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M1Or3F-05: Filament area variation in Bi-2212 round wire and its impact on critical current

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Currently, the record critical current density (Jc) achieved in Bi-2212 short samples is around 9600 A/mm¬2 at 5 T in 4.2 K. However, even this very high Jc is still less than 1% of the depairing current density (Jd) of Bi-2212. The 1% Jc/Jd value in Bi-2212 suggests that the long-range filament connectivity in Bi-2212 is rather poor. There are multiple intrinsic and extrinsic factors that can impact filament connectivity in superconducting wires. One of them is irregularities in filament cross-sectional area along the length of the wire. Here we report on wire drawing and heat-treatment-induced area variation along the length of individual filaments that may limit Jc in Bi-2212. Using progressive polishing and image analysis, we observed significant filament size variation, referred to as sausaging, along the length of as-drawn wire that developed during wire drawing. The degree of sausaging increased with the decreasing filament diameter, leading to a filament area variation of individual filaments up to 50%, which may have a negative impact on Jc. Using a special sparse filament 27x18 Bi-2212 wire, we observed that the degree of sausaging in individual filaments increased with increasing time that the wire was in the melt state during the overpressure heat treatment (OPHT) due to Rayleigh instability. Our results show that this heat treatment-induced area fluctuation is more severe for smaller filaments and at long times in the melt can lead to pinch off of individual filaments.
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