§26. Stabilization of Cable in Conduit Superconductor with Non Uniform Current Distribution among Strands

Tsukamoto, O., (Faculty of Eng., Yokohama National Univ.)

The purpose of our study is to develop a technology to stabilize a cable-in-conduit superconductors(CCSC'S) suffering from the uneven current distribution in the strands. In our work of lost fiscal year, we obtained an evidence that the stability of the CCSC can be drastically improved when strands in first level cable were electrically short-circuited in a pitch of certain length. When a strand is quenched, the current flowing in strand is transferred quickly to other strands in the first level cable through the short-circuited part,and the quenched strand recovers superconducting state, provided that the currents of the other strands after the current transfer are less than their critical currents. Thus, the whole cable is stable. In this fiscal year, we experimentally and theoretically studied on this method in more details.

i) Experiment [1)]

A test sample used in the experiment is schematically shown in Fig.1. Three superconducting strands were wound in parallel on a GFRP bobbin of 20mm diameter. The strands were placed on the bobbin closely but without touching and short-circuited by copper wires as is show in Fig.1. The strands were AC superconducting wires and highly unstable. A heater was attached to one strand and, applying a pulse current to the heater, the minimum quench energy (MQE) was measured by changing the transport current of the assembled three strands Ip with 0T and 0.3 T background magnetic fields. The results are shown in Fig.2, As is seen in Fig.2, the MQE is low at region for Ip > 170A and jumps up by more the two orders of magnitude for Ip <170A for the both cases of the background fields 0T and 0.3T. Actually the strands was not quenched for Ip <170A because of the limit of the power supply for the heater. The DC quench current of the three strands was 320A at 0T and 258A at 0.3T. For the background field of 0.3T, 170A is 66% of the quench current which is the theoretical limit that the cable of three strands is kept stable when one of the strands is quenched.

ii) Analysis

By modifying a computer code which we developed to analyze the stability of three strands superconducting cable, We analyzed the stabilty of a cable with short-circuited parts. The analysis also shows the phenomenon that the MQE jumps up for a certain level of Ip.

iii) Concluding remarks

It was experimentally and theoretically demonstrated that the stability of a first-level cable was drastically improved by our method, In the next step, we try to demonstrate its effectiveness in a multi-level cable.

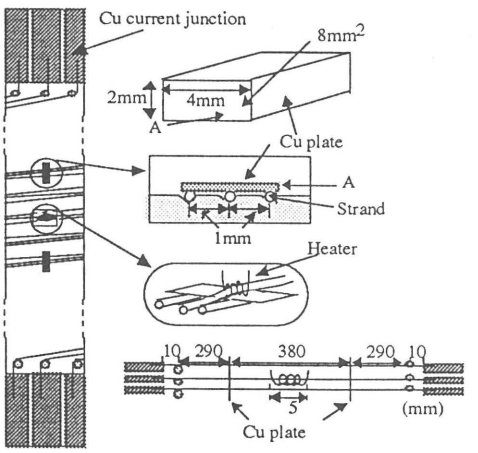

Fig.1 Schematic illustration of sample coil

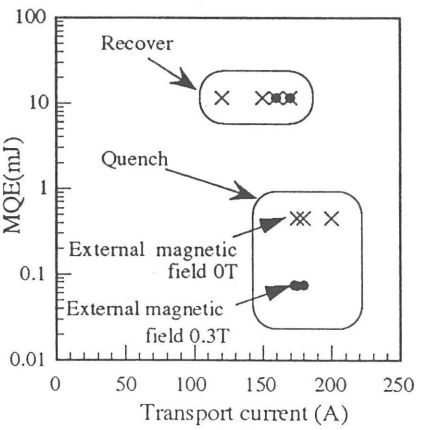

Fig.2 MQE vs. transport current

Reference

1) T.Sasaki, O.Tsukamoto et al,Technical report of JIEE, ASC-95-39, P83('95)