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微纳技术与精密机械

不完整球形超导转子静平衡的气浮测量

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摘要: 提出了一种控制转子不平衡方位的气浮平衡测定方法来提高对空心薄壁不完整球形超导转子平衡量测定的精度。采用在转子内部增加重量的方法来改变转子的不平衡量大小,使得该转子的不平衡量的方位角处于精确测量范围内,当增量变化时其测量值也会发生相应的变化,通过静不平衡计算的相关公式即可得出其静不平衡量。该方法能够提高这种超导球形转子平衡测定的精度,不破坏转子的加工精度,不影响转子的电磁特性、超导特性等。测量转子偏心距的波动大小在 $\pm 6 \mu\text{m}$ 之内,偏心距Z轴分量的波动在 $\pm 8 \mu\text{m}$ 之内,同时可有效提高超导重力计等基于该类型超导转子的仪器的工作性能和测量精度,对于其它无机械支撑轴转子的平衡测定也有一定借鉴意义。测量过程中采用的设备简单,实验周期短,测量结果精度较高。

关键词: 静平衡测量 超导转子 不完整球形转子 气浮法

Measurement of static balance for incomplete spherical superconducting rotor with compressed air

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Abstract: A flotation method involving the control of the unbalance orientation of a rotor is put forward to improve the measurement precision of mass imbalance of an incomplete spherical superconducting rotor. By adding additional weights within the rotor to change its quantity of the mass unbalance, this method limits the azimuth of the mass unbalance to an accurate measurable range. As the additional weights change, the observed values change simultaneously, and the mass unbalance can be derived by a relevant formula. This method can improve the measured precision without any damage to the rotor or influence on its electromagnetic and superconducting properties. The fluctuation of the measured offset is within $\pm 6 \mu\text{m}$, and its Z-axis component is within $\pm 8 \mu\text{m}$. Moreover, it can improve the working performance of some types of the devices based on the rotor greatly, and can offer some references for other balanced measurements of the machines without mechanical support for its rotor. The measurement equipment of this method is simple, precise, and its experimental period is short.

Keywords: static balance measurement superconducting rotor incomplete spherical rotor flotation method

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