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微纳技术与精密机械

非球面超精密机床静压轴承温度场的分布

夏毅敏[1], 张刚强[1], 罗松保[2], 张建明[2]

1. 中南大学 高性能复杂制造国家重点实验室,湖南 长沙,410083;
2. 北京航空精密机械研究所 航空科技重点实验室,北京 100076

摘要： 利用ANSYS CFX流体力学分析软件建立了不同油膜厚度下的液体静压轴承流体模型,研究了非球面超精密加工机床液体静压推力轴承的温度场分布。对静压推力轴承进行了试验研究,获得了工作台上不加负载、加300 kg负载、加500 kg负载3种情况下主轴性能各参数。仿真结果表明：油腔区域初始温度为20 ℃,从封油边开始温度逐渐升高,其中外侧的温度要比内侧温度稍高；当油膜厚度为33 μm时,最高温度为20.29 ℃,当油膜厚度为23 μm时,最高温度为21.72 ℃,油膜厚度越薄,温度越高。试验计算值与仿真值分别相差3.33%、8.33%、1.32%,证实了液体静压推力轴承设计和数值计算的正确性。

关键词： 非球面超精密机床　液体静压轴承　油膜　温度场　数值模拟

Temperature field distribution of non-spherical hydrostatic bearings for ultra-precision machine tools

XIA Yi-min[1], ZHANG Gang-qiang[1], LUO Song-bao[2], ZHANG Jian-ming[2]

1. State Key Laboratory of High-performance Complex Manufacturing, Central South University, Changsha 410083, China;
2. State Key Laboratory of Ultra-precision Machining Technology, China Precision Engineering Institute for Aircraft Industry,Beijing 100076,China

Abstract: A series numerical models were conducted by using the computational fluid dynamic software ANSYS CFX to research the internal temperature distribution of the hydrostatic thrust bearings of aspherical ultra-precision machine tools.An experiment was performed on the hydrostatic bearings and the spindle performance parameters of the worktable were obtained in 0,300,500 kg loads,respectively.The results show that the initial temperature of the oil lumen area is 20 ℃,the temperature arises from resistive oil edges towards,and the lateral temperature is higher than that of the medial.The respective highest temperature is 20.29 ℃ or 21.72 ℃ with a lubricant film thickness of 33 μm or 23 μm, and the thinner the oil film is,the higher the temperature is. The difference of the simulation and the tests are 3.33%,8.33%,1.32%, respectively,which proves the validity of design and simulation methods for hydrostatic thrust bearings.

Keywords: non-spherical ultra-precision machine　hydrostatic thrust bearing　oil film　temperature field　numerical simulation

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