

§4. Superconducting Current Leads Prepared by the YBCO Tapes

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1. Introduction

High temperature superconductor (HTS) of $Y_1Ba_2Cu_3O_7$ (YBCO) with critical temperature T_c of 39 K is attractive for current lead application¹⁾⁻²⁾. In this work, transport performance at 77 K for the current lead composed of twenty YBCO tapes has been reported. The YBCO HTS current leads with large transport current and small heat load are promising for superconducting magnet systems³⁾.

2. Experimental

Fig. 1 shows a current lead unit composed of the YBCO tapes, a GFRP board, two stainless steel (SS) boards and Cu caps. The YBCO tapes with 5 mm in width are prepared by Trifluoroacetates - Metal Organic Deposition (TFA-MOD) process. Ten pairs of the YBCO tapes are arrayed on the GFRP board and soldered into slits (A to J) of both Cu caps. The GFRP board serves mechanical reinforce and relieves thermal stress in the thin YBCO tapes. Two SS boards are attached as shunt in case of quenching.

The current lead was cooled down to 77 K by liquid nitrogen in a tub. Transport current of the HTS current lead was measured by the facilities of National Institute for Fusion Science NIFS.

3. Results and Discussion

Fig. 2 shows transport current at 77 K for the YBCO tapes soldered into ten slits (A to J) of both Cu caps. The transport critical current I_c ranges from 65 A to 120 A (mean current: 80 A), and the total current of twenty YBCO tapes is 1,603 A.

Fig. 3 shows transport performance at 77 K for the current lead unit assembled from ten pairs of the tapes. The transport current of 1,600 A was stably carried for ten minutes. Although the voltages of both Cu ends: V_{Cu+} and V_{Cu-} ranges from 0.23 mV to 0.68 mV and the voltage of YBCO tapes: V_{YBCO} is 0.2 mV maximum, the overall voltage: $V_{overall}$ of 0.90 mV equals to the sum of V_{Cu+} , V_{Cu-} and V_{YBCO} . The ohmic resistance at both Cu ends is calculated to be $0.43 \mu\Omega$. In future work, 20 kA HTS current lead assembled from 2 kA-class YBCO current lead units will be prepared and evaluated at 77 K.

- 1) Yamada, Y. et al. : IEEE Trans. Appl. Supercond., 21 (2011) pp.1054 - 1057.
- 2) Yamada, Y. et al. : IEEE Trans. Appl. Supercond., 20 (2010) pp.1714-1717.
- 3) Shiohara, K, et al. : Physica C, 470 (2010) pp.1887-1889.

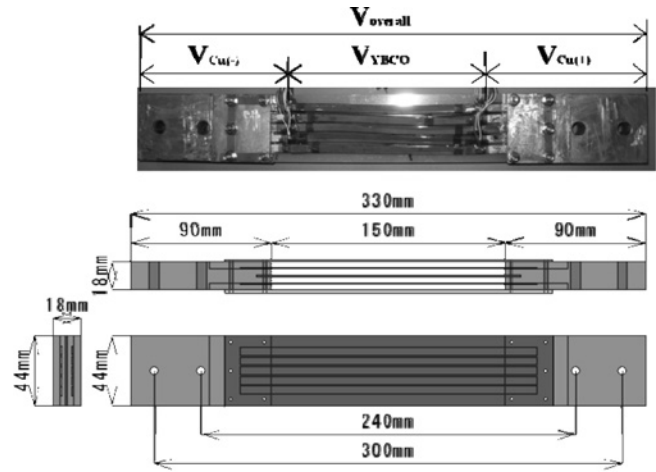


Fig. 1. HTS current lead unit prepared by twenty YBCO tapes soldered to both Cu caps.

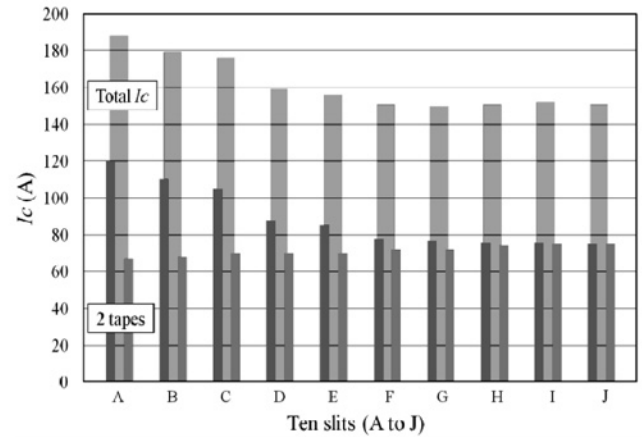


Fig. 2. Transport current at 77 K for the twenty YBCO tapes soldered into ten slits (A to J) of both Cu caps.

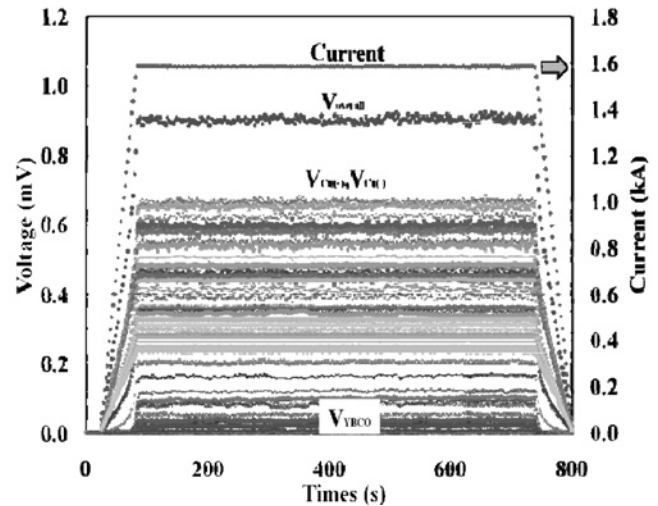


Fig. 3. Transport performance at 77 K for the HTS current lead composed of twenty YBCO tapes.