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Effects of oxygen doping on vortex pinning and connectivity in highly dense Bi-2212 round wire

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It is now understood that the critical current density J_c of Bi-2212 is optimized when the density of the filaments is maximized by overpressure processing. What is not yet clear is the way that the intrinsic current density determined by vortex pinning may be compromised by poor connectivity. Overpressure processing almost completely removes obstructions to the current path introduced by voids, but the potential for blockage at grain boundaries remains, although it is largely unknown. The recent demonstration by Kametani et al. that there is a strong biaxial growth texture in Bi-2212 in principle suggests that grain boundary blocking is significantly reduced compared to Bi-2223 where only uniaxial texture is possible. Here we describe a set of experiments in which we vary the doping state after OP reaction. Varying the doping state from the underdoped to the overdoped state should strongly decrease the electronic anisotropy, increase the vortex stiffness, and thus increase the vortex pinning contribution to J_c. We follow these changes in vortex pinning strength by measuring the change in irreversibility field with doping state, finding that indeed the irreversibility field increases significantly as we moved to the overdoped state. Measurements of the transport current and magnetization hysteresis at 4K are also maximized as we overdope the material. We are also trying to follow changes in the connectivity using measurements of the critical current hysteresis to give us insight into whether overdoping is also enhancing the connectivity across grain boundaries. We will report on these detailed experiments at the conference.

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