Superconducting Properties of Liquid Infiltration Growth Processed $YBa_2Cu_3O_{7-y}$ Bulk Superconductors Using Attrition Milled Y_2BaCuO_5 Powder

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In order to improve critical current density of $YBa_2Cu_3O_{7-x}$ (Y123), attrition milling for a precursor powder and liquid infiltration growth process (LIGP) were studied. We have successfully fabricated single grain Y123 bulk superconductors by employing LIGP process to Y_2BaCuO_5 (Y211)/$Ba_3Cu_5O_8$ powder compacts. The precursor Y211 powder was milled for 2 h, 4 h, 6 h, 8 h and 10 h at a rotation speed of 400 rpm using ZrO_2 balls in ethanol. By attrition milling, very fine Y211 powder of a nano-size was successfully achieved. The Y211 pre-forms which are used for the LIG process were made using the milled Y211 and $Ba_3Cu_5O_8$ powders. For the growth of a single Y123 grain, a Sm123 seed was placed on the Y211 top surface and melt growth heating cycles was applied to the pre-forms. After LIGP process, samples were annealed at 450 ^oC -500^oC for 150 h in flowing oxygen for oxygen embedding in Y123 samples. Microstructure was investigated by an optical microscope and scanning electron microscope for the polished/etched surfaces of samples Magnetization measurement was made for rectangular bar specimens with the dimensions of 1x2x2.5 mm^3 using a superconducting quantum interference device (SQUID) magnetometer.

Compared with the sample prepared using un-milled Y211 powder, the samples prepared using milled Y211 powders exhibited lower porosity and of the Y211 refinement. The critical current density increased as the milling time increased and reached to a maximum for 8 h without any degradation of superconducting transition temperature. It is concluded that the attrition milling for precursor Y211 powder gave a beneficial effects on the morphology, the size and the distribution of Y211 inclusions, which influenced the flux pinning of the Y123 superconductors.

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