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The Myth of the Resistive Transition: Decoupling Dissipation from Irreversibility Field in Coated Conductors

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The irreversibility field (H_irr) in practical superconductors is frequently—and erroneously—identified with the onset of resistive transition in transport measurements. This assumption lacks fundamental justification and is valid only in limited cases, such as granular superconductors with weak intergranular coupling. In contrast, in materials exhibiting δl -pinning, where effective pinning centers at low fields have locally enhanced Hc2 under high magnetic fields, these regions transform into preferential pathways for weak excitation current. Consequently, the resistive onset reflects the degree of inhomogeneity rather than the irreversibility properties.

In this work, we investigate state-of-the-art second-generation high-temperature superconducting (2G HTS or coated conductors) using complementary magnetization and transport measurements. By directly comparing the irreversibility field derived from magnetic moment hysteresis with resistive transition curves, we demonstrate a systematic discrepancy between the two. Our results align quantitatively with published data —yet our interpretation diverges dramatically. We show that in most cases, the resistive onset significantly overestimates H_irr, leading to misleading assessments of pinning performance and critical current density in high-field applications. The results highlight the need for a comprehensive and complementary characterization using both magnetic moment and transport measurements. The study was supported by grant No. 25-72-10037 from the Russian Science Foundation.

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