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The influence of carrier density on the in-field J_c of (Y,Gd)BCO+BZO CCs

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Trifluoroacetate-metal organic deposition (TFA-MOD) produced $REBa_2Cu_3O_y$ (REBCO) coated conductors (CCs) are an important research subject because of the potential for low-cost and excellent superconducting properties. A high critical current density (J_c) in magnetic field for REBCO CCs is critical for magnetic applications. For the enhancement of the in-field J_c, there are two ways: 1) introducing pinning centers, and 2) carrier density control. So far, we have succeeded in obtaining higher in-field J_c by adding $BaZrO_3$ nanoparticles (BZO NPs) in TFA-MOD $(Y_{0.77}Gd_{0.23})Ba_2Cu_3O_{7-\delta}$ CCs ((Y,Gd)BCO+BZO) [1, 2]. However, the influence of the carrier density on the superconducting properties of TFA-MOD (Y,Gd)BCO+BZO CCs is not clear.
In this work, in order to investigate the influence of carrier density on superconducting properties, we fabricated $(Y,Gd)Ba_2Cu_3O_y$ and $(Y,Gd)Ba_2Cu_3O_y$+BZO CCs with various post annealing conditions. The (Y,Gd)BCO+BZO CC with optimum annealing conditions shows higher carrier density at 300 K and higher self-field J_c ($J_c^{s.f.}$) compared with that of other conditions. Moreover, the in-field J_c of (Y,Gd)BCO+BZO CC with optimum conditions is higher. We will discuss the mechanism of the improvement of the superconducting properties based on crystallinity, carrier density, critical temperature and self-field J_c.

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