

胶层厚度对三点支撑反射镜面形的影响

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Influence of adhesive thickness on surface deformation of mirror supported by three-point mount

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摘要

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摘要 以45 nm浸没式光刻物镜中采用的三点支撑反射镜为研究对象,建立了胶层连接的三点边缘支撑结构模型,用以确定胶层厚度对三点支撑反射镜面形变化的影响。分析了重力作用下三点支撑反射镜的面形变化情况,通过解析表达式描述了胶层厚度对反射镜受力变形的影响。建立了“支撑块-胶层-反射镜”的有限元计算模型,针对不同胶层厚度对反射镜的面形变化进行了仿真分析。仿真结果表明:随着胶层厚度的增大,反射镜的面形变化(均方根值RMS)呈现先减小后增大的趋势;当胶层厚度为280 μm 时,反射镜面形变化的RMS值最小,约为1.25 nm。最后,通过实验测量了柔性双脚架三点边缘支撑导致的反射镜面形变化。结果显示:当胶层厚度为200,280,400 μm 时,反射镜面形的变化结果均与仿真结果一致,验证了本文仿真结果的正确性。

关键词 : 光机系统, 反射镜, 三点支撑, 表面面形, 胶层, 有限元模型

Abstract : By taking the mirror supported by a three-point mount used in a 45 nm immersed lithographic objective lens for a research object, a support structure model with the three-point mount by adhesive connection was established to determine the influence of adhesive thickness on surface deformation of the mirror supported by the three-point mount. The mirror surface deformation distribution due to gravity was analyzed, and the effect of different adhesive thicknesses on surface deformation was discussed through analytical expressions. Then, a finite element model of "block-layer-mirror" was established. The deformation of mirror surface was simulated for different adhesive thicknesses. The simulation results show that the Root Mean Square(RMS) values of mirror surface deformation first decrease and then increase with the increasing adhesive thickness, and it reaches a minimum of 1.25 nm when the adhesive thickness is about 280 μm . Finally, surface deformation changes of the mirror caused by the three-point support were tested through an experiment while adhesive thicknesses were 200 μm , 280 μm and 400 μm . Experiment results show that surface deformation of the mirror is in agreement with simulation result, which verifies the validity of simulation results.

Key words : opto-mechanical system mirror three-point mount surface deformation adhesive Finite Element Model(FEM)

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