QUENCH STUDIES ON $Bi_2Sr_2CaCu_2O_x$ CONDUCTORS AND COILS

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Introduction

The next generation of superconducting high-field magnet systems will reach beyond the technological limits of Nb_3Sn and will include substantial sub-sections based on HTS-conductor technology. At the NHMFL, plans are evolving for a 30 T/1.3 GHz NMR magnet to include an innermost HTS coil. An increasing amount of attention by the research community has been given recently to Bi2212 based conductor as a potential candidate for a variety of high field magnet applications. Bi2212 has a very high upper critical field and has also shown high transport properties in short samples at 4.2 K implying potential for compact, efficient high field magnets. It is available in tape and wire configuration of long lengths with various aspect ratios. Still there are critical issues to be addressed to develop Bi2212 into a robust technology in order to satisfy the various needs driven by the proposed technical applications, like consistency of conductor performance in long lengths, mechanical and stability. This investigation focuses on the quench behavior of Bi2212 straight tape conductor samples and wire-wound coils and addresses the question of how Bi2212 can be implemented in a combined HTS-LTS magnet system.

Experimental Approaches

Straight 14 cm long, mechanically not reinforced and fiber glass reinforced epoxy backed, short Bi2212/Ag tape samples were mounted on a sample holder and instrumented with set of six voltage taps and thermocouples placed with equal spacing along the sample. To initiate quenches, a W-shaped wire heater was mounted with epoxy resin at the center of the sample.
An 8 layer, 425 turn coil, wound from Al_2O_3-fiber braided, 0.8 mm dia. Bi2212/Ag alloy wire, manufactured by Oxford Superconducting Technology, was instrumented with axial and circumferential foil heaters to initiate controlled quenches in a magnetic background field of 8 T. An array of voltage tabs and thermocouples were used to map quench propagation on the coil envelope. All measurements were done at 4.2 K. Voltage and thermocouple transients on short samples and coil were measured using a number of fast DMM's and scanner cards controlled through GPIB.

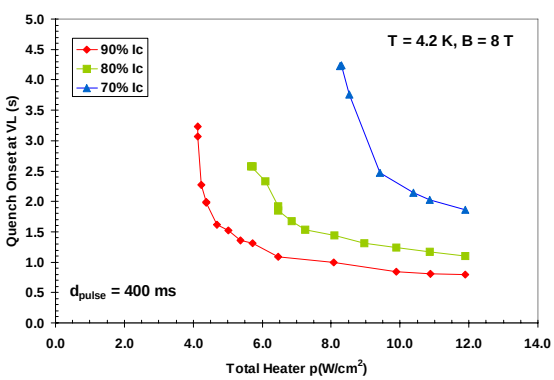

Figure 1. Onset of quench voltage after ignition of heater pulse using the axial heater. Duration of heat pulse was 400 ms.

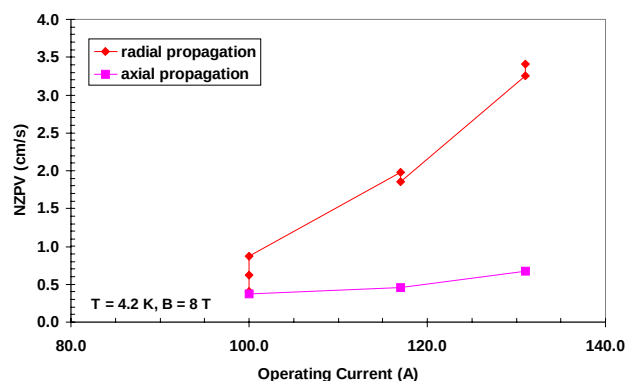

Figure 2. Quench propagation velocities in azimuthal and radial direction. Quench is about 5 times faster in radial direction.

Results and Conclusions

An experimental setup has been completed to initiate controlled quenches on a Bi2212 coil. Preliminary results show that short tape samples degraded after every quench with or without mechanical reinforcement present, likely caused by a lack of cooling around the heater during a quench, resulting in high local temperatures. The coil could be quenched at moderate heater powers and did not degenerate after a series of about 40 quenches. Quench propagation velocity was on the order of a few cm/s and was approximately the same for short tape samples and the wire-wound coil. The time scale of quenches on the Bi2212 coil is comparable with slow quenches of Nb_3Sn coils.

Acknowledgements

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