Field and Temperature Scaling of the Critical Current Density in Commercial REBCO Coated Conductors

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Abstract – Scaling relations describing the electromagnetic behaviour of coated conductors (CCs) are essential for the proper design of REBCO-based devices. The performance of REBCO CCs is strongly influenced by fabrication route, conductor architecture and materials, and these parameters vary from one manufacturer to the others. In the present work we have examined the critical surface for the current density, J_c(T,B, θ), of coated conductors from six different manufacturers: American Superconductor Co. (US), Bruker HTS GmbH (Germany), Fujikura Ltd. (Japan), SuNAM Co., Ltd. (Korea), SuperOx ZAO (Russia) and SuperPower Inc. (US). Electrical transport and magnetic measurements were performed at temperatures between 4.2 and 77 K and in magnetic field up to 19 T. Experiments were conducted at three different orientations of the field with respect to the crystallographic c-axis of the REBCO layer, θ = 0, 45 and 90°, in order to probe the angular anisotropy of J_c. In spite of the large variability of CCs' performance, we show here that field and temperature dependences of J_c at a given angle can be reproduced using a scaling relation based only on three parameters. As a complement to this analysis, we present an overview of the electromechanical and thermal conduction properties of the CCs from the six manufacturers and we discuss the implications for the design of high field insert coils.

Keywords (Index Terms) – Coated conductors, critical surface, critical current, scaling relations, electromechanical properties, irreversible strain limit, thermal conductivity, normal zone propagation velocity.