Advanced Microscopy for Better Nanostructural Insights in Bi-2212 Round Wires

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Recent advances in precursor powder and processing technologies have helped to propel Bi-2212 Round Wires as a promising candidate for future high-field magnet applications. However, *there is still a need to understand and optimize the processing parameters in a bid to push Bi-2212 Round Wire to the forefront as a viable technology*.

Advanced microscopy techniques (Electron Back Scatter Diffraction Orientation Imaging Microscopy (EBSD-OIM) (Figure 1) and Transmission Electron Microscopy (TEM) (Figure 2)) allowed this research group to find nanostructural correlations in Bi-2212 Round Wire between processing parameters used in the heat treatment and superconducting properties that result. *These results show that a new precursor powder combined with highly optimized processing parameters, including the cooling rate, play a vital role in the development of grain boundary cleanliness and high a-axis grain alignment (figure 2), both of which are necessary for high superconducting critical current density (J_c).*

Understanding the particular roles that these factors play will help to unravel the complex interactions necessary for high J_c in Bi-2212 Round Wire, which is the key to unlocking the potential of this high-temperature superconductor for future applications in high-field magnets.

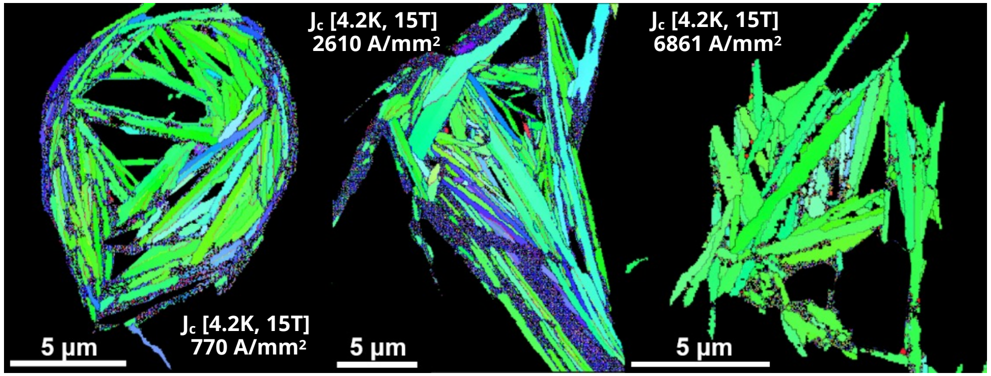

Figure 1: Electron micrograph of the cross sections of three Bi-2212 round wires with widely varying critical current densities (J_c) showing their *a*-axis grain alignments. The wire with the best a-axis alignment (far right, highest proportion of grains in green) had the highest J_c of 6861 A/mm^2 (at 4.2K and 15T).

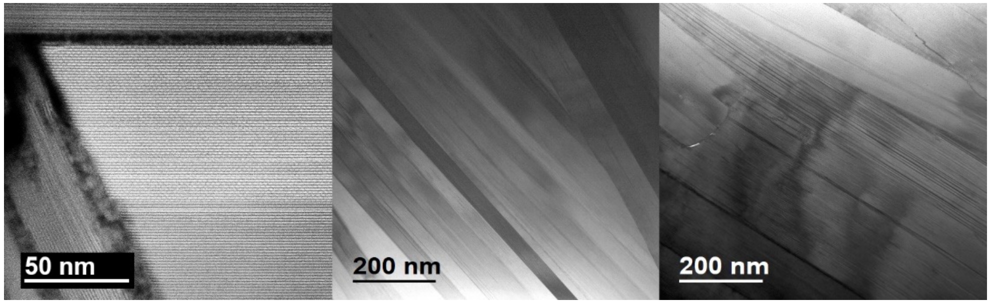

Figure 2: Transmission Electron Microscope (TEM) images of the three wires showing grains and grain boundaries. Our results showed that the wire with the lowest J_c of only 684 A/mm^2 (measured at 4.2K and 15T) had high *a*-axis alignment but also had amorphous content at its grain boundaries, which acted as a current transport barrier and thus significantly lowered the J_c of the wire.

Facilities and instrumentation used: Applied Superconductivity Center (ASC – MagLab) Carl Zeiss 1540 EsB Scanning Electron Microscope (SEM), Thermo Fisher Scientific Helios G4 high resolution Scanning Electron Microscope (SEM), JEOL ARM 200CF atomic resolution Cs-corrected analytical Transmission Electron Microscope (TEM).

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