An Intermediate Grown Superconducting (iGS) Joint Between REBCO Coated Conductors: Fabrication, Microstructure and Superconducting Properties

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***Abstract*—Over the past few years, several studies have been performed on the superconducting joint of $REBa_2Cu_3O_y$ (REBCO, RE: rare earth elements) coated conductors (CCs) which is one of the key technologies to realize persistent current operations of prominent HTS magnets [1, 2]. Park has succeeded in the superconducting joint of REBCO CCs [1]. However, the total processing time is too long for large coil applications such as nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI).**

We have developed a novel superconducting joint technology for REBCO CCs. It uses a joining strap with a microcrystalline REBCO precursor layer. The joint technology has an advantage of a sufficiently short total processing time of less than one day. The joining strap and the GdBCO CCs were heated at 800 °C for 20 min. in an atmosphere of 100 ppm oxygen to make the polycrystalline GdBCO on the joining strap grow epitaxially. This intermediate grown superconducting (iGS) joint gives a critical current of > 100 A at 77 K in a self-field.

Cross sectional investigation of the joint area was carried out by a scanning electron microscope (SEM) and a transmission electron microscope (TEM). An SEM image indicates that there are some voids and inclusions, such as CuO and Gd_2O_3, in the joint area. In spite of the voids and the inclusions, approximately 60% of the superconducting layers were directly connected.

Furthermore, a high resolution image obtained by the TEM shows that the microcrystal grows epitaxially and the boundary of the GdBCO layers of the CCs and the GdBCO layer of the joining strap were atomically connected with the grown intermediate layer. It was estimated from the persistent field decay curve that a joint resistance was in the order of 10^{-12}–10^{-13} at 77 K in a self field over three days, with an operating current of ~10 A (~14% of the calculated coil critical current).

In this presentation, the magnetic field dependence of the critical current will be shown. We believe the superconducting joint technology is promising for realization of the persistent current mode operation of NMR and MRI.

[1] Park Y, Lee M, Ann H, Choi Y H and Lee H 2014 NPG *Asia Materials* **6** e98**.**
[2] Jin X, Yanagisawa Y, Maeda H and Takano Y 2015 *Supercond. Sci. Technol.* **28** 75010**.**

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