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现代应用光学

使用优化的固着磨料磨盘全口径加工碳化硅反射镜

王旭

中国科学院 长春光学精密机械与物理研究所 中国科学院光学 系统先进制造技术重点实验室, 吉林 长春 130033

摘要: 为提高碳化硅非球面反射镜的加工质量,对加工中涉及的固着磨料工艺去除函数进行了研究。在早期的实验中测试了圆形丸片的去除函数,引入填充因子的概念来评价实验所获得的去除函数,定量获得了丸片结构与填充因子之间的关系。为了提高填充因子和磨盘的加工特性,根据圆形丸片的实验结果优化了磨头的结构并基于Matlab软件模拟了新型磨头的去除函数。在全口径范围考察了磨头工作的稳定性,并在相同加工参数条件下完成了固着磨料和散粒磨料的加工实验。为了对理论模拟和实验结果进行比较,引入结构相似度指数的概念来评价全口径反射镜去除量模拟结果与实验结果之间的相似程度。结果显示,实验得到的结构相似度指数达到了0.425 7,证明优化后的固着磨料磨头在大口径碳化硅反射镜加工方面极有应用前景。

关键词: 光学加工 碳化硅 非球面反射镜 固着磨料 丸片 填充因子 结构相似度指数

Fabrication of SiC mirror in full aperture with optimized fixed abrasive polishing pad

WANG Xu

Key Laboratory of Optical System Advanced Manufacturing Technology, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China

Abstract: To improve the fabricating quality of a SiC aspheric mirror, this paper researched the removal function in fixed abrasive technology involved in the mirror fabrication. The removal function was tested in the earlier round-pellet polishing pad, then a filling factor was introduced to evaluate the removal function obtained from the experiments and the relation between round-pellet pad structure and filling factor was established. To improve the filling factor and the characteristic of polishing pad, the pad structure was optimized according to the experimental results of the round-pellet pad. The removal function of the new polishing pad was simulated by MATLAB. A stability experiment in the full aperture was performed, and the both fixed abrasive and slurry abrasive polishing experiments were conducted under the same fabricating conditions. Finally, the Structural Similarity Index (SSI) was introduced to evaluate the similarity between simulations and experiments for the removal of large aperture mirror, and the best SSI of multi-square-pellet pad is 0.425 7. The comparison results are acceptable and positive, which shows that the optimized fixed abrasive polishing pad is highly promising for fabrication of large aperture SiC mirrors.

Keywords: Optical polishing SiC aspherical reflector pellet fixed abrasive filling factor structural similarity index

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通讯作者: 王旭, E-mail: wangxu-308@163.com

作者简介: 王旭(1982-),男,辽宁沈阳人,博士,助理研究员,主要从事光学精密加工与检测方面的研究。E-mail: wangxu-308@163.com

作者Email: wangxu-308@163.com

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