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微纳技术与精密机械

复合湿法腐蚀工艺制备硅基三维曲面

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摘要: 提出了将各向异性湿法腐蚀与各向同性湿法腐蚀相结合的复合工艺,通过控制刻蚀工艺参数进行体硅加工,成功刻蚀了硅基材料三维曲面回转体结构。在各向同性腐蚀过程中,由各向异性刻蚀得到的多面体结构的表面垂直腐蚀速率与刻蚀液浓度呈指数关系,而搅拌使得多面体结构表面峰值与谷底的刻蚀液存在流速差,基于此原理可得到光滑的三维曲面。刻蚀过程中,通过各向异性湿法腐蚀控制结构深度,通过各向同性湿法腐蚀“抛光”结构曲面。最后,采用实验优化湿法腐蚀过程的工艺参数,基于直径为600~1 000 μm 的圆形掩模板,在硅材料表面制备得到了高度为100~200 μm 的三维曲面回转结构。提出的工艺简单、有效且便于操作,有望用于制作不同曲面形状的三维硅结构及聚合物光学器件模具。

关键词: 体硅加工 湿法腐蚀 各向异性 各向同性 硅模具 三维曲面

Fabrication of three-dimensional silicon profile by wet etching

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Abstract: A fabrication method combining anisotropic wet etching with isotropic wet etching process is proposed to obtain silicon-based three-dimensional curved rotary profile. In the isotropic etching process, the corrosion rate increases exponentially with the concentration of the etching solution in the vicinity of the silicon surface. The little fluctuation of etching solution concentration varies significantly due to the velocity of the etching liquid flow. On this principle, the surface peak and the bottom of octahedral structure obtained by anisotropic etching are polished by the flow difference existing in the condition of the stirring until one smooth three-dimensional surface occurs. By using the anisotropic wet etching to control the depth of the structure and the isotropic wet etching process to polish the curved surface of the structure, a silicon-based three-dimensional curved rotary profile with the height of 100-200 μm is fabricated based on a circle mask pattern with the diameter of 600-1 000 μm . The method proposed is simple, effective and can be used in fabrication of various three-dimensional silicon molds.

Keywords: silicon processing wet etching anisotropic isotropic silicon mold three-dimension curved profile

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