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微纳技术与精密机械

含金属芯压电纤维的测试标准与夹具设计

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摘要： 针对新型压电器件—含金属芯压电纤维（MPF）—结构尺寸细小，很难找到合适的测量夹具和测试方法等问题，提出了一种操作方便的MPF测试方法。首先，通过MPF的压电方程得到其测试模型，并确定了MPF的电学性能测试步骤。然后，研究了测量夹具对测量结果的影响。实验显示：夹持位置在MPF的中间时容易产生偏离，影响测量结果；夹持位置在端部时，谐振频率和反谐振频率的相对导纳值较小，也不利于准确测量。另外，MPF尺寸细小，夹持力也会影响MPF的谐振，使测量结果产生误差。最后，提出一种不需要夹持测量MPF的方法。采用该方法对PZN-PZT压电陶瓷的MPF进行了测量，结果显示其压电应变常数d31为-97 pC/N，机电耦合系数k31为0.197，介电常数εT33为1 458。这种方法测试准确，操作简单，不易损伤MPF，可作为MPF压电性能测试标准。

关键词： 金属芯压电陶瓷纤维 压电陶瓷 夹具设计 谐振 测试标准 电学性能

Test standards and design fixtures for piezoelectric ceramic fibers with Pt core

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Abstract: As Metal-core Piezoelectric Ceramic Fibers (MPFs), one types of the new piezoelectric devices, have smaller structrures and sizes, it is difficult to find proper mesurement method and corresponding measuring fixture. Therefore, this paper proposed a precise and easily operated method to measure the MPFs. First, the test model was deduced by using the constitutive equations of a MPF, and the measuring steps for electrical performance of the MPF were established. Then, the effect of test fixture on the measurement results was investigated. Experiments show that it is easy to produce deviation when the clamping positions in the middle of the MPF, which can influence the measurement results . When the clamping position is at the end of the MPF, the relative admittance values of resonance and anti-resonance frequency are smaller, which is hard to be measured either. Furthermore, an improper clamping pressure have a strong effect on the measured value due to the smaller size of MPF. Finally, a measurement method without clamping for the MPF was presented. By the proposed methd, the PZN-PZT MPFs were measured, obtained results give the piezoelectric property values by piezoelectric strain d31 of -97pC/N, electromechanical coupling coefficients k31 of 0.197, and dielectric constant ε33T of 1 458. This kind of method is accurate, simple operation, and not damage to MPFs, and can be used as a test standard for MPFs.

Keywords: Metal-core Piezoelectric Fiber(MPFs) PZT fixture design resonance test stardard electrical properties

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