光学 精密工程
OPTICS AND PRECISION ENGINEERING
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 2013, 21(6) 1380-1386 ISSN: 1004-924X CN: 22-1198/TH

现代应用光学

极紫外Mg/SiC、Mg/Co多层膜的稳定性

朱京涛,宋竹青,丁涛,马爽,李浩川

同济大学 物理科学与工程学院 精密光学工程技术研究所

摘要： 采用磁控溅射法在Si(100)基底上镀制了膜系结构分别为$[Mg/Co]_{20}$、$[Mg/SiC]_{20}$的两组多层膜，以研究Mg基多层膜的稳定性。对放置在室温和80%相对湿度环境下的样品进行显微镜、表面粗糙度和X射线掠入射反射率测试，对比研究了Mg/Co和Mg/SiC两种多层膜结构在相同环境中的损坏状况。对比结果显示：放置4天后，Mg/SiC损坏面积为26.34%，表面粗糙度为10 nm；Mg/Co的损坏面积为2.78%，表面粗糙度为5 nm。6天后，X射线掠入射反射率测量显示Mg/SiC多层膜一级反射峰完全消失，而Mg/Co多层膜的一级反射峰仍有47.63%的反射率。实验表明，Mg/Co多层膜的表面层和内部多层膜结构的损坏速度较Mg/SiC慢，具有较好的环境稳定性。另外，X射线光电子谱（XPS）测试Mg基多层膜损坏后的产物主要为$MgCO_3$、$Mg(OH)_2$和少量的MgO，且内层$Mg(OH)_2$与$MgCO_3$含量的比值显著高于表面层。分析认为，水汽是造成Mg基多层膜损坏的主要原因，今后Mg基多层膜保护层的研究可主要针对如何防止水汽进入膜层。

关键词： 极紫外多层膜 多层膜反射镜 稳定性 湿度

Stability of Mg/SiC, Mg/Co EUV multilayers

ZHU Jing-tao,SONG Zhu-qing,DING Tao,MA Shuang,LI Jie-chuan

Institute of Precision and Optical Engineering, School of Physics Science and Engineering, Tongji University

Abstract: To research the stability of Mg-based multilayers,two groups of multilayers, [Mg/Co]20 and $[Mg/SiC]_{20}$ were coated on a Si(100) substrate by magnetron sputtering method. The two samples were tested by a microscopy, a surface roughness experiment and an X-ray grazing incidence reflectivity test at room temperature and a relative humidity of 80%.The contract experiments on multilayer damage for Mg/Co和Mg/SiC were performed in the same condition. The results show that after being exposed in the atmospheric environment for 4 days, the damaged area and surface roughness of the Mg/SiC multilayer sample are up to 26.34% and 10 nm, respectively, while those of the Mg/Co multilayer sample are 2.78% and 5 nm, respectively. After 6 days, the 1st reflection peak of Mg/SiC sample is completely disappeared, and Mg/Co sample still has a peak of 47.63% reflectivity. The experimental results show that the Mg/Co multilayer sample has a better environmental stability as compared with the Mg/SiC multilayer. The X Photoelectron Spectroscopy (XPS) shows that the productions of the damaged Mg-based multilayers are mainly $MgCO_3$, $Mg(OH)_2$ and modest MgO. Moreover, the content ratio of Mg $(OH)_2$ and $MgCO_3$ in the inner layer is significantly higher than that in the surface layer. Experimental results suggest that the reason for Mg-based multilayer damage is the erosion of H2O(g), so the capping layer of Mg-based multilayer should prevent the H_2O(g) penetrating into the mulilayer.

Keywords: Extreme ultraviolet (EUV) multilayer multilayer mirror stability humidity

收稿日期 2013-01-11 修回日期 2013-03-15 网络版发布日期 2013-06-20

基金项目:

大尺寸有障碍空间角度与基面位置测量的关键技术;大尺寸有障碍空间角度与基面位置测量的关键技术;国家重点基础研究发展计划（973计划）

通讯作者: 朱京涛

作者简介: 朱京涛（1978-），男，教授，博士生导师，2005年于复旦大学获得博士学位，主要从事极紫外与X射线光学薄膜与技术的研究。

作者Email: jtzhu@tongji.edu.cn

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