論　文　要　旨
Thesis Abstract

（yyyy/mm/dd）　2025 年　03 月　07 日

※報告番号	甲第　359　号	氏　名 (Name)	Akash Garg Agarwal

主論文題名　（Title）

Advancements in Infiltration Growth of Bulk Ternary LRE-$Ba_2Cu_3O_y$ Superconductors: Comprehensive Investigations on Growth Mechanisms, Microstructure, and Superconducting Properties

内容の要旨　（Abstract）

High-temperature bulk ternary LRE-$Ba_2Cu_3O_y$ (LRE= Nd, Sm, Eu, Gd, Y etc.) superconductors hold significant potential for various technological applications due to their remarkable critical temperature (T_c > 77.3 K), high critical current density (J_c), high irreversibility field and enhanced trapped field performance. However, fabricating these ternary bulks in the air presents considerable challenges, mainly due to RE/Ba substitution, which negatively impacts superconducting performance. This work aims to address these challenges and improve the fabrication of ternary LRE-$Ba_2Cu_3O_y$ bulk superconductors in the air. The goal is to explore the methods and techniques that enhance the superconducting properties and enable cost-effective, industrial-scale production of these high-performance superconductors.

Initially, a ternary (Gd,Y,Er)$Ba_2Cu_3O_y$ bulk, exhibiting low RE/Ba substitution, was utilized for air fabrication. To understand the microstructural variations in the top-seeded infiltration growth (TSIG) processed bulk in air, varying liquid source compositions were employed. These experiments revealed the impact of liquid sources on controlling the bulk growth, microstructure and size of secondary phase particles. The optimum composition led to improved superconducting performance, including enhanced trapped field capability.

Further, the role of various $REBa_2Cu_3O_7$+$Ba_3Cu_5O_8$ compositions (RE= Sm, Gd, Y, Er) used as liquid sources for the fabrication of ternary (Sm,Eu,Gd)$Ba_2Cu_3O_y$ bulks processed in air was investigated. It was observed that the peritectic decomposition temperature of each $REBa_2Cu_3O_7$ composition influences the liquid supply, resulting in a significant impact on the growth and superconducting properties of bulk. Notably, the optimum liquid supply, using an appropriate $REBa_2Cu_3O_7$ composition, resulted in improvements in superconducting critical temperature (T_c) and superconducting transition width (ΔT_c). A substantial improvement in ΔT_c, narrowing it to less than 1 K, was achieved in air-fabricated ternary (Sm,Eu,Gd)$Ba_2Cu_3O_y$ bulks with the addition of barium. Finally, the incorporation of silver improved both the high-field J_c and the irreversibility field of air-processed ternary (Sm,Eu,Gd)$Ba_2Cu_3O_y$ bulk.

Through the systematic optimization of various parameters for TSIG-processed ternary LRE-$Ba_2Cu_3O_y$, a framework for fabricating these superconductors in air has been established, aimed at facilitating industrial-scale production for various applications.

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