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Development of a REBCO innermost coil for a persistent 400 MHz (9.39 T) LTS/REBCO NMR magnet

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We are starting the development of a persistent 400 MHz (9.39 T) LTS/REBCO NMR magnet as a first step towards a 1.3 GHz (30.5 T) LTS/HTS NMR. The 400 MHz magnet consists of a layer-wound REBCO innermost coil and an LTS outer coil which are operated in individual persistent circuits. The system requires the following technical developments; (a) a REBCO-REBCO superconducting joint, located above the REBCO coil, with a current capacity of >130 A at 4 K in a field of <1 T, (b) a reasonably fast 4 K REBCO persistent current switch (PCS), operated below a heat input of <10 Wand (c) the design and fabrication of the REBCO innermost coil. We measured the transport properties of a new REBCO-REBCO superconducting joint [1], at 77 K and 4 K. The lift factor of the critical current from 77 K to 4 K and n-index at 4 K were 6.6 and 60, respectively. The assumed resistance based on the power-law V-I characteristics is much lower than the permissible resistance estimated from the required field decay rate of a NMR magnet. We developed a 4 K PCS with a resistance of 7 mΩ at 5 W and on/off times of <5 s and ˜50 s, respectively. The performance of the PCS fulfills the operation requirement of the present magnet. The major challenge in the fabrication of the REBCO innermost coil is to avoid degradation of the performance of the terminal conductors connected to the PCS terminals since the REBCO conductor is easily degraded by handling and electromagnetic forces. We will present the results of persistent operations at 77 K and 4.2 K.
[1] T. Nagaishi et al., Presented at 1st Asian ICMC and CSSJ 50th Anniversary Conference, 3A-p02, Kanazawa, Nov.7-10 (2016)
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