Modern High-Temperature Superconducting tape found suitable for magnets up to 50 teslas and beyond

D. Abraimov[1], J. Jaroszynski[1], Y. Zhang[2], A. Francis[1], A. Constantinescu[1], Y. L. Viouchkov[1], and D. C. Larbalestier[1];
[1] National High Magnetic Field Laboratory, Florida State University; [2] SuperPower Inc.

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Two reports from the National Academy of Sciences have determined that a 60T DC magnet is a high priority for the nation. This 60T magnet will necessarily rely heavily on improvements in high-temperature superconducting (HTS) materials that can be wound into magnets, with the present-day leading candidate conductor being state-of-the-art Rare Earth Barium Copper Oxide (REBCO) tape **[Fig 1a].**

In order to make realistic conceptual designs of future magnets, researchers must measure critical conductor properties to the highest magnetic fields possible and must determine valid extrapolations to predict critical current density (*Jc*) behavior in presently inaccessible domains of magnetic field, temperature, and magnetic field orientation, θ, where θ=0˚ is defined as the magnetic field perpendicular to the plane of the tape conductor.

Recent measurements in the MagLab's 45T hybrid magnet allowed researchers from the MagLab and SuperPower, Inc. to determine that the power law dependence of *Jc* on magnetic field, first observed from 5T to 30T, remain valid up to 45T for temperatures below 10K **[Fig.1b]**. For magnetic field in the plane of the tape conductor (θ = 90˚), almost no magnetic field dependence is observed, even at high temperatures **[Fig.1c]**

Our data shows that design of ultra-high-field magnets, capable of reaching 50T and higher, is feasible using the latest high critical current density REBCO tape.

Facilities and instrumentation used: 45T hybrid magnet from the DC Magnet User Facility and instrumentation from the Applied Superconductivity Center

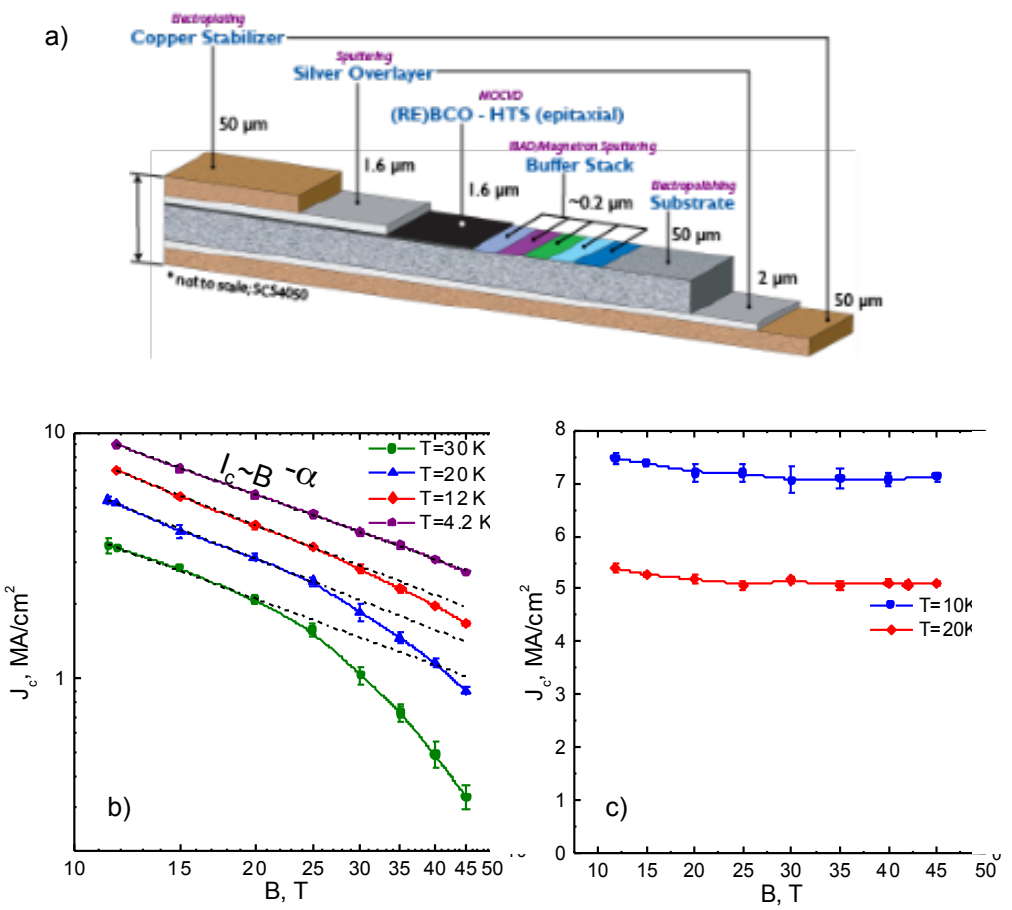

Fig.1 (a) Schematic cross-section of the multi-layer REBCO tape conductor in which the REBCO layer is less than 1% of the total thickness of the tape. **(b)** *Jc* (B,T) for magnetic field perpendicular to the REBCO tape with 7.5% Zr doping; **(c)** *Jc* (B,T) for magnetic field in the plane of the tape from a new R&D version of REBCO tape with 15% Zr doping.