No.:4MP6-08

Effect of the Defects on the Quench Properties of Stacked YBCO tapes

Jiangtao Shi, Wei Chen, Haiyang Zhang, Jian Chen,Liyuan Liu, Ke Zhao, Xinsheng Yang*, Yong Zhao

Superconductivity and New Energy R&D Center, Southwest Jiaotong University, Chengdu, 610031, China

* *xsyang@swjtu.edu.cn*

Abstract

The local thermal disturbance of superconductor would generate a large amount of Joule heat, which may lead to the quench of HTS devices. The same problem exists in superconducting current leads. In this paper, a Ni-Cr heater glued on the YBCO coated conductor surface is used to generate a local heat disturbance. The defects of YBCO superconducting tapes can not be recovered under different bending radius. The voltage and temperature trace are measured during the quench process. The quench characteristics of the minimum quench energy (MQE) and normal zone propagation velocity (NZPV) of the stacked YBCO superconducting tapes are investigated in the following three stacked forms at self-field in 77K: 1) two normal YBCO tapes (N-N tapes); 2) a normal YBCO tape and a YBCO tape with defect (N-D tapes); 3) two YBCO tapes with defects (D-D tapes). The general law of the quench of stacked YBCO superconducting tapes is studied by these three different stacking forms. The results are significant to the quench detection and protection of current leads.

Experimental detail

TABLE I
SPECIFICATIONS OF YBCO TAPE

Items	Parameters
Length	120.0mm
Width	4.0mm
Thickness	0.1mm
Critical current (77K, 1uV/cm)	98.0A
Minimum bending diameter	11.0mm

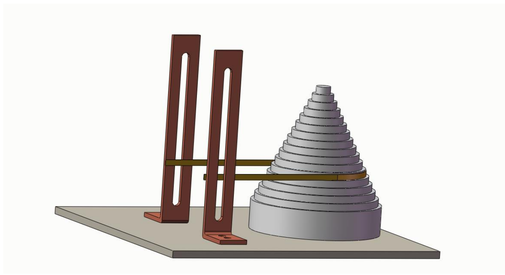

Fig. 2 Experimental device: Diagram of cylinder used in bending test

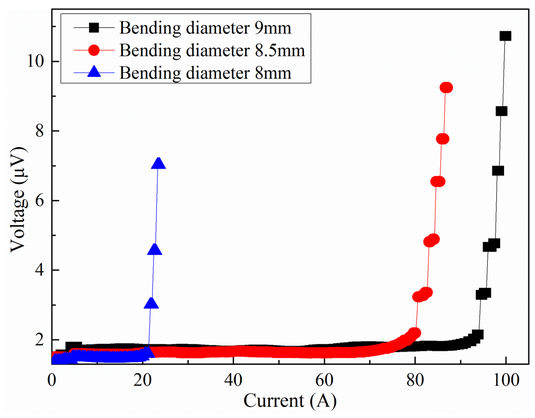

Fig. 3. The critical current of YBCO tapes under different bending diameters was measured by four lead methods.

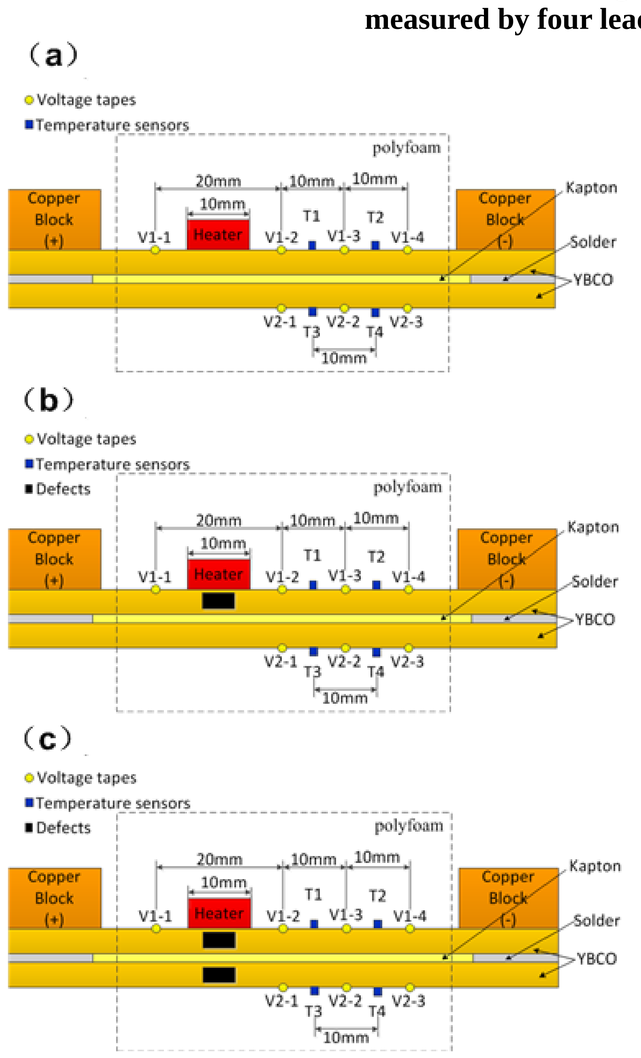

Fig.1. (a) is stacked with two normal YBCO tapes (N-N tapes),(b) is stacked with a normal YBCO tape and a defects YBCO tape (N-D tapes),(c) is stacked with two defects YBCO tapes (D-D tapes).

Results and discussion

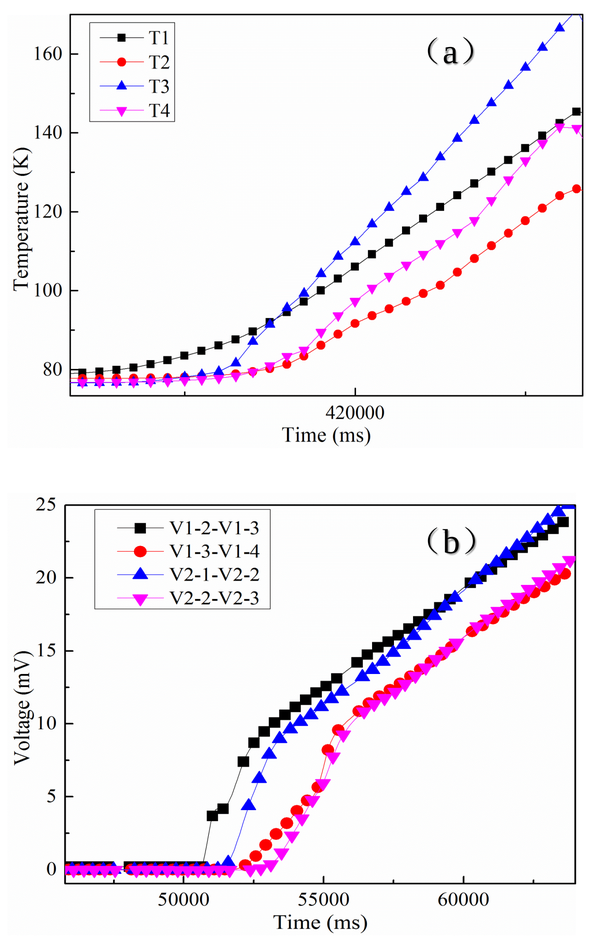

Fig. 5. Temperature and voltage trace when MQE is applied to the stacked with two normal YBCO tapes.(a) Temperature–time plot at I_{op}/I_c = 0.8. (b) Voltage–time plot at I_{op}/I_c = 0.8

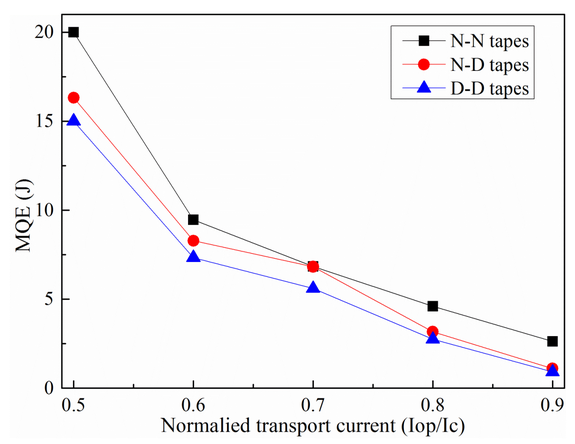

Fig. 6. The MQE of the stack YBCO tapes as normalized transport current I_{op}/I_c.

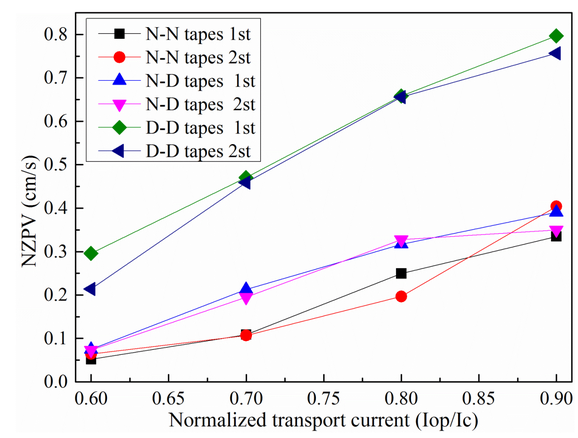

Fig. 7. The NZPV of the stack YBCO tapes as normalized transport current I_{op}/I_c.

Conclusion

1) The MQE value of the defectives stacked YBCO tapes is smaller than that of the YBCO tapes without defects, and the MQE values of both the defective YBCO tapes are smaller than the MQE values of the single defective YBCO superconducting tapes MQE.

2) The NZPV value of the defective stacked YBCO tapes is larger than that of the YBCO tapes without defects, and the MQE values of both the defective YBCO tapes are larger than the MQE values of the single defective YBCO superconducting tapes MQE.

3) In the same stacking type of YBCO tapes, the NZPV value of the defect layer is slightly larger than the NZPV value of the normal layer.