§25. Stabilized Current Density of Hybrid Conductor with High-Tc and Low-Tc Superconductor

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Ag-sheathed Bi based high temerature superconductor (BSCCO-2223) which is available recently shows fairly high critical current density at around 7 T and 4.2 K. A composite conductor made of both NbTi and copper of large current capacity will be considerably stabilized by using such a high Tc superconductor. In the present study, the stability of a hybrid conductor composed of both Cu-clad NbTi superconducting wire and Ag-sheathed BSCCO-2223 wire of which amount of critical current will be only 10 to 20 % of the total critical current of the hybrid conductor will be analyzed from a view point of the Maddock' equal area criterion [1].

In the analysis, the stabililzed critical current densities Jr's of the hybrid superconductor were calculated. when the three parameters, i.e. the ratio α_{HTS}(%) of critical current densities of high-Tc conductor and that of the hybrid conductor, a total transport current I(A), and a ratio i of I(A) and a critical current Ic0 at a coolant temperature were changed over a wide range.

The result is shown in Fig.1 when α_{HTS} was varied from 0 % to 20 % for the case of 5,000A of Ic0 and 0.5 of i. It indicates that a stabilized current density Jr was increased from about 62 A/mm2 at 0 of α_{HTS} to about 86 A/mm2 at 20 % of α_{HTS}. At 15 % of α_{HTS}, a stabilized current density Jr was calculated to be 78A/mm2 which will be 25 % larger than that of an usual Cu-clad NbTi conductor. The calculated stabilized current densities Jr's are shown in Fig.2 for the fixed α_{HTS} and I when i was varied from 0.2 to 1.0. The result shows that the stabilized current density Jr will be about 90 A/mm2 at 0.4 of i of which value will be often adoped in a large scale magnet design. This value is fairly large compared to the one of NbTi conductor as seen in Fig.2.

These calculations will be confirmed by experiments by using a hybrid conductor composed of both Cu-clad NbTi and BSCCO flat tapes.

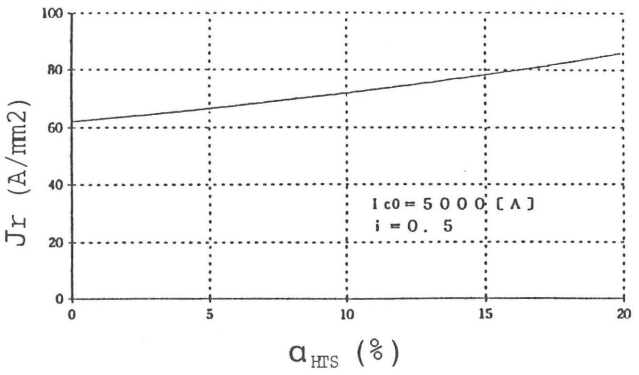

Fig. 1 Dependency of stabilized current density on α_{HTS}.

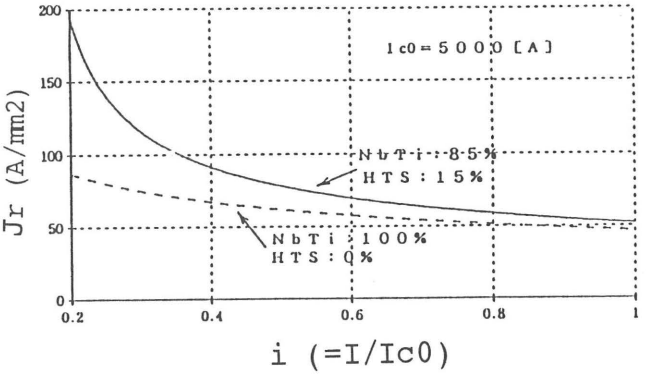

Fig. 2 Dependency of stabilized current density on i.

References

1) Maddock, B.J., James , G.B., and Norris, W.T., Cryogenics (Aug., 1969) p. 261