§25. Reinforcing Stabilization of Advanced Superconducting Wires and Higher Current Density

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Recently, a bronze processed multifilamentary Nb_3Sn superconducting wire with CuNb reinforcing stabilizer, CuNb/ Nb_3Sn , has been developed by K.Watanabe et al [1]. It was shown in their work that the CuNb/ Nb_3Sn wire has the performance enough for both mechanical and superconducting properties under an enormous electromagnetic force in the high magnetic field. In this study, a stability test on the CuNb/ Nb_3Sn wire is made applying a pulsed disturbance. Moreover, a numerical analysis is performed on stability and quench characteristics of the CuNb/ Nb_3Sn wire.

Figure 1 shows a schematic diagram of a stability test . The stability measurement was made on the CuNb/ Nb_3Sn wire operating a constant current at 4.2 K and in a magnetic field of 14.8 T. A thermal disturbance for several pulsed amplitudes was applied to the test wire with a heater (carbon resistor) . In particular, the propagated velocity of the normal zone and the corresponding minimum quench energy (MQE) are estimated from the observed data. A numerical analysis on the stability test was made using the two-dimensional thermal conduction equation. In comparison, the stability test and the numerical analysis on the Cu/Nb_3Sn wire with a pure Cu stabilizes. were made under the same condition.

The experimental result for the disturbance time of 1ms and operating current of 43.2 A is shown in Fig.2. It is found that the MQE value of the CuNb/ Nb_3Sn wire is about one-forth as small as that of Cu/Nb_3Sn wire. This is probably due to the difference of the electrical and thermal conductivities for the stabilizers. A stability test on both the CuNb/ Nb_3Sn wire and the Cu/Nb_3Sn wire was also made for the highly operating current of $0.85I_c$ to $0.95I_c$ (I_c: critical current) . As a result, it is shown that the CuNb/ Nb_3Sn wire has a thermal stability comparable with the Cu/Nb_3Sn wire . Thus, the CuNb/ Nb_3Sn wire is suitable for a conductor of large scale and/or high-field superconducting magnets. A numerical analysis on the stability test is in progress.

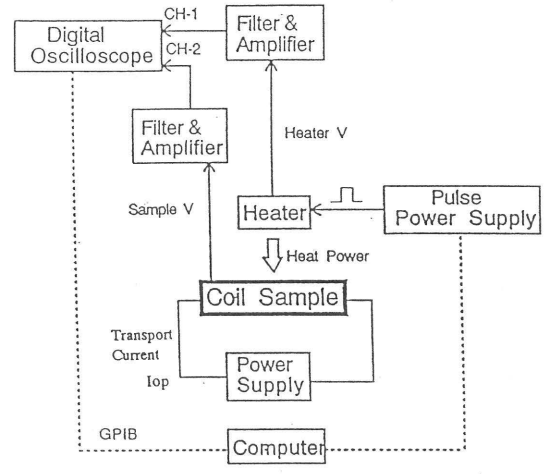

Figure 1 A schematic diagram of a stability test on the CuNb/ Nb_3Sn wire

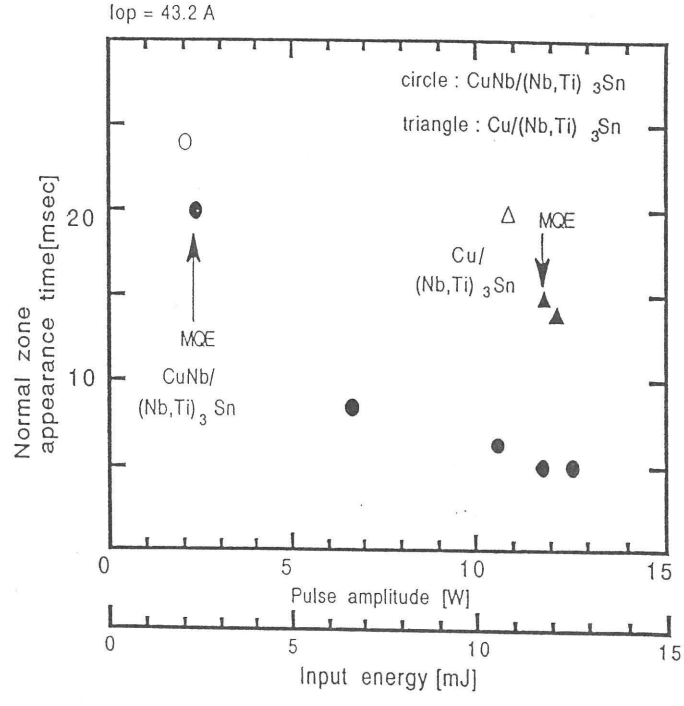

Figure 2 A stability test on both the CuNb/ Nb_3Sn wire and the Cu/Nb_3Sn wire

References

1) Watanabe, K. et al., IEEE Appl. Superc. 3 (1993) 1006.