Uniform Dependence of the Critical Current Density on YBCO Layer Thickness in RABiTS and IBAD-type Coated Conductors*

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European Conference on Applied Superconductivity (EUCAS
Sorrento, Italy
September 14-18, 2003

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prepared by
SOLID STATE DIVISION
OAK RIDGE NATIONAL LABORATORY
Managed by
UT-BATTELLE, LLC
under
Contract No. DE-AC05-00OR22725
with the
U.S. DEPARTMENT OF ENERGY
Oak Ridge, Tennessee

April, 03

[Abstract to be submitted to the European Conference on Applied Superconductivity (EUCAS), Sorrento, Italy, September 14-18, 2003]

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The role of substrate texture and the relation between thickness *d* of the superconductor layer and critical current density J_c was studied for $YBa_2Cu_3O_7$ (YBCO) RABiTS and IBAD type coated conductors. YBCO coatings with *d* increasing from 0.3 to 3 μm were grown by a BaF_2 *ex situ* process, using electron-beam evaporated precursors. Similar to reported results for *in situ* YBCO, J_c decreases with *d* for each of the substrates studied. However, the rate of decline, $\Delta J_c/\Delta d$, decreases with *d*, so that I_c, the total critical current, increases monotonically. The overall level of I_c (J_c) correlates with the substrate texture. In terms of both variables, we show that $J_c = J_\Phi \cdot j(d)$ may be written as the product of a texture dependent scaling factor J_Φ, and an invariant function $j(d) = 1/d^{1/n}$ describing a uniform dependence on YBCO layer thickness. Good agreement with the combined dataset is obtained for $n \cong 2$, indicating an inverse-square-root dependence. Initial results from a complementary study on YSZ single-crystal substrates suggest that the uniformity in thickness dependence of the grain-boundary limited J_c in these conductors relates to the intra-grain J_c. The data are thus consistent with the existence of an intrinsic $J_c(d)$ dependence controlled by vortex pinning behavior. We present structural data from transmission electron microscopy and $J_c(d)$ data from thinning studies of thick coatings to further investigate the origin of thickness dependent trends in *ex situ* YBCO.

*Research sponsored by the U.S. Department of Energy under contract DE-AC05-00OR22725 with the Oak Ridge National Laboratory, managed by UT-Battelle, LLC.