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Mon-Af-Po1.22-12 [109]: Analytical and Experimental Study of Multiphysics on Starting of a 50 kW Class Fully HTS Induction/Synchronous Motor and Its Variable Speed Controllability

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Our group has been developing a High Temperature Superconducting Induction/Synchronous Motor (HTS-ISM) for highly efficient transportation equipment. So far, the 20 kW class prototype, which consists of BSCCO rotor and copper stator, has already been developed and shown its excellent characteristics based on experiment and analysis. Furthermore, the 50 kW class model, in which both the rotor and the stator are made of BSCCO superconducting tapes, has been fabricated, and various characteristics have been evaluated.
In order to realize a practical HTS-ISM drive system, not only the HTS-ISM but also peripheral devices such as an inverter and a refrigerator must be investigated. Furthermore, the cooling characteristics during drive condition is really important.
In this paper, we have developed a multidisciplinary analysis method which couples the nonlinear voltage equation, the motion equation and the thermal equivalent circuit. We performed a multidisciplinary analysis for starting and variable speed controllability of a 50 kW class fully HTS-ISM. We consider the standby mode temperature (stationary mode) at 110 K and drive temperature (operation mode) at 80 K. We showed that the nonlinear resistance of HTS stator winding should be considered in the voltage equation to express exact performance of the HTS-ISM. We also clarified there exists optimal waiting time before motor operation when the cryocooler is in higher temperature stand-by mode. These results would be very important for the achievement of highly efficient HTS-ISM system for transportation equipment.

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