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Tue-Mo-Po2.11-01 [88]: Design and Analysis of an HTS Synchronous Motor with a Hybrid Magnets Rotor

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High-temperature superconducting (HTS) materials, including bulks and tape stacks, have shown high current-carrying and field-trapping capacity in previous studies, which makes them employed in the synchronous motors (SMs) as a substitute of permanent magnets (PMs). When used as rotor magnets, hybrid magnets (HMs) made of HTS tape stacks and PMs show remarkable advantages compared with bulks and pure tape stacks, such as magnetization convenience, low cost, and operation safety. In this work, an HTS synchronous motor with a hybrid magnets rotor is proposed. A full-scale sample of hybrid magnets rotor is fabricated first and tested at 77 K. According to the experimental results, a prototype of the hybrid magnet synchronous motor (HMSM) is designed and the performances of the motor is obtained using finite element method (FEM) and analytical calculation. The results show that the introduction of hybrid magnets could significantly enhance the power and torque density with a minimal consumption of HTS tapes at 30 K. Due to the aforementioned advantages of hybrid magnets, HMSM is superior in practicability, economy and safety compared with the existing HTS motors, especially used as propulsion systems on ships and aircrafts.

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