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Development of HTS bulk NMR relaxometry with ring-shaped iron rings

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The unique magnets for compact NMR relaxometry device consisted of the stacked high temperature superconducting (HTS) bulk annuli trapped by a field cooling (FC) method are suggested and studied. The magnetically charged HTS bulk magnet for NMR relaxometry device is cooled by liquid nitrogen and no more need a power supply. The strength and homogeneity of the magnetic field required for the NMR relaxometry device are 1.5 T and 150 ppm/cm respectively, these values are much lower than those of a conventional NMR device. The superconducting magnet (JASTEC, Inc.) wound with low temperature superconductors, and have a 100 mm room temperature bore size and 10 T was used in our experiments. The field homogeneity of our superconducting magnet is 610 ppm in the center region along the 10 mm axial direction. It is relatively easy to obtain a magnetic field of 1.5 T using suggested HTS bulk magnet at liquid nitrogen temperature. However, it is hard to obtain 150 ppm/cm field homogeneity using our superconducting magnet, and the field compensation methods are required. So, in this study, the passive field compensation method using the ring-shaped irons was studied, and the size and position of the iron rings were optimized to obtain the target field homogeneity by 3-D FEM based analysis. The obtained analytical and experimental field properties against the developed HTS bulk magnet with optimized iron rings and measured NMR signals using the fabricated NMR probe will be presented.

Submitters Country

Japan

Primary author: Prof. KIM, SeokBeom (Okayama University)

Co-authors: UEDA, Hiroshi (Okayama University); Mr FUKADA, Susumu (Okayama UNiversity); Mr NOMURA, Ryouta (Okayama University)

Presenter: Prof. KIM, SeokBeom (Okayama University)

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