

摘要: 针对国家同步辐射实验室燃烧与火焰实验站中1 m Seya-Namioka 单色仪对光栅的需求,采用全息离子束刻蚀工艺制作了1 200 lp/mm Laminar光栅。首先,通过光刻胶灰化技术调节光刻胶光栅掩模占空比,在理论设计的误差允许范围内,对此光栅掩模进行扫描离子束刻蚀;然后,将光栅图形转移到光栅基底上去除残余光刻胶;最后,采用离子束溅射法镀制厚度约40 nm的金反射膜,采用热蒸发法镀制厚度约60 nm的铝反射膜。用原子力显微镜分析光栅微结构,结果显示光栅槽深为40 nm,占空比为0.45。同步辐射在线波长扫描测试结果表明,镀铝光栅效率明显高于镀金光栅,获得的实验结果与理论计算结果基本符合。镀金光栅已替代进口光栅在线使用3年,其寿命大大超过复制光栅,基本满足了燃烧实验站的实验研究需求。

关键词: 单色仪 衍射光栅 全息光刻 离子束刻蚀 真空紫外

Fabrication of 1 200 lp/mm Laminar gratings for 1 m Seya-Namioka monochromator at NSRL

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Abstract: To meet the need of 1 m Seya-Namioka monochromator for gratings in the combustion and flame endstation at National Synchrotron Radiation Laboratory(NSRL),1 200 lp /mm Laminar gratings were succesfully fabricated with holographic lithography and ion beam etching.The duty cycle of a resist grating mask was adjusted by resist-ashing, then the resist grating mask was etched in the range of theory design error and its pattern was transfered on a substrate by the scanning ion beam etching method. A gold film with a thickness of 40 nm was coated by ion beam sputtering and an aluminium film with a thickness of 60 nm by evaporating on gratings, respectively, after the rest resist was removed and cleaned. The microstructures of gratings were characterized by an Atomic Force Microscopy (AFM), and results show that the groove depth is 40 nm and duty cycle is 0.45 for the gratings. Synchrotron radiation wavelength scanning were also performed at the exit slit of the combustion and flame endstation, the results indicate that the photon intensity of Al-coated grating is better than that of Au-coated one which agrees well with the calculated results.The Au-coated grating has been used for experimental investigation for 3 years, futhermore its lifetime has been larger than that of the replica grating.

Keywords: monochromator diffraction grating holographic lithography ion beam etching vacuum ultraviolet

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