## § 18. Copper Stabilization of YBCO Coated Conductor for Quench Protection

Tsukamoto, O. (Yokohama National Univ. Eng.)

1. Purpose of study

YBCO coated conductors that are made by deposition of thin YBCO film on high resistance metal substrates such as hastelloy and nickel tapes are highly resistive when they are quenched. Furthermore, YBCO conductors have much higher *n* values compared with Bi/Ag sheathed tapes. Therefore, measures for stabilization and quench protection are more important for YBCO conductors than for Bi/Ag sheathed tapes which have low resistive silver matrices. We studied necessary amount of copper stabilizer to protect the YBCO conductors in coils from damages caused by hot spots due to quenches.

2. Analytical model and results of study

A model tape conductor used in the analysis is illustrated in Fig.1 and its parameters are listed in Table.1. Copper layer is soldered to the silver layer protecting the YBCO layer deposited on the buffer layer on the substrate. The copper layer is for the stabilization and quench protection.

In the analysis, time evolutions of temperature profile of the conductor subject to a local quest was calculated during the sequence of quench detection and energy dump for the case that the YBCO conductor was thermally isolated. Fig.2 shows the temperature profile of the conductor without copper layer where the lot spot temperature well exceeds 1600K. Fig.3 shows the case that the hot spot temperature $T_H$ is suppressed to 300K with 19μm thick copper layer.

The study shows that the conductor is protected from damages caused by a quench by soldering copper layer of proper thickness on the YBCO conductor and that the increase in over-all current density of the conductor including copper layer necessary to suppress $T_H$ below 300K is saturated when the conductor critical current exceeds 200~300A/cm.

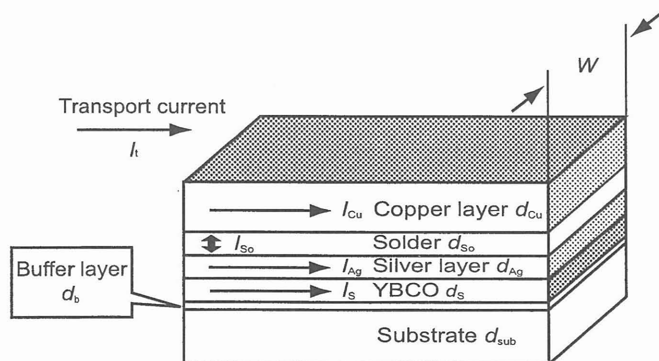


Fig. 1. Model YBCO conductor with copper layer.

Table.I. Parameters of model YBCO conductor.

| | | |
|---|---|---|
| $W$ | conductor width | $1.0 \times 10^2$ m |
| $d_{Cu}$ | copper layer thickness | variable |
| $d_{So}$ | solder layer thickness | $20.0 \times 10^{-6}$ m |
| $d_{Ag}$ | silver layer thickness | $5.0 \times 10^{-6}$ m |
| $d_s$ | YBCO layer thickness | $1.0 - 10.0 \times 10^{-6}$ m |
| $d_b$ | buffer layer thickness | $0.1 \times 10^{-6}$ m |
| $d_{sub}$ | substrate thickne | $50.0 \times 10^{-6}$ m |

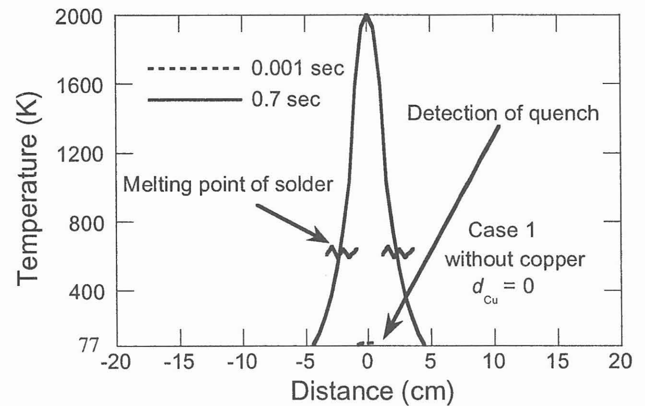


Fig. 2. Temperature profiles for without copper layer.

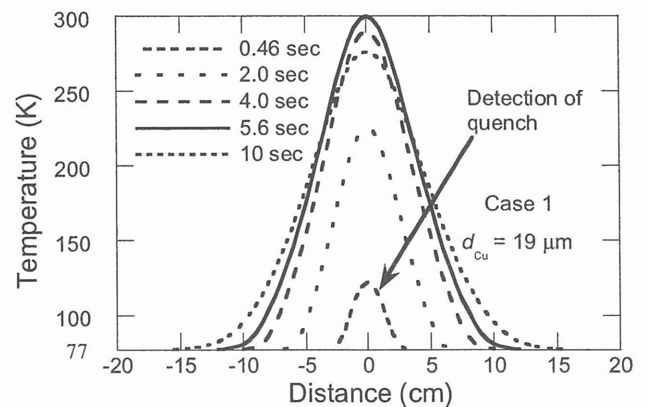


Fig. 3. Temperature profiles for with copper layer to suppress $T_H$ below 300K.

Reference

1) Fu, Y. Tsukamoto, O. and Furuse, M. : To be published in *IEEE Trans. on Appl. Super.*