On narrowed coated conductors: granular field-hysteresis effect on transport critical current

A.A. GAPUD, University of South Alabama, D.K. CHRISTEN, F.A. LIST III, R. FEENSTRA, Oak Ridge National Laboratory — Superconducting film coated onto flexible metallic tapes — so-called coated conductors — which are being developed for second-generation power transmission lines, are long polycrystals subject to effects of the film’s granularity. Although intergranular misorientations have been effectively minimized, local higher-angle misorientations remain. One earmark of such weak links is the hysteresis of the critical current density $J_c$ with respect to applied field $H$, brought about when large circulating currents trapped within adjacent grains produce a focused field within the grain boundaries (GB’s) which can partially cancel out $H$ when applied field is decreasing. This shifts the maximum $J_c$ from zero to a finite $H$ where the local field at the GB is at minimum. This effect has been seen in measurements of induced (magnetization) currents, but has not been documented using transport (applied) currents that can be percolative. However, in applications where the coated conductor is patterned into conduits 100 $\mu$m wide or less, it is possible to effectively channel the percolation across a single GB; the field-focusing effect is well known in transport currents across single GB’s. This study shows that, indeed, the effect is clearly manifested in coated conductors narrowed to a few grains wide. Systematic measurements, analyses, and ramifications will be discussed.

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