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# Use of Critical Current Distribution Measurements in Bi-2212 Round Wires as a tool to significantly enhance and stabilize the $J_c$ properties

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Bi-2212 conductor is now a serious candidate for HEP, NMR, and other ultra-high field magnet applications since our demonstration that 50 bar over-pressure heat treatment (OPHT) is reliable and predictable for many coil reactions. As more magnet designs are generated, predictable and consistent critical current density ($J_c$) values are important too. In fact there are still $J_c$ uncertainties of order 30-40\% that we ascribe to a still poorly understood convolution of powder quality, filament uniformity and the OPHT itself. We here report an extensive study of the critical current distributions in $\sim$ 1 m long wires made by B-OST derived from $d^2V/dI^2$ analyses of the $V-I$ curves measured on ITER-like barrels. These transitions can be well fitted by Gaussian distributions and characterized by their relative standard deviations $\sigma/\mu$. We find that recent Engi-Mat powder wires made by B-OST have significantly higher $J_c$ and lower $\sigma/\mu$ than found in earlier B-OST wires made with Nexans or SCI powders. We also find that the highest $J_c$ values provided by minimum $T_{max}$ and minimum time in the melt ($t_{melt}$) during OPHT also correspond to significantly lower $\sigma/\mu$ values. We attribute this property degradation with higher $T_{max}$ to a loss of filament connectivity associated with worsening texture associated with filament merging during the melt step of the OPHT. We will report $d^2V/dI^2$ evaluations of many multifilament Bi-2212 wires made over the last decade and seek to deconvolute powder and filament quality effects from OPHT variations. A huge advantage of B-OST wires is that they can be made in continuous lengths of $>$ 1 km at 1 mm diameter. We believe that such $I_c$ distribution measurements may also be an important quality control tool to apply to lead-in and lead-out ends of coil windings.

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