Joint Performance Evaluation of Curved REBCO Lap Joint for Segment-Fabrication of Fusion Magnets

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We performed bending and twisting testing of lap joint with REBCO tapes for segment-fabrication of high-temperature superconducting fusion magnets. Joint resistance and critical current characteristics under the testing are reported.

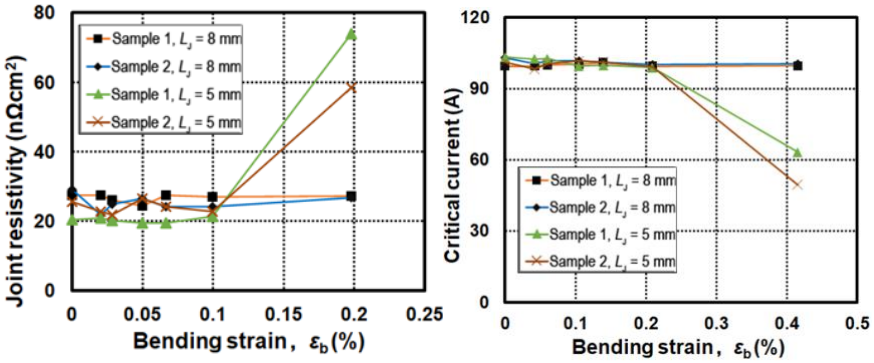
Keywords: Remountable HTS magnet, High-temperature superconductor, Mechanical joint

1. Introduction

Bridge-type mechanical lap joint of simply stacked Rare-Earth Barium Copper Oxide (REBCO) conductors with indium foil insertion has been proposed for segment-fabrication of high-temperature superconducting (HTS) magnets especially for a heliotron-type fusion reactor [1]. Because fabrication of heliotron-type fusion reactor needs to bend and twist joint part to be helical shaped coil, the evaluation of bending and twisting characteristic of lap joint is necessary. The present study focuses on bending and twisting characteristic of lap joint of REBCO tapes in two fabrication procedures: 1) joint, twist, and bend (JTB) procedure 2) twist, bend and joint (TBJ) procedure.

2. Joint performance evaluation of bending and twisting characteristic of REBCO lap joint

4-mm-wide REBCO tapes were used for joint samples, whose critical current is 98 A at 77 K, self-field. 100-μm-thick indium foil was used as joint interface material. We applied the pickling process [2] and heat treatment at 90°C [3] to complete fabricating process of the joint. The joint length, L_J, was 5 mm or 8 mm for each lap joint in joint and bend procedure. Fig. 1 shows results of joint and bend procedure. Fig. 1(a) shows the joint resistivity increased when ε_b = 0.1–0.2% with L_J = 5 mm, whereas no joint resistance increases with L_J = 8 mm. The joint resistivity also decreased from 42 nΩcm^2 to 20 nΩcm^2 compared with the previous study [4] by using pickling process [2] and has the same R_JS_J increases tendency about ε_b = 0.1–0.2% with L_J = 5 mm. Fig. 1(b) shows critical current deteriorated when bending strain about 0.4% with L_J = 5 mm and no deteriorate with L_J = 8 mm. Because the single lap joint is obviously insufficient in the evaluation of the bending stress, the stacked lap joint experiment has been carried out. All samples maintain low resistance and no I_C deterioration until bend radius was 10 mm in bend and joint procedure. Twist characteristic is under experiment and will be presented at the conference.



(a) (b)

Fig. 1. joint and bend procedure: (a) Joint resistivity as a function of bending strain and (b) critical current as a function of bending strain

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