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Design and test of a 10 MJ hybrid high-temperature superconducting magnetic energy storage module

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The high-temperature superconducting magnetic energy storage device can realize the rapid support of the grid voltage and frequency, and has a good application prospect in the new energy grid. In order to reduce the leakage magnetic field of the energy storage magnet, the large superconducting energy storage magnet can adopt a toroidal magnet structure. At the same time, in order to improve the utilization rate of superconducting materials, different types of superconducting materials or the same type of superconducting materials with different parameters can also be used at different magnetic field positions. A 10 MJ superconducting energy storage magnet is presented, which operates in the 20 K temperature region and consists of a toroidal superconducting magnet structure composed of 16 D-type coils. A YBCO superconducting coil is used in the inner high-field area of a single D-type coil, and a low-cost MgB2 superconducting coil is used in the outer low-magnetic field. In order to reduce the inductance of the superconducting coil, both YBCO and MgB2 superconducting cable are used to make the superconducting coil with a maximum operating current of 1.6 kA and a maximum operating voltage of 10 kV. We have fabricated and tested one D-type coil with a maximum steady-state operating current of 1.6 kA and a maximum DC withstand voltage of 15 kV.

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