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Magnetic field homogeneity and stability of a conduction-cooled REBCO MRI magnet with a room-temperature bore of 396 mm

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We started developing REBa2Cu3O7-δ (REBCO) magnets for ultra-high-field MRI systems in 2013. Our final targets are 9.4 T MRI systems for whole-body and brain imaging. In the project, a conduction-cooled REBCO MRI magnet having a room-temperature bore of 396 mm was fabricated and tested in order to evaluate the magnetic field homogeneity and stability. The magnet composed of 60 single pancakes whose inner diameter was 500 mm. The total conductor length was 10.3 km, and the total inductance was 12.4H. The size of the homogeneous magnetic field region was 200 mm diameter square volume (DSV). The central magnetic field was as high as 1.5 T at 192.7 A. The measured field homogeneity was 249.7 ppm because of the tolerances in the z-axis positions of the coils, and this was improved to 4.1pm by shimming. The field stability was improved from 2 ppm/h to 0.09 ppm/h by not only operating the magnet with current sweep reversal but controlling the coil temperature. Furthermore, the magnet was energized over 1.5 T, and the field homogeneity and stability were measured. This paper describes the experimental results of the field homogeneity and stability, not only when the magnetic field was changed but also when the coil temperature was changed.

Submitters Country

Japan

Primary author: Dr MIYAZAKI, Hiroshi (Toshiba Corporation)

Co-authors: ISHIYAMA, Atsushi (Waseda University); Dr FUKUYAMA, Hidenao (Kyoto University); UEDA, Hiroshi (Okayama University); IWAI, Sadanori (Toshiba Corporation); Mr URAYAMA, Shinichi (Kyoto University); Dr NOMURA, Shunji (Toshiba Corporation); NOGUCHI, So (Hokkaido University); Dr TOSAKA, Taizo (Toshiba Corporation); Mr UTO, Tatsuro (Toshiba Corporation); Dr KURUSU, Tsutomu (Toshiba Corporation); Mr OTANI, Yasumi (Toshiba Corporation); Mr KUBO, Yoichi (Toshiba Corporation)

Presenter: IWAI, Sadanori (Toshiba Corporation)

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