Cooling and ac-losses in the superconducting super motor

Saleh, Muhamnad, and Minaru, Kawamura

Corresponding Author:
Minaru Kawamura, minaru@ee.ous.ac.jp, Okayama University of Science, Japan

We have been developing a new type of superconducting synchronous rotating machine to achieve very high power-to-weight ratio over jet engines while reducing ac-losses sufficiently.[1] This machine, we call superconducting super motor/generator, whose self-inductions in the armature are cancelled out with iron ring cores, which enables naturally elimination of ac-losses owning to self-magnetic flux. In this work, we demonstrate that the other ac-losses due to alternating external magnetic field caused by rotating permanent magnets also can be reduced significantly by wounding 2G-HTS wires placed between permanent magnet and iron ring core, as their surfaces are perpendicular to the cores. The ac-losses in a prototype with 2G-HTS wire 50 meters in total length are measured by a thermal and a mechanical method. The results shows that the ac-losses are reduced to an eighth or less of ac-losses in wounding parallel to the cores. While the extent of the reduction of the ac-losses ensures development of the practical machine, we are analyzing further the remaining ac-losses in detail and developing a passive or an active method to eliminate them to the utmost limit to allow cooling with a compact cryocooler.

[1] M. Kawamura and J. A. Jones, “Superconducting Super Motor”, IEEE trans. appl. supercond., vol. 27 (2017)