IN-FIELD TRANSPORT CHARACTERIZATION OF STATE-OF-THE-ART HTS-CONDUCTORS UP TO 45 T

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Introduction

HTS-technology will soon play a very important role in the successful development of the new generation of high-field magnets. An important key to mastering the upcoming tasks is the availability of HTS-conductor of high performance. During the past tree years there has been significant improvement in the production of first and second-generation conductors. To understand the properties of these new conductors and to produce a framework for new magnet designs various HTS-conductor samples of the most recent generation were characterized in fields up to 45 T using the Hybrid magnet of the NHMFL.

Experimental

Short samples of 22 mm length were cut from long length state-of-the-art, industrial grade HTS conductor batches. The conductors investigated were Bi2212 wires and tapes, Bi2223 tapes, and YBCO coated conductor. To minimize Lorentz force induced strain the samples were partially embedded in cryogenic grade epoxy, Fig. 1. The sample holder was mounted to the probe allowing for measurements in two field orientations, 0° and 90° to the sample surface, Fig. 2. Once the field was established, current-voltage data were taken. This was repeated for every field step up to 45 T. To verify sample integrity, data were also taken for decreasing field steps. The critical current measurements were carried out applying the standard four-point method and a voltage criterion of 5 μV/cm was used. This relatively high voltage criterion was used to accommodate for the short sample length and relatively high noise levels of the hybrid magnet.

Results

For the first time a set of HTS conductors has been characterized in fields up to 45 T. The data clearly reveal the high degree of performance HTS conductors have reached within the last three years, Fig.3. Each of the conductors retained high transport current values even at highest fields. It also became clear that the pinning force maximum of all of the characterized conductors is far beyond the experimental limit of 45 T. The most recent Bi2212 round wires have a clear edge over tapes particularly in respect of their isotropic in-field transport properties. They will have to be considered a potential conductor for future high-field magnet applications.

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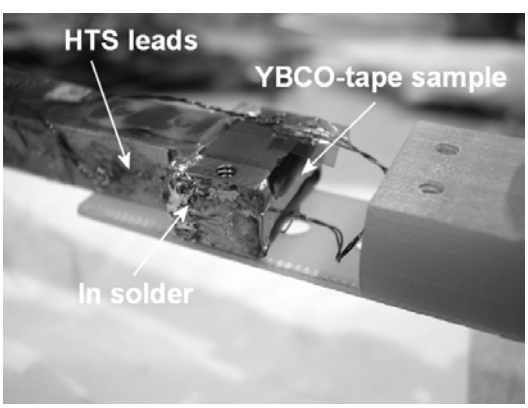

Figure 1. Sample holder with sample fixture to allow for measurements in two field orientations, 0° and 90° to the sample surface. The samples are each 22 mm long.

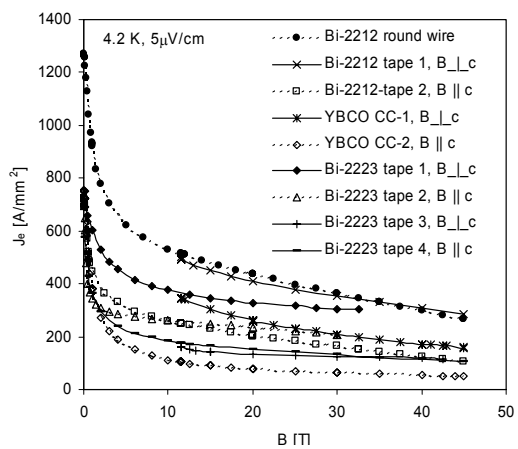

Figure 2. $J_e(B)$ curves for the samples in 0° and 90° orientation to the applied field. (The letter c denotes the crystallographic axis of the HTS material.)