Operating characteristics of a superconducting rotating machine using no-insulation type HTS rotor magnet

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The development and introduction of an HTS rotating machine has recently been attracting related researches. The HTS technologies make it possible to design a larger capacity rotating machine compared to conventional rotating machine.

An HTS rotor magnet is a core part of the HTS rotating machine. General HTS rotating machines were designed using an electrically insulated HTS rotor magnet. But, these machines have lower electrical and mechanical stability compared to the conventional rotating machine. This problem is more serious in a large-capacity rotating machine.

A no-insulation type HTS rotor magnet is one of the solutions for these problems of the HTS rotating machine. HTS rotor magnet of the HTS rotating machine is operated by a DC energy source. Thus, the conductor resistance of the HTS rotor magnet is zero and the normal operation of the no-insulation type HTS rotor magnet is available. The no-insulation type HTS rotor magnet is considered a new and innovative concept for DC application due to its many benefits as compared with existing HTS rotor magnet. It is possible to make thermally and mechanically robust HTS rotor magnets by removing the insulation layers.

This paper reports on the design and performance analysis of the no-insulation type HTS rotor magnet. The no-insulation type HTS rotor magnet consists of 4 double pancake type racetrack coils (DPC) generating 2-pole magnetic field. The no-insulation type rotor magnet was made of 2G HTS GdBCO wire. The stator for test of the no-insulation type HTS rotor magnet has 3-phase armature windings, and a 24-slot copper conductor. The no-insulation type HTS rotor magnet was designed. Charge-discharge and over-current operating characteristics were tested on the designed rotor magnet. Based on the rotor magnet experiment data, the no-insulation type magnet-based HTS rotating machine was fabricated. The output waveform and generating power of the fabricated HTS rotating machine were examined.

The no-insulation type HTS rotor magnet suggested in this paper was well operated. These fundamental data will usefully be applied to design a large scale HTS rotating machine.