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微纳技术与精密机械

磁力弹簧式压电共振型气泵的设计

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摘要： 利用压电振子的振动激励相连接的隔膜共振原理,提出了用磁力弹簧式压电共振型气泵来提高压电泵对气体的驱动能力。首先,分析磁力弹簧式共振泵的工作原理,建立了共振泵的动力学模型,计算得出了影响隔膜振幅的主要因素。接着,设计和制作了样机,使用阻抗分析仪和激光位移计分别测得系统的共振频率及压电振子的位移放大倍数。最后,设计了测量共振泵流量和输出压力的实验装置,得出了磁力弹簧轴向间距对输出流量和输出压力的影响。实验测试表明:当输入正弦电压为200 V,系统共振频率为134 Hz,磁力弹簧的轴向间距为9 mm时,压电振子的位移放大倍数约为4.3,其最佳输出流量为524 ml/min,最佳输出压力为9.2 kPa。结果显示,提出的磁力弹簧式压电共振型气泵提高了气体的输送能力。

关键词： 磁力弹簧 共振泵 气泵 压电振子

Structure design of piezoelectric resonant air pump with magnetic spring

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Abstract: On the basis of principles of vibrating piezoelectric vibrators to syntonize the connected diaphragms, a piezoelectric resonant air pump with a magnetic spring was proposed to improve the driving ability of the piezoelectric pump for gas moving. First, the working principle of the piezoelectric resonant air pump with magnetic spring was analysed, a dynamic model of the pump resonance was established and the main factors effecting the membrane amplitude were obtained .Then, a prototype was designed and the resonance frequency of the system and the displacement magnification of the piezoelectric vibrator were measured by an impedance analyzer and a photovoltaic displacement sensor, respectively. Finally, a testing facility to measure the volume and output pressure of the resonance pump was developed and the effects of the axial distance of magnetic spring on the output volume and pressure were analyzed. Experimental results indicate that the amplification factor is 4.5 when the sinusoidal AC driving voltage, resonant frequency and the magnetic force of the axial spacing of the magnetic spring are 200 V, 133 Hz and 9 mm,respectively. Moreover, the maximum flow rate is 524 ml/min and the maximum pressure is 9.2 kPa. Results demonstrate that the gas transportation capacity has been improved by using the proposed piezoelectric resonant air pump.

Keywords: magnetic spring resonance pump air pump piezoelectric vibrator

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