**INTRODUCTION**

High Temperature Superconducting Induction/Synchronous Motor (HTS-ISM)

For next generation transportation equipment, e.g., train, bus, etc.

**Structure**

HTS-ISM has the same structure as squirrel-cage induction motor, but its rotor bars and end rings are replaced with high temperature superconducting (HTS) tapes.

**Advantages**

- High efficiency
- High torque density
- Coexistence of synchronous as well as slip rotation mode and so on.

**50 kW FULLY HTS-ISM**

**Fully HTS-ISM**

In order to improve the efficiency, stator windings are also fabricated by HTS tapes.

**Fabricated 50 kW class fully HTS-ISM**

We fabricated the 50 kW class fully HTS-ISM prototype.

**AC loss of HTS stator windings**

Power losses of HTS stator:
- AC loss of HTS windings
- Iron loss of the core

We evaluated AC losses of the HTS stator windings of the 50 kW fully HTS-ISM.

\[ P_{A_{\text{loss}}} = 24.69 \times 10^{-5} \times f^{1.25} \mu \text{W} \]

**RESULTS AND DISCUSSION**

**Load test**

World first success of 39 kW output (at 1500 rpm) for fully superconducting motor

**WLTC rotation test (multidisciplinary analysis)**

WLTC is a newly adopted global harmonized driving test cycle for measuring fuel consumption and CO₂ emission.

**WLTC test of 50 kW fully HTS-ISM**

The test was successfully carried out with developed multidisciplinary analysis method.

**Multidisciplinary analysis code**

- Electric consumption (km/kWh) was calculated: 10.7 km/kWh
- Our drive system possesses high efficiency even if considering power consumption of cryocooler

(More study is necessary)

**CONCLUSION**

- We developed multidisciplinary analysis method which combines nonlinear voltage equations, equation of motion and thermal equivalent circuit for 50 kW class fully HTS-ISM.
- The maximum output reached 39 kW at 1500 rpm in load test (World first success).
- WLTC rotation test was carried out with developed multidisciplinary analysis method, and transient rotation and cooling characteristics were investigated.

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