Bi-2212 Coil Technology

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Introduction

Efforts on the application of Bi-2212 round wire for high field nested solenoids and accelerator magnets for the HEP community are further gaining momentum. For high field solenoids, Bi-2212 is currently being explored as a part of the NHMFL's ongoing 40 T project. Operating conditions at 40 T are extremely demanding on the coil mechanics and have yet to be explored in HTS coils in general. A series of test coils will be built and tested in the coming year to evaluate various coil reinforcement schemes, Fig.1. For HEP several more race-track coils have been made at LBNL and over pressure heat treated in our high pressure furnace. Performance test that were successfully carried out at LBNL showed very high transport properties and also that an upper critical current limit has yet to be reached, Fig. 2.

Experimental

Bi-2212 round wire wound solenoids carrying various amounts of reinforcement are currently being designed, which will be tested in high background fields of up to 14 T. A 14 T superconducting magnet, made by Cryogenic LLC, has recently been installed and put into commission at the ASC. It will be used as a high field test bed for these coils. To evaluate the mechanical properties of coils reinforced with high strength alloy tape, two coils have been made and tested using aspected conductor with a high strength alloy tape bonded to it and aspected conductor with high strengths alloy tape added as a co-wind, respectively. The bonded conductor was provided by Solid Matrerials Solutions (SMS) IncNew furnace. These coils were tested in our 8 T cryo-cooled magnet, Fig. 3a & b. Two more race-track coils made with Bi-2212 17-strand Rutherford cable were made by LBNL. One coil, RC-6, was over pressure heat treated (OPHT) and tested while the other coil, RC-7, will be OPHT'ed and tested soon.

Results and Discussion

Both coils with aspected conductor performed well during the tests. The coil made with SMS wire mitigated a maximum stress of ~300 MPa before degradation while the co-wound coil could not be degraded in the 8 T background and may be tested again in the now available 14 T cryogenic magnet. In tests at LBNL RC-6 achieved a critical current of ~8600 A which is the highest performance among all Bi-2212 race-track coils made at LBNL so far. The desire of heat treating larger race-track coils as well as solenoids has generated funding through DOE and NSF for a project to build a larger over pressure furnace to accommodate these needs. This project has just started and the new furnace is expected to be completed within a time frame of two years.

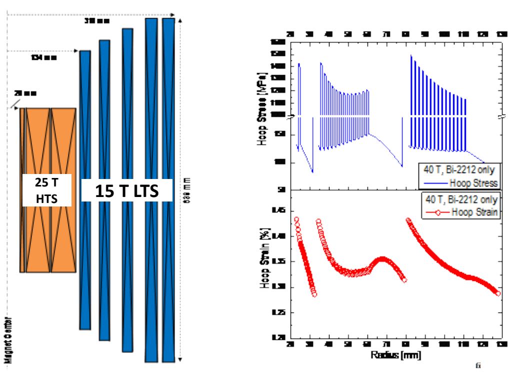

Fig. 1: Hypothetical 40 T magnet design using a 25 T Bi-2212 insert. The stresses on the coil reinforcement are exceptionally high.

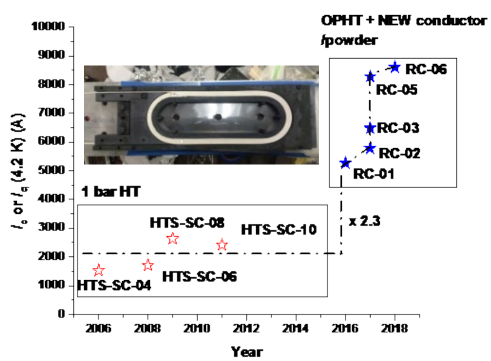

Fig.2: Performance of LBNL made and NHMFL OPHT'ed racetrack coils over the past years. OPHT and new Bi-2212 powders dramatically boosted their transport properties.

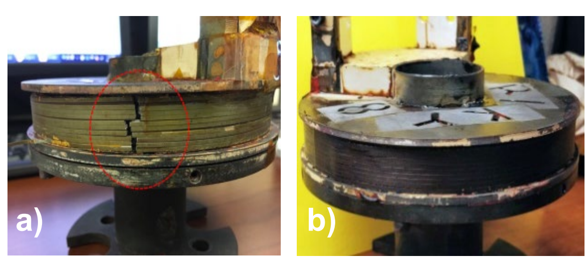

Fig. 3a, b: Two test coils made with a) aspected conductor made by SMS and b) aspected conductor co-wound with high strengths alloy tape.

Acknowledgements

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