Absence of Weak-Links in Bi-2212 Round Wire

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$Bi_2Sr_2Ca_1Cu_2O_x$ (Bi-2212) is the only high temperature superconductor (HTS) available as a round wire with high critical current density (J_c), making it a very compelling candidate for applications in high-field (>25T) magnets. *New understanding of the mechanisms that create high J_c in Bi-2212 round wires is important because it is breaking the long-standing belief that HTS grain boundaries are the primary mechanism that limits J_c in all high-temperature superconductors*. The traditional belief has been that grain boundaries limit J_c by virtue of being underdoped compared to nearby grains.

Researchers studied the suppression of J_c by magnetic fields for different oxygen doping levels in underdoped, optimal-doped, and overdoped Bi-2212 round wires. *While underdoping severely reduced J_c, researchers did not observe hysteretic $J_c(H)$ curves that would be a signature of grain boundary weak-links due to underdoping. They conclude that the presently-optimized biaxial texture in Bi-2212 round wires intrinsically constitutes a strongly-coupled current path, regardless of the oxygen doping state*.

Further study of Bi-2212's unique biaxial texture will seek to understand how current flows from grain to grain by focused ion beam (FIB) surgery of single- and bi-crystals to directly measure their inter-granular current transport properties.

Facilities/instrumentation used: Helios G4 Scanning Electron Microscope, 5T SQUID, 14T Vibrating Sample Magnetometer, 15T Superconducting Magnet; MagLab's Applied Superconductivity Center

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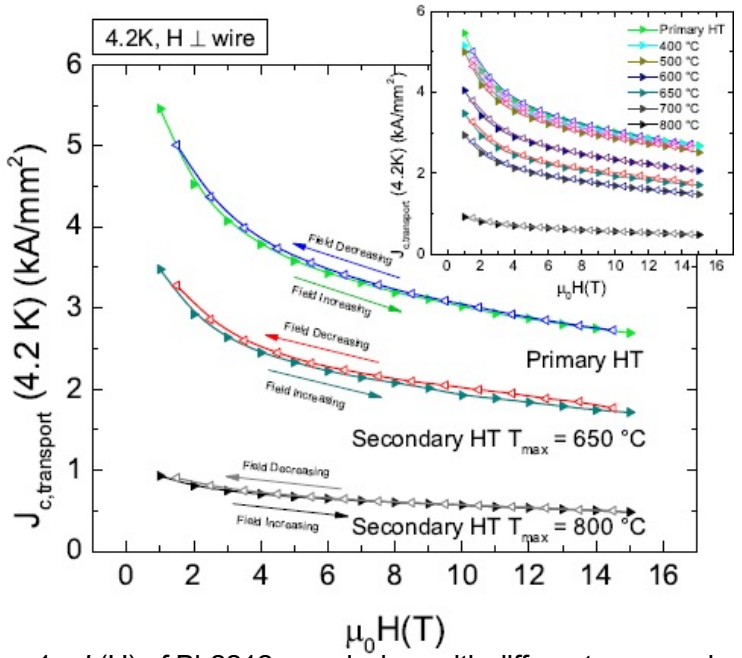

Figure 1: J_c(H) of Bi-2212 round wires with different oxygen doping levels in increasing and decreasing perpendicular magnetic fields. Despite an almost six-fold reduction in J_c, no field up/down hysteresis is observed, indicating a surprising lack of grain boundary weak-links.

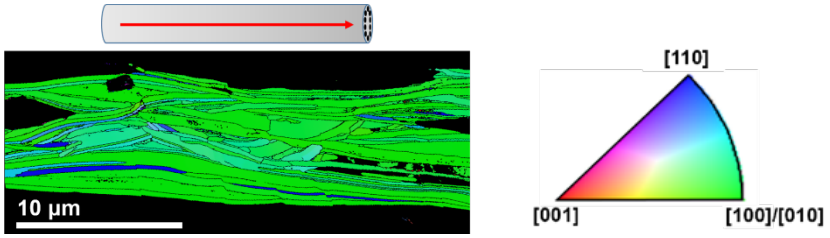

Figure 2: Inverse pole figure maps (IPF) of a longitudinal cross section of an individual Bi-2212 filament in the highest J_c sample. The dominance of green indicates a strong *a*-axis alignment.