Inductive Evaluation of the Electromagnetic Granularity of YBCO Coated Conductors

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Coated conductors have appeared as one of the most promising materials for superconducting power applications. Many advances have been reached in tape processing, however the physical mechanisms for current percolation are not fully understood yet. We present an inductive analysis of YBCO IBAD and RABiTs coated conductors based on complementary measurements of dc-magnetization and ac-susceptibility addressed towards enlarging this understanding. The non-destructive character of both inductive methods enriches their applicability to the study of magnetic granularity effects in coated conductors. In addition, the number of samples from different sources widens the obtained results. We have clearly identified the signature of electromagnetic granularity inherent to these materials from dc-magnetization curves. The thorough analysis of the particular features of the hysteresis loops has enabled us to determine and separate the inter and intra-grain critical current densities, J_c, of each tape, and infer the reasons for the thickness dependence of J_c. Ac-susceptibility measurements have been shown to be unique to analyze flux penetration through a grain boundary, GB, network and determine the corresponding dissipation and J_c. The appearance of differentiated dissipations as the temperature rises has evidenced the formation of distinct GB networks in a single conductor with associated different J_c's. Remarkably, this is seen as a common feature of both types of conductors and thus has been further used to quantify their quality. Ac-susceptibility measurements are envisaged as a measure of the homogeneity degree of the grain boundary network. Calculations in the Bean critical state model of return fields (stray fields), full penetration fields and critical current densities for finite size cylinders has enabled us to properly quantify the results.