Bending Strain Effect on the Critical Current of Jointed BSCCO Tapes

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Abstract : In this study, the effect of bending strain on the transport property and critical current of lap and butt-jointed BSCCO tapes have been investigated. The samples were joined using a mechanically controlled jointing procedure. In order to ensure a uniform pressure application at the joint part, a single point contact has been devised and also to achieve a uniform thickness at the joint interface.

Key Words : BSCCO tape; Lap and butt joint; Electro-mechanical property; Joint-resistance

1. Introduction

Application of superconducting tapes to electric devices such as BSCCO tapes made it possible to achieve a clean and efficient utilization of energy. However, in these applications BSCCO tapes will be subjected to various stress and strain and therefore, electro-mechanical investigation should be done in order to ensure its current carrying capacity as well as the performance of the device. Jointing of tapes is also necessary which requires several kilometers in length for coil manufacturing. In this study, critical current behavior of jointed BSCCO tapes under bending deformation has been investigated.

2. Experimental Procedures

A commercially available Bi-2223 tapes with no lamination has been used as sample. It has an average thickness and width of 4.3 and 0.23mm, respectively. Lap and butt joint types have been adopted. Jointed tapes with 20 mm joint length have been made by employing a mechanical controlled jointing with an applied pressure of 1 MPa. A single loading point was devised to ensure the uniform pressure application on the joint part. Samples were subjected to easy and hard bending deformations using mandrels with different bending radii employing mechanical contact for current terminals. Bending procedures employed in the jointed tapes are the same with single tapes as in [1]. Bending strains under easy and hard bending mode are calculated at the outer surface/edge of the tape as described in [2]. Critical current behavior of the jointed tapes in bending strains has been investigated.

3. Results and Discussions

Fig. 1 shows the normalized I_c as a function of bending strain in single tape under easy bending mode. The bending radius and bending strain corresponding to the 95% I_c retention were 22.5mm and 0.49%, respectively. For easy bending test, lap- and butt-jointed tapes showed resistivity across the joint of 9.34 and 24.7 nanoOhms, respectively. Joint thickness is on the order of 0.46mm. In Fig. 2, I_c degraded significantly starting from bending radius of 67.5 mm. for lap-jointed tape. The sudden degradation of I_c is caused by the occurrence of local bending stress concentration due to non uniform deformation at the edge part of the joint as can be seen in the inset.

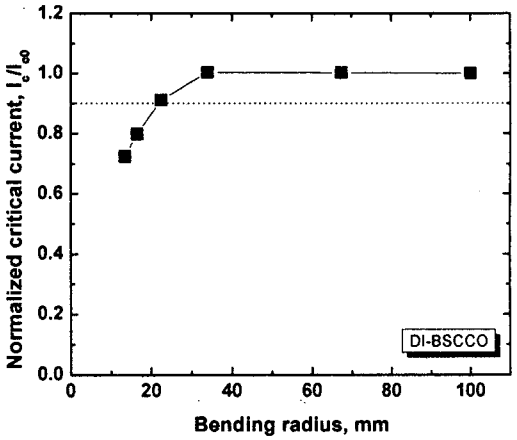

Fig 1. Normalized Ic – bending radius relationship in jointed BSCCO tapes.

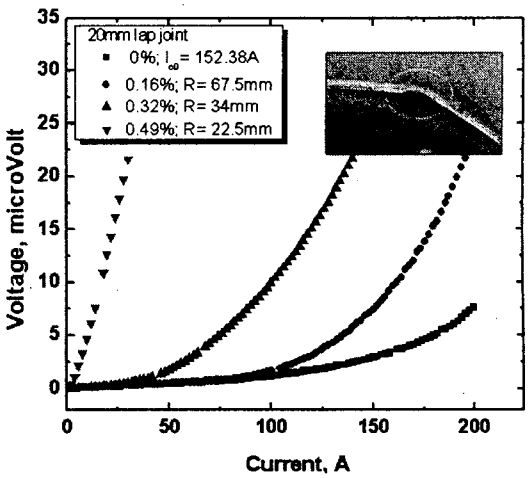

Fig. 2 I-V curve characteristics in lap-jointed BSCCO tapes.

4. Conclusions

Electromechanical property of a single tape is important since the deformation occurred at the unjointed part, especially at edges and central region of jointed tapes. tapes depended

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