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Film thickness dependence of in-field J_c in (Y,Gd)BaCuO+$BaMO_3$ (M=Zr, Hf) nanoparticle CCs

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$REBa_2Cu_3O_y$ (REBCO) coated conductors (CCs) derived from the Trifluoroacetate-Metal Organic Deposition (TFA-MOD) process are a promising candidate for magnet applications because of the low-cost and the high critical current density (J_c). However, practical applications, such as MRI, generators, etc., require further enhancement of the in-field critical current (I_c). For high in-field I_c, increasing film thickness and the suppression of the formation of large second phase precipitates and uniform dispersion of pinning centers are important. So far, we have succeeded in obtaining high in-field I_c by controlling the crystal growth rate and introducing $BaZrO_3$ nanoparticles (BZO NPs) into the TFA-MOD $(Y_{0.77}Gd_{0.23})Ba_2Cu_3O_y$ (YGdBCO) CCs [1]. Recently, we have reported more improvement of in-field J_c by introducing $BaHfO_3$ (BHO) NPs instead of BZO NPs because of the former's higher NP density and smaller NPs size [2]. However, the effect of film thickness dependence of in-field J_c is not yet clear.

In order to investigate the film thickness dependence of the magnetic field (B) = 0.3 T, we prepared 12 vol.% BHO doped YGdBCO (+12BHO) CCs with various thicknesses. We found several common characteristics obtained in samples prepared by both pulsed laser deposition (PLD) and MOD REBCO CCs. For thinner films (d < 400 nm), a rapid decay of J_c (J_c μ $1/d^{0.5}$) is observed for with and without BHO NPs. For thicker films, the J_c value is almost constant. These thickness dependences of J_c may be caused by the change from 2D pinning to 3D pinning. We will discuss the influence of natural defects and BHO NPs on the thickness dependence of J_c in MOD-REBCO CCs based on a theoretical pinning model.

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