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Mon-Af-Po1.13-05 [25]: Design Methodology for Ferromagnetic Shimming of HTS NMR Magnets Using a Stacked Multilayer Shim

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In this paper, a new design method using a stacked multilayer ferromagnetic shim is proposed and experimentally verified. Because of large harmonic errors caused by the screening-current induced magnetic field (SCF) and absence of superconducting active shim coils, ferromagnetic shimming is one of the most important technologies to develop the homogeneous high temperature superconducting (HTS) NMR magnets. In conventional designs of ferromagnetic shim, it has been important to optimize the thickness of hundreds of shim elements. Since the optimal thickness combination can be very complex, 0.025 mm (1 mil) to 0.5 mm (20 mils) thick, a method to reduce manufacturing errors should be considered from the design stage. Even if the shim of the complex combination is well fabricated, the performance may not be perfect, so that the shimming is iterative process. In order to reduce the manufacturing errors of the shim layer and flatten the contact section when stacking, each shim set is designed with shim elements of the same thickness. In this paper, the design method to reach 1 ppm with ferromagnetic shim alone and the process of installing multilayer shim are explained. The newly designed shim has been fabricated and verified by the shimming test of a 400 MHz all-ReBCO NMR magnet, which is supposed to have the final homogeneity level of sub-ppm, including room-temperature (RT) shims.

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