§22. HTS Conical Bulk for Current Lead Use

Tamura, H., Mito, T.
Yamada, Y., Tachikawa, K. (Tokai Univ.)
Heller, R. (FZK)

Bi-Sr-Ca-Cu-O HTS system has been expected as a current lead for a superconducting apparatus. We have developed Bi-2212 bulk prepared by using a diffusion reaction. The substrate of the Bi-2212 HTS could be made in any shape because it is made by using a cold isothermal pressing method. In this point, the Bi-2212 bulk has a potential for flexible design.

We have made some cylindrical bulk to investigate properties of this kind of HTS bulk and the maximum transport current of 8 kA was achieved at 4.2K. A current lead usually has a temperature distribution for a warm end to a cold end. From the result of the transfer current against temperature rise, the maximum transfer current was 2 kA under the condition of warm end temperature was 50 K. Under this condition, the cross section of the cold end can be smaller since the temperature of cold end is almost 4.2K. From this point of view, if a conical shaped HTS bulk was made, it could be an advantage for heat leakage. To confirm this effect, we calculated heat leakage of the prototype current lead. Fig. 1 shows a design example of a current lead using HTS superconductor and a heat leakage was estimated by this example. The heat leakage of the conical shaped HTS was estimated almost half of that of the cylindrical one.

We made the first prototype conical HTS bulk with the size of 37/29 mm in outer/inner diameter at the warm end, 27/19 mm in outer/inner diameter at the cold end, and 200 mm in length. Fig. 2 shows a photograph of the samples we have made. The bottom one was reinforced by using Alumina fiber and epoxy resin. The current transport test was done without any reinforcement on the surface of the sample at first. The sample was immersed into liquid helium up to the warm end section to know the maximum transport performance. When the whole HTS section was immersed in the liquid helium, the maximum transport current of 7 kA was achieved. After the flow level of the liquid helium was decreased under the cold end of the sample, the warm end was warmed up by using electrical resistive heater. As the temperature of the warm end section increased, the quench current decreased. The quench current of 2 kA was observed at 50 K. Fig. 3 shows the transport current against the warm end temperature. The reinforced sample and a steeper conical sample have been made and performance tests are being planned.

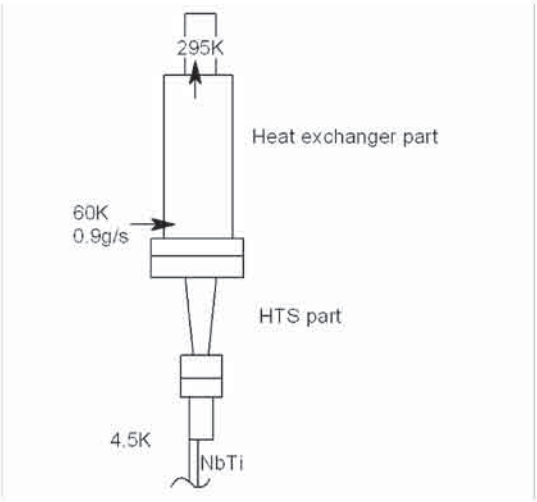

Fig. 1. Current lead model using conical shaped Bi-2212 HTS.

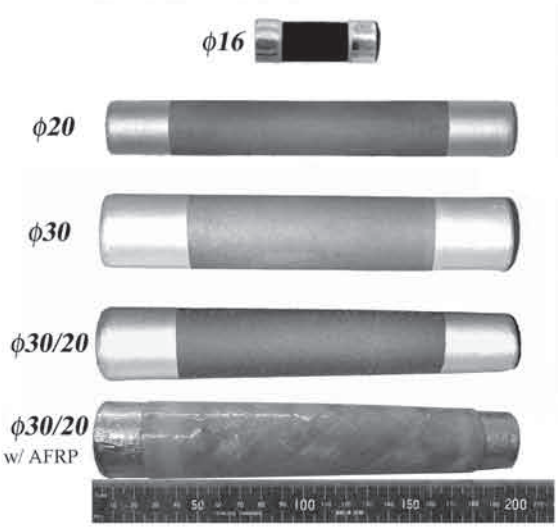

Fig. 2. Bi2212 cylindrical and conical specimens.

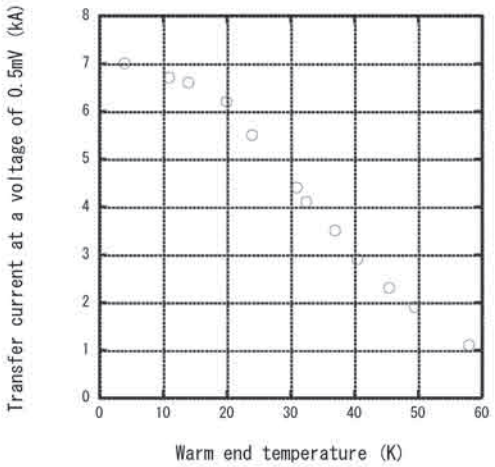

Fig. 3. Transport current performance of the conical Bi-2212 HTS against the temperature of the cold end.