光学 精密工程
OPTICS AND PRECISION ENGINEERING
Ei 核心期刊
主管：中国科学院
主办：中国科学院长春光学精密机械与物理研究所
中国仪器仪表学会
主编：曹健林

光学精密工程 2012, (8) 1718-1724 ISSN: 1004-924X CN: 22-1198/TH

现代应用光学

Φ510 mm SiC超轻量化反射镜的设计与有限元分析

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摘要： 针对Φ510 mmSiC超轻量化反射镜的研制,提出了一剖面为船型、内部为正三角形、面板加密呈正六边形的轻量化结构。当设计重量为1.85 kg时,通过调整各个结构参数与另外两种相同重量的轻量化结构进行了比较。结果表明,在同样背部6点支撑作用下,该超轻量化结构在光轴指向天顶时由自重引起的面形(RMS)具有较大优势。利用Patran\Nastran有限元软件模拟计算了该超轻量化反射镜在光轴水平状态下的自重镜面变形,并对其进行了热力学及动力学特性分析。分析结果显示,该超轻量化反射镜各项指标均能满足使用要求。最终,根据设计结果试制加工了一块镜坯.初步加工后的重量约为2.2 kg.面密度约为10.8 kg/m^2.已达到目前SiC超轻量化反射镜的先进水平。

关键词： 超轻量化反射镜 碳化硅反射镜 反应烧结 Patran\Nastran

Design and finite element analysis of Φ510 mm SiC ultra-lightweight mirror

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Abstract: To develop a Φ510 mm SiC ultra-lightweight mirror, this paper proposes an ultra-lightweight structure with a section in ship form, an internal structure in regular-triangle, and a face plate reinforced with regular-hexagon. When the design weight is 1.85 kg, the structure performance is compared with those of other two lightweight structures with the same weight by adjusting all structure parameters. It is shown that in the same 6 point supportings on mirror backs, this ultra-lightweight structure owns absolute advantages in the gravitational deformation of mirror surface (RMS) as comparing with other two structures when the optical axis is pointed to the zenith. Furthermore, Patran\Nastran finite element software is used to simulate and calculate the gravitational deformation of the mirror surface when the axis is pointed to the horizon, and its thermodynamic and dynamical characteristics are analyzed. The results present that all performance indexes of this ultra-lightweight mirror meet requirements of applications. Finally, according to the design, a mirror blank with a weight about 2.2 kg and surface density about 10.8 kg/m^2 is fabricated. With excellent performance, it has been up to the today's advanced level in the SiC ultra-lightweight mirror field.

Keywords: ultra-lightweight mirror SiC mirror reaction bonding Patran\Nastran

收稿日期 2012-02-16 修回日期 2012-03-23 网络版发布日期

基金项目:

中国科学院光电技术研究所前沿部署项目(No.C09K007)

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