§31. Effects of the Current Redistribution within Nb_3Sn Compacted-strand Cable on its Stability

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The effects of current redistribution on the stability have been studied using two kinds of Nb_3Sn compacted-strand cables with chrome coating which has a thickness of 2.5 μm and without any coating. Table I shows the specifications of the strands and the cable. The minimum quench energy (MQE) has been measured in various external magnetic field and with various transport current. Fig. 1 shows the relationship between the minimum quench energy (MQE) and the transport/critical current ratio, I/Ic under the external magnetic field of 6, 7 and 8 T. Open and closed symbols indicate the MQE for the cable without coating and with chrome coating, respectively. The duration of heat input is fixed to be 10 ms. The MQE improves drastically with decreasing I/I_c. The sharp increase in the MQE may be due to the improvement of current redistribution and/or thermal diffusion among strands. The MQE of the cable with chrome coating is slightly higher than that of the cable without coating when I/I_c is small. The effects of the different surface condition of strands on the stability becomes smaller, when the transport current approaches the critical current.

Different characteristics have been observed for the normal zone propagating processes depending on the strand surface condition of the cables. The current redistribution occurred in both cables and the time required to establish normal zone in several strands is different for each cable. Fig. 2 shows the relationship between the time required to establish normal zone in several strands and I/I_c. The beginning of the normal zone propagation in the cable without coating is slower than that in the cable with coating. It is supposed that a current redistribution among strands continues until the normal zone starts to propagate.

According to our experiment, the MQE of the cable with chrome coating was slightly higher than that of the cable without coating when I/I_c is small. This is the contrary to the stability of the cable which is primarily caused by the current redistribution among strands. Further experiments are necessary to understand the stability of Nb_3Sn compacted cable.

Table I Specifications of the compacted-strand cable

Strand diameter	0.81 mm
Cu/Nb3Sn ratio	1.5
RRR at 17.8 K	43.3
Number of strands	11
Cabling twist pitch	47 mm

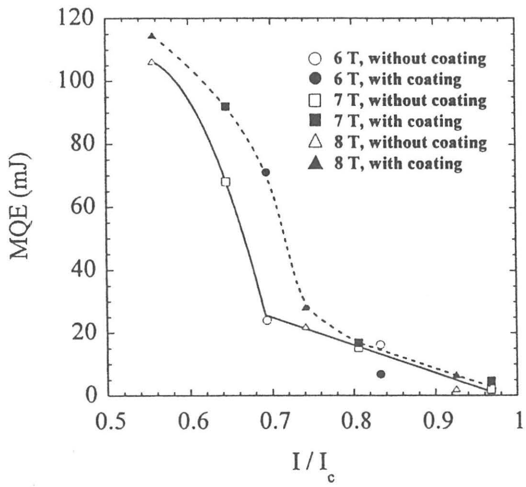

Fig. 1. The relationship between the MQE and the transport/critical current ratio, I/I_c.

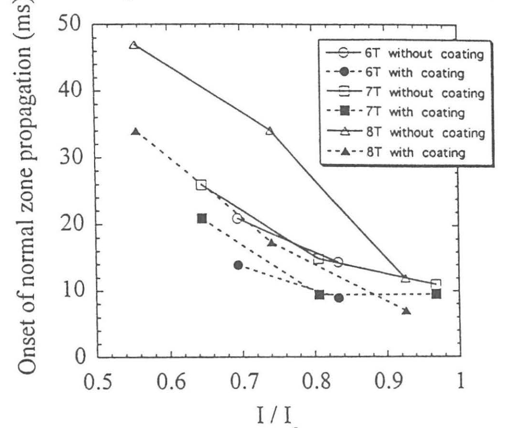

Fig. 2. Plots of the time required to establish normal zone in several strands versus the transport/critical current ratio, I/I_c.