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电工理论与新技术

超磁致伸缩材料内部磁场特别及材料参数对其影响分析

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摘要： 基于麦克斯韦方程和压磁理论建立了超磁致伸缩材料棒内的磁场分布模型，导出了含有材料磁弹性参数的超磁致伸缩材料棒磁场分布函数，讨论了材料特性参数对材料内部磁场和材料内部涡流损耗的影响。结果表明，材料内部磁场不仅与外激励磁场有关，而且与材料的压磁系数、杨氏模量及相对磁导率有关，同时材料内部磁场与外激励磁场间具有滞回特性；考虑材料特性参数时材料内部的涡流损耗达到最大值所需的材料半径，将大于不考虑材料特性参数时的半径值，同时涡流损耗的变化趋势也将变得和缓，而不论材料参数如何变化，超磁致伸缩棒内磁能损耗的基本规律没有发生变化。

关键词： 超磁致伸缩材料 内部磁场分布模型 开尔文-贝塞尔函数 材料特性参数

Inner Magnetic Field Characteristic of Giant Magnetostrictive Materials and Effects of the Materials Parameters on the Characteristic

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Abstract: The magnetic field distribution model in the giant magnetostrictive materials rod is build by means of Maxwell's equation combining with the piezomagetic theory. The magnetic field distribution function in the giant magnetostricive materials rod is derived. In the inner magnetic field distribution function, the magneto-electric characteristic parameters of the material are induced. The influence of the material characteristic parameters on the inner magnetic field distribution and eddy current loss of the material are discussed. The results indicate that the inner magnetic field of the material not only has relations with the external magnetic field but also with the material piezomagnetic coefficient, Young's modulus and the relative magnetic permeability. Meanwhile, the hysteresis characteristic exists between the inner magnetic field and the external magnetic field; the material radius when material inner eddy current loss under condition of considering the material characteristic parameters reaches its maximum will be larger than the material radius without considering the material characteristic parameters, and the change trend of the eddy current loss will also becomes moderate. No matter how the material magneto-electric parameters change, the basic law of the magnetic energy loss doesn't change in the giant magnetostrictive rod.

Keywords: giant magnetostrictive materials inner magnetic field distribution model Kelvin-Bessel function material characteristic parameters

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