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Wed-Af-Or13-01 [Invited]: Ac loss and shielding-current-induced field in a coated-conductor test magnet for accelerator applications under repeated excitations

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Ac losses and shielding currents affecting field qualities in coated conductors are concerns in accelerator magnets which must be excited repeatedly. We carried out repeated excitation experiments of a test magnet for accelerator applications of coated conductors. The magnet consists of a pair of 4-stacked racetrack coils with iron return yoke at low temperature region. It can generate 2.4 T of dipole magnetic field at its room temperature beam duct with its rated current of 200 A, and the maximum magnetic field to which the coated conductor is exposed is about 4 T.
At first, we controlled the coil temperature at 18 K, and, then, the magnet was excited repeatedly using a bipolar power supply with a saw-tooth waveform: the magnetic field was ramped up to 4 T at the conductor in 120 s and down to 0 T in 120 s. The excitation time was limited by the output voltage of the power supply. During seven times of ramping up and down, the coil temperature was controlled stably at 18 K. We successfully ramped up in 40 s once using another power supply, whose output voltage is higher but not bipolar. Next, we examined the influence of shielding current on the field quality at the steps during ramping down, where the current was hold constant. Such steps, at which constant and reproducible magnetic fields must be generated, are required in magnets for carbon gantries. In the initial 3 s of an entire step whose duration is 10 s, some field change caused by the decay of the shield current was observed, but, in the last 7 s, the relative field change was less than 0.01%. The difference between the repeated excitation was less than 0.01% as well. These values are good enough for the applications to carbon gantries.

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