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Compact, high field coils made with strong, rectangular Bi2212 superconductor wire

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A Bi2212-based rectangular wire approach has been developed, with up to 500 MPa stress tolerances and useful current densities for building compact solenoid coils that are more problematic to make with wide HTS tapes, and that need to operate beyond the field and temperature limits of low temperature superconductors. We are applying long lengths of this new Bi2212-wire to develop a practical and low cost approach for producing robust HTS insert coils that are capable of boosting the fields of Nb3Sn based magnets to above 30 T levels and that are required to for example advance NMR from its present 900 MHz capability to a targeted 1.2 GHz level. As a first step, we built and qualified a coil winding test bed that we then used to develop wind-and-react coil fabrication techniques by producing short length, multilayer coil samples with different wire, thin insulation and build configurations, followed by reaction and testing. The results were then applied to design and develop techniques for building 5 T to 10 T class, compact field-boosting demonstration coils with configurations and sufficiently strong wire for utilization in the ˜ 22T Nb3Sn magnet background fields and at diameters of interest for use in NMR magnet field boosting. A simple and practical 1 atm heat treatment approach has also been developed to the point where now it can be applied to achieve usefully high current densities in these coils, in place of the more difficult to scale, up to 50 atm over-pressure approach that was initially developed. Techniques for attaching current leads with very low resistance joints have also been qualified, preparing a foundation for producing unique, HTS wire-based, sufficiently-robust, field-boosting insert coils.

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