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Thu-Af-Or23-01: Construction and Test Results of a Cryogen-Free 23.5-T REBCO Magnet Prototype towards a Tabletop 1-GHz Microcoil NMR Magnet

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We are developing a tabletop 1-GHz microcoil nuclear magnetic resonance (NMR) spectrometer of compact, low-cost, and small-footprint features while having better peak resolution and sensitivity than conventional lower field NMR spectrometers, enabled by the high-temperature superconducting (HTS) REBCO no-insulation (NI) magnet. In this paper we present construction and test results of a cryogen-free 23.5-T REBCO magnet prototype operated at 10 K. This prototype aims to validate the conductor performance, coil design parameters, and a conduction-cooling towards a subsequent full-scale tabletop 1-GHz microcoil NMR magnet. This magnet prototype is a stack of NI pancake coils each wound with 128-m long REBCO conductor: the middle 10 coils adopt 6-mm width; and the end 2 coils adopt 8-mm width. A 0.2-mm thick copper sheet, inserted between pancake coils and thermally linked to an 8W@10K cryocooler, maintains a uniform temperature throughout the magnet. This paper includes: 1) winding and joint procedure; 2) individual pancake coil test results at 77 K in liquid nitrogen; 3) magnet assembly procedure with a conduction-cooled cryogenic system; and 4) charging and operating test results at 10 K. The paper concludes with a summary of enabling features validated by this prototype and discussion of additional issues to be further investigated and resolved towards a 1-GHz microcoil NMR magnet.

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