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论文

粘结巨磁致伸缩颗粒复合材料的磁致伸缩性能及涡流损耗

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摘要:

采用模压成型、室温固化的粘结方法制备了各向同性的粘结TbDyFe巨磁致伸缩颗粒复合材料. 对其组织形貌、磁致伸缩性能、动态特性、涡流损耗特性和电阻率进行了测试和分析. 结果表明, TbDyFe合金颗粒尺寸为74-150 μm以及150-300 μm时, 树脂与颗粒结合相对紧密, 浸润性良好; 而颗粒尺寸为0-74 μm时, 出现明显的不良浸润和颗粒团聚现象. TbDyFe合金的颗粒尺寸和质量分数对材料的磁致伸缩性能影响较大, TbDyFe合金颗粒尺寸为74-150 μm, 质量分数为90%时, 该复合材料磁致伸缩率在400 kA/m磁场下可达723.0×10^{-6}. 相比于取向生长的TbDyFe合金, 粘结巨磁致伸缩颗粒复合材料的电阻率提高了5个数量级, 在32.7 mT偏置磁场下声速降低1/3以上, 涡流损耗因子在2×10^{5} Hz条件下的降幅超过90%, 在1×10^{7} Hz的高频条件下仍可降低近50%.

关键词: TbDyFe合金 磁致伸缩 涡流损耗

MAGNETOSTRICTION AND EDDY CURRENT LOSS OF BONDED GIANT MAGNETOSTRICTIVE PARTICLE COMPOSITES

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Abstract:

Rare–earth–iron alloy TbDyFe is an advanced magnetostrictive material to date because of its giant magnetostriction, high energy density, and rapid response at room temperature and low magnetic field. Due to the high sound velocity and eddy current losses of TbDyFe alloy under high frequency, its applications are limited. The bonded giant magnetostrictive materials are expected to exhibit high resistivity to reduce the eddy current loss. In the present study, the bonded giant magnetostrictive materials were prepared by mixing TbDyFe alloy particles with epoxy resin. The electrical resistivity, impedance and eddy current losses of the bonded materials have been primarily analyzed. The optimized magnetostriction is observed to be 723.0×10^{-6} at magnetic field of 400 kA/m in the bonded material witparticle mass fraction of 90% and particle size of 74—150 μm. TbDyFe particle size and mass fraction show a significant influence on the magnetostriction of the bonded mateials. Compared to the advanced oriented TbDyFe allo, the electrical resistivity is 5 orders of magnitude greater, and the sound velocity is 1/3 lower under the applied magnetic field of 32.7 mT, ad the eddy current loss factor is reduced by 90% at 2×10^{5} Hz, and by nearly 50% at 1×1^{7} Hz.

Keywords: TbDyFe alloy magnetostriction eddy current loss

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