Development of Persistent Superconducting Joint for High-Temperature Superconducting Magnets

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The Bi-2212 round wire was supplied by Oxford Superconducting Technology.

Bi-2212 is the only high temperature superconducting (HTS) cuprate available in a round wire form (Fig. 1). As such, Bi-2212 conductor has become a strong candidate for future high-field, high-homogeneity magnets, especially for nuclear magnetic resonance (NMR) and particle accelerator magnets. *The development of superconducting joints is one of the critical enabling technologies for Bi-2212 round wire to find successful NMR applications, where persistent operation is highly desirable to achieve the stringent "parts per billion per hour" field stability required for high-resolution NMR.*

MagLab researchers have recently invented a practical superconducting joint between two Bi-2212 round wires. The joint technique allows a native Bi-2212 to Bi-2212 wire superconducting joint to be formed without introduction of any other material. The joint fabrication procedure is practical and compatible with standard wind-and-react coil manufacturing.

The joints exhibit near-zero resistance, as evidenced by the lack of ohmic components to *V-I* traces (Fig.2). With a criterion of 0.1 μV/cm, a critical supercurrent of ~900 A was achieved at self-field and 4.2 K. Using the conventional field decay approach, the joint resistance was determined to be below 5 $x10^{-12}$ Ω at self-field and 4.2 K, sufficiently low to demonstrate the potential for persistent mode operation of future magnets fabricated from Bi-2212 round wire.

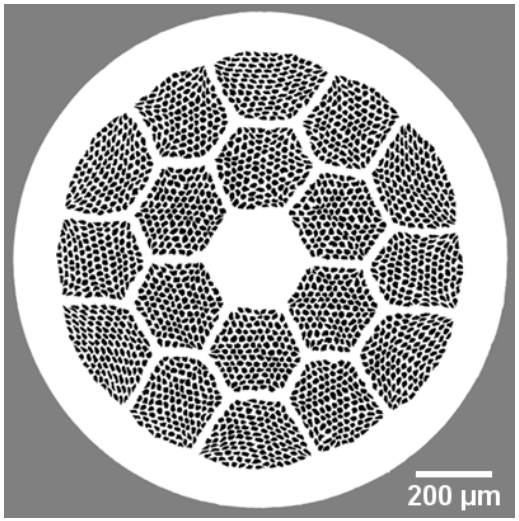

Fig 1. Light microscope image of a transverse cross-section of an as-drawn 1.3 mm diameter Bi-2212 round wire. The Bi-2212 filaments are shown as black. As such, this is revealed to be a "double-stack" wire composed of 18 bundles, each of which consists of 121first-stack Bi-2212 filaments.

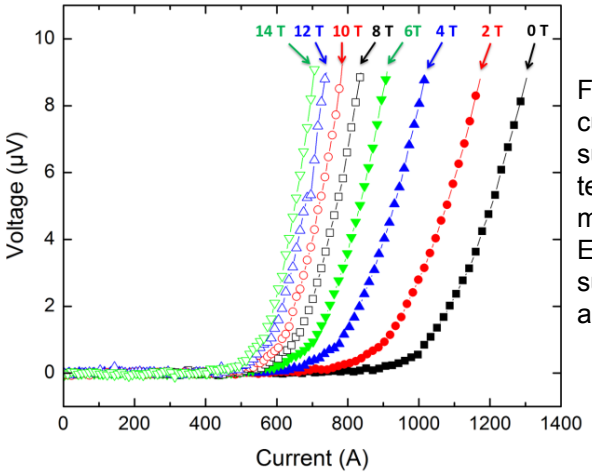

Fig 2. Voltage-Current (*V-I*) curves of a typical Bi-2212 superconducting joint at a temperature of 4.2 K and in magnetic fields of up to 14 T. Even at 14T, the joint carries supercurrents exceeding 400A and remains superconducting.

Facilities: MagLab's Applied Superconductivity Center

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