary

This study evaluates improvement on shear strength of mechanical lap joint between *RE*BCO tapes using indium as bonding material by changing the sample fabrication method. Preliminary results show increase in shear strength when using heat treatment method.

References

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