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Fri-Mo-Po.04-05: Development of Bi-2212 shim coil for extremely high field high-temperature superconducting NMR magnets: design, construction, and testing results

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Extremely high field NMR magnets have received much attention by improved resolution and higher sensitivity. However, one of the main reasons limiting its development is the magnetic field inhomogeneities generated by high-temperature superconducting (HTS) magnets cannot be compensated by conventional superconducting and room temperature shim coils. The design, fabrication, and testing results of the world's first Bi-2212 shim coils for the inner-layer of the extremely high field NMR magnet is presented in this paper. The effects of stress on the coil at extremely high field and dimensional change after heat treatment has been considered for the electromagnetic design and the fabricated coil prototypes are tested at 77 K. The complete results will be fully applied to the already built 26T and the upcoming 35T extremely high field superconducting magnets and the peak-to-peak field homogeneities over a 30 mm length on the Z-axis of the 35T magnet can be improved from 631.47 ppm to 4.71 ppm by using Z1 and Z2 Bi-2212 shim coils. The almost negligible screening current of Bi-2212 wire compared to REBCO tape gives it a unique advantage when applied to the fabrication of shim coils at extremely high field. Meanwhile, The Bi-2212 shim coil has a much higher critical current at extremely high field than conventional NbTi shim coil, allowing for minimal space occupation, and being placed inside the HTS magnet which is unaffected from the windings' diamagnetic wall effects. These advantages are particularly attractive when applied to extremely high field nuclear magnetic resonance (NMR) magnets. The Bi-2212 shim coil brings more possibilities to the next-generation, extremely high field NMR magnets, allowing more factors to be taken into account during the magnet design phase rather than just being limited to field homogeneity.

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