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Performance Evaluation of a Novel Axial Flux Claw Pole Machine with Soft Magnetic Composite Cores

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By using the powder metallurgy technology and magnetic isotropy characteristic of the soft magnetic composite (SMC) material, various kinds of permanent magnet (PM) machine can be designed and fabricated easily. However, if the torque density of the PM machine with SMC cores is much lower than that with the silicon steels, if it is designed with the traditional structures and methods. In the designing of PM machine with SMC cores, some design guidelines should be followed, e.g. 3-D magnetic flux path and high operation frequency. In this work, a novel axial flux claw pole machine (AFCPM) with SMC core is proposed and its performance is comparative studied with the benchmark of a standard transverse flux machine (TFM) with SMC cores.
The structure of the AFCPM is very novelty, it has both merits of the axial flux machine and the claw pole machine, its operation principle is quite similar to that of the traditional claw pole machine however its main flux path is on the axial direction. Considering that the manufacturing cost of the AFCPM with SMC cores is very low, this work proposes two kinds of AFCPM, one is designed for high performance application which is with NdFeB magnets and another one is designed for the low cost application which is designed with ferrite magnets. For the performance calculation, the 3-D finite element method (FEM) is used. To evaluate the performance of these two AFCPMs, a TFM with SMC cores and NdFeB is used. It can be found that the AFCPM with the NdFeB can provide higher torque density, ration of torque to cost and efficiency than those of TFM with NdFeB. As for the low cost application, the AFCPM with ferrite magnet is a good choice.

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