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Levitation force enhancement of a magnetic bearing using the stator of hybrid superconducting magnet

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Superconducting magnetic bearing (SMB) is a promising candidate for flywheel energy storage systems due to its great advantages of low friction loss, long-life operation, and maintenance-free. Since the amount of the SMB stored energy is strongly related to its levitation force, in this work, we have proposed a novel structure of hybrid superconducting stator which combines the HTS bulks and HTS coils, taking the advantages of strong trapped magnetic field and large size respectively, to increase the magnetic field and improve the levitation force accordingly. The structure of the hybrid superconducting stator is firstly presented, in which several HTS bulks are fixedly arranged inside an HTS coil. Then, a verified 2-D axisymmetric finite element model is adopted to estimate the magnetic field distribution as well as the levitation force of the proposed SMB. The results indicate that the levitation force could be greatly improved with the hybrid superconducting stator comparing to the traditional way. Its feasibility is furtherly examined by using the proposed hybrid structure to replace the original superconducting stator of a flywheel energy storage system with a capacity of 100 kWh developed in Japan.

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