The Puzzle of Two Different Sub-Micrometer Tungsten-Rich Deposits in Bulk YBCO: One Acts as Pinning Centers and the Other Does Not

Ravi-Persad Sawh, Roy Weinstein, Drew Parks, and Alberto Gandini

Beam Particle Dynamics Laboratory, Department of Physics, and Texas Center for Superconductivity, University of Houston
Houston, Texas, 77204, USA

Abstract - Two types of large grain YBCO samples doped with tungsten oxide, one with platinum and the other without, were produced using a slow cooling process. Observations of the trapped magnetic flux density showed that the flux density of the W-doped, Pt-free samples did not change with W doping levels of up to 2.1 mol%. In contrast, the (W + Pt)-doped samples resulted in a monotonic improvement in trapped magnetic flux density as a function of W doping. Microstructure studies indicate that both types of samples contain profuse sub-micrometer deposits of a W-rich compound. The Pt-free samples contain $(W_{0.4}Y_{0.6})BaO_3$ deposits while the (W + Pt)-doped samples contain deposits of a $(W_{0.5}Pt_{0.5})YBa_2O_6$ compound. Both types of deposits are of essentially the same size and have comparable number density. The results are strikingly similar to an earlier experiment in which uranium doped, Pt-free, large grain YBCO also did not show any improvement in trapped magnetic flux density. The U-doped, Pt-free samples contain profuse sub-micrometer deposits of a $(U_{0.4}Y_{0.6})BaO_3$ compound, which have been shown to be ferromagnetic. The inability of both the $(W_{0.4}Y_{0.6})BaO_3$ and $(U_{0.4}Y_{0.6})BaO_3$ sub-micrometer deposits to act as pinning centers in self-field, suggest that this behavior is systematic.

Keywords - Tungsten doping. Profuse sub-micrometer deposits. Ineffective pinning centers. Ferromagnetic non-pinning centers. Melt-textured YBCO high temperature superconductor.

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