

## APP2-1

### Novel Performance for WLTC Operation Mode of 50kW Fully Superconducting Motor Drive System

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Our group has been developing a high temperature superconducting motor, which has been expected for the applications of next-generation transportation equipment, e.g., train, bus, etc. Our motor is so-called High Temperature Superconducting Induction/Synchronous Motor (HTS-ISM). 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 experiments and analysis. Furthermore, the 50 kW class HTS-ISM prototype, 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, it is really important to study the cooling characteristics during drive conditions.

In this paper, we developed a multidisciplinary analysis method which combines the nonlinear voltage equation, the motion equation and the thermal equivalent circuit. Then, we carried out the so-called World-wide harmonized Light duty driving Test Cycle (WLTC) rotation test for the 50 kW class fully HTS-ISM. The WLTC is a newly adopted global harmonized driving test cycle which is used to measure the fuel consumption and CO<sub>2</sub> emissions. It was shown that the nonlinear resistance of HTS stator winding should be considered in the voltage equation to express the exact performance of the HTS-ISM. It was also clarified that the heat generation of the motor is absorbed into the heat capacity of the motor body after the temperature of the rotor bar as well as the stator coil rise instantaneously, due to the large starting current. Furthermore, we successfully calculated the electric power consumption of the 50 kW class drive system and showed that our system possesses high efficiency even we consider the power consumption of cryocooler.

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