# Longitudinal Magnetic Field Effect in Critical Current Characteristics of YBCO Superconducting Tape

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## 1. Introduction

Because of its excellent superconductivity, high temperature copper oxide superconducting materials (HTS) are greatly expected to be used in the field of electric power application [1]. However, the critical current characteristic of HTS at this stage is still below the expected level for power application. It is necessary to enhance the critical current density in HTS tape or wire at a certain low temperature and in a magnetic field. Although there are several methods to improve the critical current characteristics, in this study we put emphasis on the phenomenon known as the longitudinal magnetic field effect in superconductor. The effect is usually observed as that the critical current density in a magnetic field parallel to the transport current is large than the value in a magnetic field perpendicular to the transport current [2].

As one of the highest performance materials in copper oxide superconductors, many studies on the development of superconducting power cable using YBCO coated conductor is carried out by many groups. As part of these studies, in this paper, the longitudinal magnetic field effect of YBCO coated conductor at various temperatures and in various directions of the applied magnetic field is measured and discussed.

## 2. Experiment

YBCO superconducting tape was prepared by Shanghai Superconducting Technology co., LTD. Before the experiment began, all samples were treated with micro bridge process. Through this process, the cross-section of tape is reduced and a small current can be used to measure the critical current. In addition, the heating condition at the current terminal is also suppressed.

The cryogenic cooler was utilized to control the temperature in 40 K, 50 K, 60 K, 70 K, 77 K and 80 K, the magnetic field strength in the range of 0 to 5 T; Figure 1 shows the direction of the magnetic field change in the range of 0° ($B$ // $I$) to 90° ($B \perp I$), the flow through the use of the four-probe method of experimental circuits, resistance method is used to determine the critical current, as well as in 1 $\mu$V/cm of the electric field criteria determination of critical current ($I_c$).

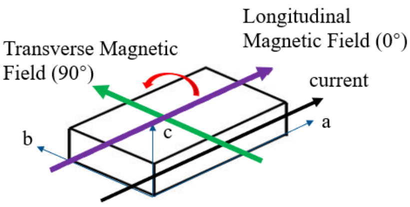


Fig. 1 direction of the magnetic field change

## 3. Results and discussion

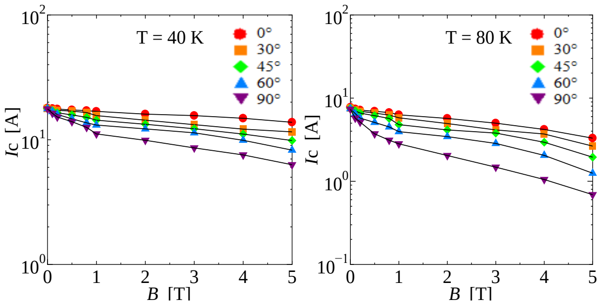


Fig. 2 $I_c$ vs $B$ Characteristic at 40 K and 80 K

Figure 2 shows the $I_c$ vs $B$ characteristics at 40K and 80K. When $B$ = 5 T, the $I_c$ in the longitudinal magnetic field is more than twice and four times that in the transverse magnetic field at 40 K and 80 K.

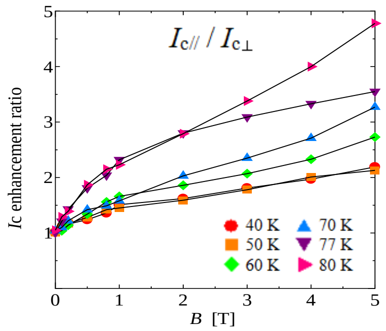


Fig. 3 $I_c$ enhancement ratio vs $B$ Characteristic

Figure 3 shows the $I_c$ enhancement ratio: $I_{c//}$ / $I_{c\perp}$(the ratio of $I_c$ in longitudinal magnetic field to $I_c$ in transverse magnetic field) vs $B$ characteristic. When $B$ = 5 T and $T$ = 80 K, the $I_c$ enhancement ratio is the largest, 4.78.

## 4. Conclusion

As the results of the study, the conclusions are obtained as below:

1. When the current has a component in the direction of the magnetic field, the critical current increases.
2. The maximum enhancement ratio of the critical current is 4.78, which indicates that at high temperature and high magnetic field, the longitudinal magnetic field effect has a great influence on the critical current.

## References

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