Current transport characteristics of a superconducting joint between REBCO conductors made by a novel method

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**Background and Motivation**

REBa₂Cu₄O₈ (REBCO, RE: rare earth) coated conductor (CC) is one of the promising high-temperature superconductors (HTS) to be used for ultra-high field nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI). Superconducting joint technology is the key for their persistent current operation. The first superconducting joint of REBCO CCs was reported by a group of Korea University [1]. For the practical use in a real magnet, the oxidation time has to be sufficiently short. In the present work, we developed a practical superconducting joint method for CCs with a short fabrication time towards a persistent current 1.3 GHz (30.5 T) NMR.

**Fabrication of the IGS joint**

1. An alcohol solution of fluorine-free metal-organic complex, with a Gd²⁺Cu₂O₄ molar ratio of 1:2:3, was applied to the GdBCCO jointing strap by spin coating.
2. This precursor film was decomposed at 500 °C.
3. The jointing strap and the GdBCCO CCs were heated at 800 °C for 20 min. in an atmosphere of 100 ppm oxygen to make the polycrystalline GdBCCO on the jointing strap grow epitaxially.
4. After cooling down to 500 °C, an atmosphere of 100% oxygen was introduced to make the GdBCCO superconducting phase and cooled down to 200 °C over 6 h.

The total heat treatment and oxygen annealing time is less than a day.

**Microstructure of the IGS joint**

1. The grain size is in the range of 20 nm to 200 nm.
2. The intermediate layer is well aligned that it is impossible to identify the boundary in this image.
3. The layers are atomically connected.

**Critical field of the IGS joint**

The Ic for the GdBCCO CC is 30-50 A and that for the joint 77 K (45%). The Ic for the joint remains to be 75 A/45 μm, 17 days after the first measurement.

**Conclusions & Outlook**

- Heat treatment/oxygen annealing time of the joint is less than one day.
- Critical current is higher than 50% of the critical current of a short CC.
- The joint shows persistent current in a magnetic field of 10 T.
- Joint resistance measured at 77 K is <3x10⁻¹⁰ Ω - <5x10⁻¹⁰ Ω.
- We will develop a persistent current 400 MHz (9.39 T) LTS/REBCO NMR with IGS joints.

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