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M2Or1A-04: Predensification of Bi-2212 wires and its impact on critical current density

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Achieving high J_c in Bi₂Sr₂CaCu₂O_x (Bi-2212) round wire requires overpressure heat treatment (OPHT) to eliminate current-limiting bubbles. The OPHT has a maximum temperature of ~890 °C and is done with 50 bar overpressure with 1 bar oxygen partial pressure (PO₂). During OPHT, the diameter of the Bi-2212 wire shrinks about 4%, with about 80% of this densification occurring during a 2 h hold at 820 °C before the Bi-2212 powder melts. As part of his PhD studies, Maxime Matras from our group investigated predensifying Bi-2212 round wire for 2 h at 820 °C at 50 bar overpressure with different PO₂, followed by the full OPHT with 1 bar PO₂. A surprising result of his study was that 0.2 bar PO₂ predensification decreased the J_c of Ag-Mg sheathed wire by 32% while 5 bar predensification increased J_c by around 25%, compared to predensification using 1 bar PO₂. However, this change in critical current is not universal and we could not reproduce the results in some of our new generation wires. We are investigating the underlying causes and how the processing parameters (time, temperature, and PO₂) affect this significant increase in J_c to understand what causes J_c to increase in some wires but not in others that have the same nominal Bi-2212 composition. Irreversibility field and critical temperature measurements did not reveal any discernible difference, and scanning electron microscopy showed no microstructural differences between samples that were preoxygenated with different conditions and had different J_c . Our current thinking is that either changes in Bi-2212 stoichiometry or in grain orientation that's responsible for differing J_c in differently heat treated wires. We will report on EDS analysis of wires with different J_c using TEM and also on Bi-2212 grain alignment of these wires studied with Electron Backscattered Diffraction.

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