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M1Or3F-06: High Ic Superconducting Joints Connecting Reinforced Bi2223 Tapes

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Superconducting magnets equipped with the persistent current circuit have been extensively used for NMR and MRI systems with high resolution cooled by liquid helium. In those systems, superconducting joints with very low joint resistance are essential for realization of the closed circuit. However, practical superconducting joints connecting HTS tapes have never been developed mainly due to the intergrain weak-link problem. For this issue, a remarkable progress in superconducting joint technologies between RE123 coated conductors (RE123) [1] opened a new window toward development of persistent current HTS magnets. In this case, an epitaxially grown intermediate RE123 layer strongly connects the bi-axially oriented RE123 layer of the coated conductors.
On the other hand, Fabrication of superconducting joint between Bi2223 multi-filamentary tapes due to intrinsic characteristics of the material, such as large electromagnetic anisotropy, very short coherence length, which result in weak-links at grain boundaries, and high crystallinity, i.e., poor reactivity of Bi2223 filaments, thus far. Our previous studies on polycrystalline Bi2223 thick films [2,3] revealed that c-axis grain orientation, densification, using precursor composed of large amount Bi2223 calcined powder and small amount of Bi2223 powder, sintering under relatively low partial pressure of oxygen ˜3 kPa and increase in Pb concentration are confirmed to be effective guidelines to achieve high intergrain Jc up to ˜7 kAcm-2 at 77 K. In addition, precise polishing with very low angle for multi filamentary Bi2223 tapes was found to expose most of the filaments in Bi2223 tapes. Combining these results and technology, we succeeded in the development of high Ic superconducting joints connecting Bi2223 tapes via Bi2223 polycrystalline thick film layer[4]. Introduction of intermediate pressing and optimizations of chemical composition of the thick film layer and heat-treatment conditions improved joint Ic above 100 A at 77 K under self-field. Furthermore, high Ic superconducting joints have been recently developed for reinforced Bi2223 tapes sandwiched by soldered high strength Ni-alloy thin tapes (DI-BSCCO Type HT-NX). Since Sn in solder easily react with Ag forming Ag-Sn alloy and/or intermetallic compound such as Ag3Sn above ˜200℃, complete removal of Sn is quite important before fabrication of the joint. Through optimization of each process, joint Ic values above 100 A at 77 K and 300 A at 4.2 K in 3 T were achieved. Including results of current decay measurement performed for loop samples at various temperatures and external fields, potential of superconducting joints connecting Bi2223 tapes and their future prospects will be discussed.

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