§15. Investigation of Feasibility of Remountable Superconducting Magnet for Helical Reactor

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Remountable high temperature superconducting magnet, where parts of the magnet can be mounted and demounted iteratively, was proposed to reduce fabrication cost of the magnet and maintenance cost of the reactor.[1] This concept could be one of the solutions for engineering problems of helical magnets. Butt joint of BSCCO 2223 cable where cross sections of the cables are jointed mechanically has been investigated as a fundamental study to realize the remountable magnet.[2]

In this year, a conduit-type BSCCO 2223 cable shown in Fig. 1 is fabricated as a test sample for the butt joint. Objectives of this study in 2007 are to evaluate compressive stress-critical current characteristic of the cable, and to investigate joint performance of the conduit-type cable whose joint surface is silver-plated.

Fig. 2 shows experimental set-up. Joint region is loaded by the SUS304 rod. Fig. 3 shows decrease of critical current with change of compressive stress acting to the cable. Conventional cable presented in Fig. 3 indicates laminated BSCCO 2223 cable with no conduit materials. This result shows the conduit-type cable can prevent critical current from decreasing rather than the conventional cable because stress concentration with edge of the rod does not occur at BSCCO 2223 tape in the case of the conduit-type cable.

Fig. 4 shows relationships between joint resistance and compressive stress acting to joint region. Three kinds of test sample are prepared for this experiment: Thickness of silver-plating on the joint surface are 5μm, 15 μm, 25 μm. Fig. 4 shows that joint resistance continues to decrease even at 400MPa in every samples. In our conventional studies until 2006, joint resistance increased from 250MPa. This fact shows conduit-type cable is more suitable for the joint than the conventional cable. In term of plating, there exists the optimum thickness of the silver-plating. The minimum joint resistance is 0.4μΩ, which is obtained when the thickness is 15 μm. This value is smaller than conventional studies.

From mentioned above, the conduit-type cable is effective to prevent critical current from decreasing and to reduce joint resistance. In the next step, several treatment to joint surface will be tested to reduce joint resistance more. In addition, influence of electromagnetic force in helical magnet on the joint structure will be considered with structural analysis.

1) Hashizume, H. et al, Fusion Eng. Des. 63-64 (2002) 449.
2) Ito, S., Hashizume, H., Fusion Eng. Des. 81 (2006) 2527.

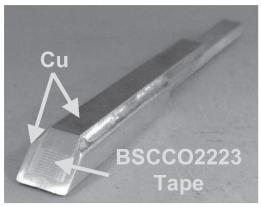

Fig. 1 Conduit-type BSCCO 2223 cable

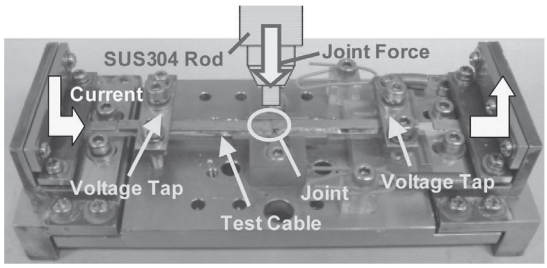

Fig. 2 Experimental set-up

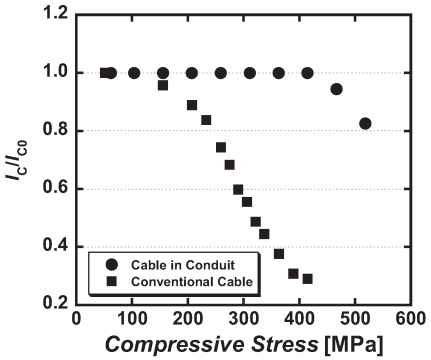

Fig. 3 Stress-critical current characteristic

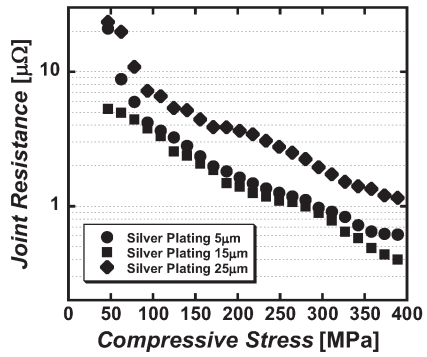

Fig. 4 Stress-resistance characteristic at 300A of transport current