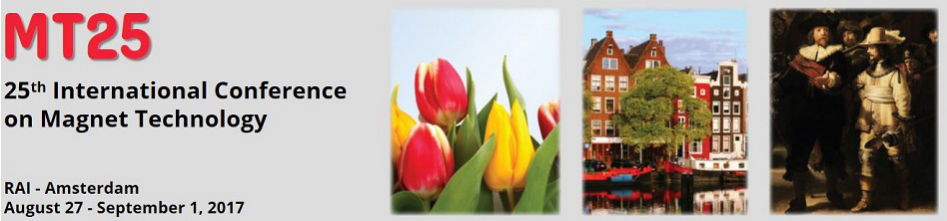

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Critical Current Properties of Precisely Cation Composition Controlled RE123 Melt-Solidified Bulks

Wednesday, 30 August 2017 13:15 (1h 45m)

Thus far, RE123 coated conductors have revealed their promising potential for high field generating materials. On the other hand, RE123 bulks grown by the melt-solidification method, which can trap much higher magnetic field than permanent magnets, have been opening new superconducting applications, such as flywheels, magnetic separation, drug delivery, levitating mixer and compact NMR. Although J_c of the bulks are more than one order of magnitude lower than that of coated conductors, their engineering J_c values are almost comparable. In both materials, precise control of chemical composition is a crucial factor to determine critical current performance as well as controls of carrier doping state and microstructures. Partial substitution of RE for the Ba-site is known to degrade superconducting properties through structural disorders and a decrease in effective carrier concentration, while the pinning characteristics is improved when the substitution level is low, less than ~1%. In the case of RE123 bulks, the partial substitution of RE is intrinsically prompted even for Y123, because their total composition is RE-rich, which results in poor J_c and low field trapping properties. In the present study, we have attempted to control cation composition of top-seeded RE123 melt-solidified bulks by various methods, such as RE-mixing, starting from Ba-excess composition and introduction of reductive post-annealing process after the crystal growth. All these methods were found to be effective for controlling cation composition of RE123 close to the integral ratio and the J_c-B characteristics of the bulks were largely improved particularly at lower temperatures reflecting the enhanced superconducting condensation energy. Details of synthesis procedure, microstructure and superconducting properties including field-trapping properties of the bulks will be reported.

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