§9. Effect of Surface Condition on Jointing Performance in HTc SC Tape

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A concept of the remountable superconducting magnet, which can reduce both costs of the construction the maintenance, has been proposed for the future design of the fusion power plant. HTc superconductors are used in this concept because their robustness against a heat generation at the jointing parts allows a direct jointing of the magnet. The butt jointing method of HTc superconducting magnet and investigations on the butt jointing of Bi-2223 HTc superconducting tapes have been performed. In this study, the experiment was performed to confirm the degradation of the superconducting tape, especially 10-layered superconducting cable.

The cable laminated superconducting tape used in the butt jointing experiment is shown in Fig. 1. Bi-2223 HTc superconducting 10-layered tape was used as the tape. The contact surface of laminated superconducting cable was cut down by angle of 45 degree inclined from the tapes. This shape might be suitable to obtain jointing force from electromagnetic force which is generated by self magnetic field of superconducting magnet.

Firstly, an experiment to evaluate change of the critical current with increase of compressive stress was performed. In this experiment, the compressive stress acts on one layer superconducting tape without jointing part. The results shown in Fig. 2 indicates that the critical current stayed constant until about 70MPa, and after that it decreased alomost linearly. At 100MPa, the critical current decreased about 10 percents of its initial value, i.e., it can be predicted that there was the degradation of the superconducting tape. Furthermore, once the performance of superconducting tape was degraded, it never recovers even though the stress was unloaded.

Secondly, the relation between the contact resistance at contact surface and the increase of compressive stress was evaluated by using the test cables shown in Fig. 3. The value of current was kept constantly 300A. From the experimental result as shown in Fig. 3, decrease of the contact resistance with the increase of compressive stress was confirmed. The contact resistance became almost constant from 180MPa. When the stress larger than 200MPa was loaded, however, the contact resistance increased slightly. The reason is considered that the effect of degradation by the stress increase exceeded the improvement of joint performance. This value of stress about 200MPa was lower than 300MPa, which the critical current of the cable became 200A. According to the result shown in Fig. 3, in the case that 200MPa stress acts on the cable, the critical current of the cable is estimated about 500A (50A per layer). Following this estimation, there is a possibility that the current distributed into only 6 layers.

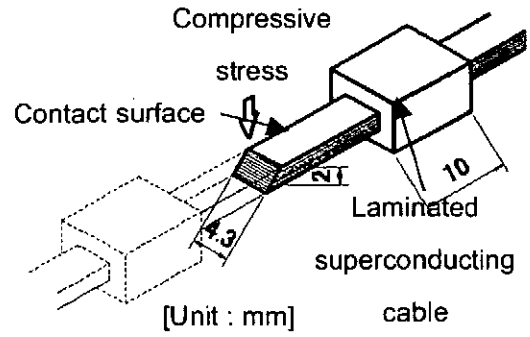

Fig. 1. Laminated superconducting cable

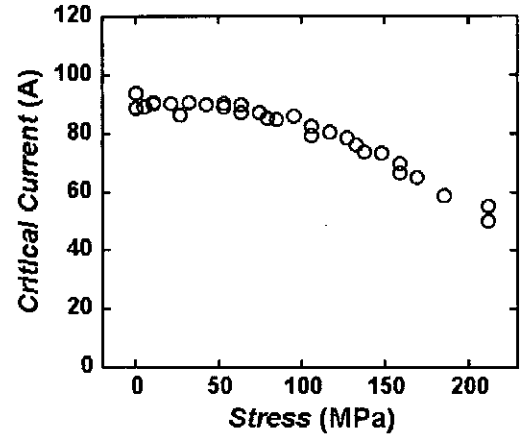

Fig. 2. Critical current dependence on compressive stress

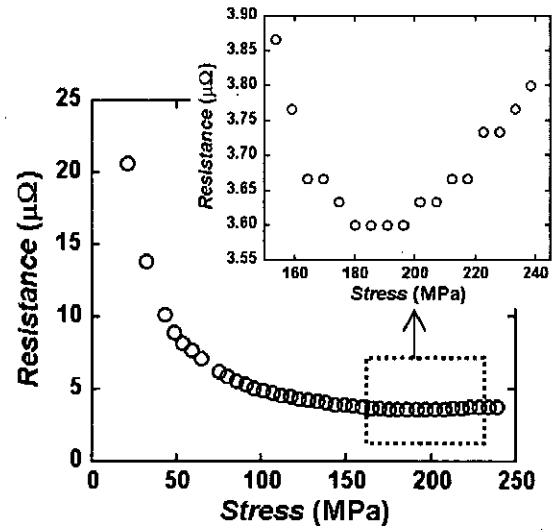

Fig. 3. Jointing resistance dependence on compressive stress

Reference
1) Hashizume, H., Fusion Eng. Des. **63-64**, (2002) 449