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Large Diameter, Single Grain (RE)BCO Bulk Superconductors Fabricated by Infiltration and Growth

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Large, single grain bulk (RE)BaCuO [(RE)BCO] superconductors have potential to generate magnetic fields that are much greater higher than those produced by conventional permanent magnets. The top seeded melt growth (TSMG) technique has been developed over the last 25 years to fabricate large, [(RE)BCO single grain samples that eliminate current limiting grain boundaries in the bulk microstructure. Although successful, there are a number of problems associated with the nature of the TSMG technique, including porosity, sample shrinkage and inhomogeneity in the distribution RE-211 content throughout the volume of sample, which leads to inefficient flux pinning. As a result, a new process based on top seeded infiltration and growth (TSIG) has been developed relatively recently as an alternative approach for the fabrication of large (RE)BCO single grains. The TSIG technique yields samples that are more dense, more uniform and have potentially better properties than those produced by TSMG. However, it is considerably more challenging to fabricate large-sized samples by this technique due to the relative complexity of the process. We describe the TSIG process and its application to a variety of (RE)BCO bulk superconductors and report the successful fabrication of single grains of up to 37.5 mm in diameter YBCO by a novel, 2-step TSIG process. This process enables a straightforward and very reliable growth process, which has clear practical implications for the manufacture of bulk samples for commercial applications. Details of the development and optimization of the microstructures and the superconducting properties of the (RE)BCO samples fabricated by this novel technique are presented.

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