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Thu-Af-Or23-02: Development and charging test of a compact 1 GHz (23.5 T)-class NMR magnet with Bi-2223 inner coils

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Abstract:
We have been developing a compact 1 GHz (23.5 T)-class LTS/HTS NMR magnet. There were two options of HTS inner coils, i.e. Bi-2223 or REBCO, and we decided to employ the Ni alloy-reinforced Bi-2223 conductors for the inner coils considering a smaller screening current-induced magnetic field of a Bi-2223 coil and its lower risk of unexpected degradation under high fields. The series-connected LTS/HTS coils are operated in a power supply-driven mode and designed to generate 1050 MHz (24.7 T) at 243 A. The total magnet size is very compact; it is comparable to that of a commercialized 600 MHz (14.1 T) NMR magnet and the total weight of the magnet is ˜90% lower than that of a previously developed 1020 MHz (24.0 T) NMR magnet [1]. This compactness is owing to a high current density operation of the Bi-2223 inner coils, which contributes as much as 53% of the total magnetic field. This design concept with a high field contribution ratio by HTS inner coils has also been employed for the designs of a 1.3 GHz (30.5 T) NMR magnet [2].
We finalized the magnet design based on research and development including (i) Bi-2223 joint resistance in external magnetic field, (ii) tensile stress tolerances of the Bi-2223 conductor under bending condition, (iii) high compressive stress on Bi-2223 coils and (iv) effect of screening current-induced magnetic field on the field homogeneity and stability. In 2019, we will make a magnet charging test, stabilization and shimming for the magnetic field, and various NMR measurements including those for solid-state samples.
[1] Hashi et al, J. Mag. Res. 256 (2015) 30-33
[2] Maeda et al, submitted to IEEE TAS

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