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Structure design on the 3-T HTS coil for desktop MRI magnet using the Distributed Genetic Algorithm method.

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High-quality magnetic resonance imaging (MRI) techniques can provide precise anatomical details of small extremities such as hands and feet. Conventional MRI systems use cryogenic superconducting magnets cooled by liquid helium, and these occupy a large amount of space. Therefore, we have been developing a compact and high-performance desktop finger MRI system using REBCO wires. The proposed HTS magnet was cooled by cryocooler with cryogen free and will be operated at 40 K. The target value of strength of magnetic field is 3 T and the magnetic field homogeneity is 10 ppm/cm2 in a cylindrical measurement space with a diameter of 20 mm and a height of 10 mm. In order to develop the desktop finger MRI system, it is necessary to downsize the entire system including the HTS coils. In the previous study, the structure of HTS coils used in the finger MRI as a previous study was designed using the Distributed Genetic Algorithm (DGA) method. The optimized structure of HTS coil designed by the DGA method is very complicated, so it is not suitable for the actual coil structure in which double pancake HTS coils are stacked. Although the effect of the incorrect magnetic field due to the screening current increases with decreasing the inner diameter of the HTS coils, the screening current was not considered in the previous coil design. In this study, we designed the HTS magnet for finger MRI using HTS coils while minimizing the influence of screening currents. We performed an analysis that combines the electromagnetic field analysis based on the 2-D FEM and the DGA method to improve the design accuracy of the HTS coils. The optimize structure of the HTS coils for finger MRI and the effects of calculated screening currents will be presented.

Primary author: OSAWA, Yoshihiro (Okayama university)

Co-authors: Mr INOUE, Yuta (Okayama university); INOUE, Ryota (Okayama University); UEDA, Hiroshi (Okayama University); KIM, SEOKBEOM (Okayama University)

Presenter: OSAWA, Yoshihiro (Okayama university)

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