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Thu-Mo-Po4.08-02 [54]: Performance analysis of a metal-insulation type lab-scale HTS wind power generator

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High Temperature Superconducting (HTS) generator for a large-scale wind power generation system draws much attention as a contemporary research item. Metal-Insulation (MI) technique greatly enhanced the thermal stability of the coil without requiring complicated protection against quenching because quench currents are bypassed through the turn-to-turn contacts, ultimately improving the mechanical integrity of the HTS pancake coil. However, there is still a question whether this technique can be applied to racetrack coils for HTS superconducting generator.

This paper deals with the performance analysis of a MI type lab-scale HTS wind power generator and examines application possibility of the MI type generator for wind turbines through hardware integration.

Total 6 double pancake coils considering MI such as stainless steel tape were fabricated. Therefore, a 5 kW class HTS generator consisted of 6 poles with MI type for the rotor. And, 36 slots copper windings for stator was designed and fabricated for the generator. The HTS coils were mounted in a vacuum vessel integrated into the rotor, and cooled down by thermosyphon cooling method with a cryogenic refrigerator.

Through the physical fabrication of the machine, we confirmed several important results as follows. The rated output power of the generator reached to 5 kW at 400 rpm, and the operating temperature was maintained at 30 K by the cooling method. The operating field current was 200 A at operating temperature. Charge-discharge and over-current tests of the MI type field coils were performed. The field coils were successfully charged with full field performance and discharged when the operating current was below its critical current value. In the case of the over-current test, the coils operated stably because the over-current was automatically diverted through the turn-to-turn contacts. The MI type coils showed enhanced thermal and electrical stabilities during over-current testing. The results will be utilized to practical design with better thermal and electrical stabilities for a large-scale HTS generator.

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