Implementation Issues of $REBa_2Cu_3O_{7-x}$ Coated Conductor in High Field Magnets

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Introduction

One goal at the NHMFL is the development of high field NMR quality magnets beyond 30 T using high temperature superconductors (HTS). During the last few years $REBa_2Cu_3O_{7-x}$ (REBCO) coated conductors have improved substantially as a number successful record coil attempts carried out by several research groups including some of ours have shown [1]. The properties of coated conductors, however, are still limited by their large electromagnetic anisotropy, long length inhomogeneity, and transverse stress sensitivity due to weak bonding between coated layers and substrate. Being essentially a highly-aspected single filament conductor, REBCO coated conductors sustain significant screening currents that are induced by the radial field components in tape-wound coils affecting their field profile and field stability.

Experiments and Results

As shown in Fig.1, a layer-wound, fully epoxy impregnated, REBCO insert test coil with one resistive electrical joint was made. To circumvent the issue of conductor delamination caused by transverse stresses our patented approach using thin polyester heat shrink tubing was used [2, 3].Two major goals were pursued: Develop and evaluate layer winding and joint making procedures, measure coil performance and study the effect of induced screening currents on the field stability of such a coil in the context of using HTS tape conductor in high field NMR magnets. Before winding the coil, the entire conductor was characterized in an in-house facility that combines Hall sensor magnetometry and critical transport current characterization (Jaroszynski, Stangl). Though the transport data did not indicate any conductor issue, the Hall data indicated a potential defect at about 55 m, which corresponds to a location within coil layers 41-49. The finished coil was tested at self field and 12 T inside our 17.8 T Oxford Instruments superconducting magnet. Except two, all of the coil sections were fully superconducting. While the section around the resistive joint showed expected ohmic behavior (~0.57 μΩ for a bridge type joint of 8 cm length, extrapolated to a reference field of 20 T), coil layers 41-49 showed an unexpected resistive offset of about 22 μΩ (extrapolated to the same reference field) which corroborated the results of the conductor characterization done earlier. During the coil tests a Hall sensor located at field center was used to measure total field and field drift caused by the decaying shielding currents in the coil. A substantial magnetic hysteresis was measured indicating changing field stability over time. More details about these measurements are given in the annual report by Hilton *et al*.

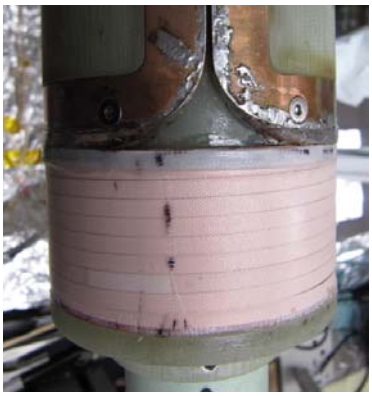

Fig.1. (left) View of the layer wound REBCO coil and coil terminals [4].

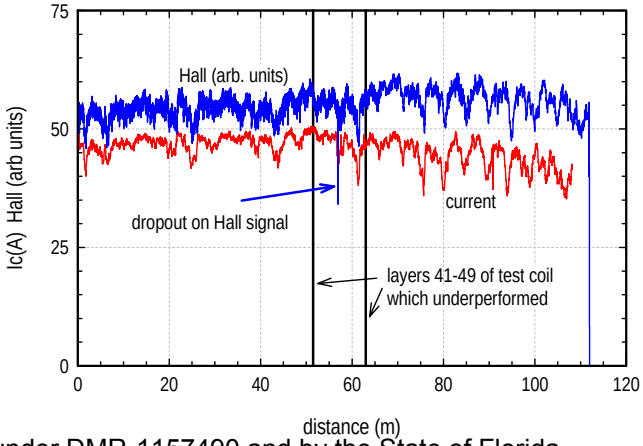

Fig.2. Continuous critical current and Hall sensor data measured with our in-house test facility on one of the conductor piece lengths used in the coil.

Acknowledgements

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References

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