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现代应用光学

全息光栅制作中光栅掩模槽形形状随光刻胶特性曲线的演化规律

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摘要： 为分析光栅槽形形成的基本原理及槽形随光刻胶特性曲线的演化规律,建立了显影过程中光栅掩模槽形形成的演化模型。基于光刻胶溶解速率在不同曝光量区间的变化,将光刻胶特性曲线分成3个不同区域并分析各区域在光栅掩模槽形形成中的作用,讨论了在不同光刻胶特性曲线条件下光栅掩模槽形的演化规律。结果表明:当光刻胶非线性效应显著时,掩模槽形易形成矩形或梯形,此时槽深由原始胶厚决定;当光刻胶线性效应较显著时,槽形形成正弦形同时槽深有所减小。该模型正确反映了光栅槽形随光刻胶特性曲线变化的演化规律,为通过控制光刻胶特性曲线制作多种掩模槽形提供了理论依据及方法。

关键词： 全息光栅 非线性效应 槽深 掩模槽形 光刻胶

Groove profile evolution of grating masks for different photoresist response curves in fabrication of holographic gratings

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Abstract: To analyze the principle of profile formation for grating masks and the evolution of photoresist response curves, a simulation model of profile formation for grating masks in development was established. Based on the difference of photoresist dissolution rate in the different regions, the complete photoresist curve was divided into three sections, the effect of each section in the profile formation of grating masks was analyzed, then the simulation surface-relief profile model was presented. The experimental results indicate that the groove profile inclines to be rectangular or trapezoidal when the nonlinearity of photoresist response curve is remarkable, and the groove depth is mainly decided by the initial photeresist thickness. The groove profile is sinusoidal when the linearity response is strong, and the groove depth is also always decreased under this condition. The experiment shows that the proposed model can predict the profile evolution for the different photoresist curves and it provides a directive theory for fabricating the various profile masks during development according to the different photoresist response curves.

Keywords: holographic grating nonlinearity effect groove depth grating mask photoresist

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