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Enhancement of in-field critical current density of BaZrO₃ added (Y, Gd)BCO coated conductors by reduced once-coat-layer-thickness in multi-coating TFA-MOD method

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The trifluoroacetate metal-organic decomposition (TFA-MOD) process is a non-vacuum process. Therefore, this process for REBa₂Cu₃O_y (RE: rare earth) coated conductors (MOD-REBCO) is useful from a cost point of view. Recently, it has been reported that the critical current density (J_c) in liquid nitrogen temperature can be increased effectively by reducing once-coat-layer-thickness in the multiple coating process of BaZrO₃ (BZO) doped MOD-YGdBCO coated conductors. In this study, we have investigated the J_c properties of the BaZrO₃ doped YGdBCO coated conductors obtained from the multi-thin-layer-coating process over a wide magnetic field and temperature region and an analytical expression for the J_c as a function T and B has been derived by using percolation transition model. We prepared two samples for comparison with the similar total thickness of 0.53 μm and 0.75 μm with the once-coat-layer-thicknesses of 30 nm and 170 nm, respectively. Transport critical current density was measured by the four-probe method with a micro-bridge by the photo lithography. The typical micro-bridge is about 70 μm wide and 500 μm long. The critical current density was determined using the criterion of $E=1 \mu\text{V}/\text{cm}$. We measured the in-field critical current density up to 27 T at temperature from 4.2 K to 77 K. The sample using the 30 nm once-coat-layer-thickness shows superior in-field J_c in the all measured conditions than that of the standard coating using 170 nm thick layer for each coating. Moreover, we found that the minimum J_c , which estimated from magnetic field angle dependence, shows even higher value than that of PLD processed EuBCO up to 5 T of magnetic field at 65 K and up to 3 T at 77 K. From these results, the new MOD-YGdBCO process using the thin once-coat-layer-thickness is very promising for the magnet applications.

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