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Magnetic Field Stability Improvement of HTS-MRI Magnet under Power Supply Driven Operation with a Micro Current Trimming Control

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There are two major problems for introducing HTS-MRI magnets. One is a long-lasting attenuation of screening current induced on the superconducting tapes at the initial excitation. The screening current affects the MRI field stability both temporally and spatially. Another is that it is by now difficult to realize a superconducting junction of REBCO tapes and a superconducting switch for the persistent current operation of MRI magnet. One of our solution is to use a power supply driven MRI-magnet system instead of the persistent current operation. Our goal is to reduce the current fluctuation of the power supply and to compensate the magnetic field deviation due to the screening current by a proper current control of the power supply. It was reported that the magnetic field deviation was reduced to a certain extent by an over-shoot excitation method (the magnet is once over-excited through the target current and then discharged to the target to eliminate the screening current). In this paper, to improve the field stability more, a micro current control function is designed. The power supply current is controlled through a major control loop based on the magnet current sensor, and at the same time, it is trimmed with range of μA through a minor control loop based on the magnetic field sensor (NMR probe) of MRI magnet. We carried out the magnetic field stability experiment with 32-H HTS-MRI magnet excited by the highly stabilized power supply equipped with the designed micro current control. The MRI magnet was excited to the target current 66 A (1.5T) without the overshooting method, and then kept 66 A constant through the major current control loop and the magnetic field stability was trimmed through the minor micro current control loop down to 0.7ppm/hr, while it was 6 ppm/hr without the micro current control.

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