Correlation between vortice state and texture of $YBa_2Cu_3O_{7-x}$ ceramics

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Two ways are known to increase the critical current density j_c of superconducting materials: 1) to generate strong pinning centers by a proper irradiation and 2) to form anisotropic texture minimizing weak intergranular contacts. The both approaches were combined in this work to study the effect of texturing degree and structure defects of $YBa_2Cu_3O_{7-x}$ ceramics on magnetization and transport critical current densities.

Samples of 12 mm diameter and 1 mm thick were sintered in the ^{60}Co gamma–ray field of 20–2000 R/s at 900–950 C and had the following parameters: a=3.824, b=3.885, c=11.878 A, oxygen index x=0.07, critical temperature T_c 91–92 K, texturing degree F_t = 0.5–0.8, density 5.5 g/cm^3. Reference isotropic (F_t=0) sample sintered by the standard powder technology had a low value of density 4.9 and j_c~50 A/cm^2 at 77 K, but a high magnetization at strong (0.5–5 Tesla) magnetic fields at 10 K. Several samples with F_t=0.5–0.6 contained 5–6 % non–conducting impurity phases, showed a higher magnetization in weak (<160 Oe) and the strong fields at 10 and 77 K, although a higher transport j_c ~100 A/cm^2 at 77 K. Single phase highly textured (F_t= 0.7–0.8) samples exhibited the maximal value of j_c~ 1000 A/cm^2 at 77 K, although a bit weaker magnetization than the multiphase samples. The obtained results show, that the transport critical current density depends directly on the texturing degree, magnetization in strong fields at 10 K depends on granularity, and that at 77 K – on the texture degree. Thus, it seems possible to find such a thermoradiation treatment, when both magnetization and transport critical current would increase.