# 蒸发速率对 ZnS 薄膜性能的影响 *

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**摘 要**:为了研究蒸发速率对 ZnS 薄膜的折射率、表面形貌和应力等性能的影响,本文采用电子束蒸发技术进行了 ZnS 薄膜的制备。首先在 K9 玻璃基片上镀制薄膜,采用分光光度计进行透射率曲线的测试,利用光谱反演法得出薄膜的折射率,采用原子力显微镜表征了样品的表面形貌。最后在聚酰亚胺基底上镀制薄膜,利用 Stoney 公式计算出薄膜的应力。结果表明,随着蒸发速率的增加,薄膜折射率先增大后减小,在 2000nm 波长处薄膜的折射率最大值为 2.21,最小值为 2.07。蒸发速率越大,薄膜样品表面结构越疏松。不同蒸发速率下制备的薄膜均呈现压应力,增大蒸发速率可以显著降低薄膜应力。ZnS 薄膜的性能受蒸发速率影响显著,蒸发速率为 1.5nm/s 时折射率可达到最大值,蒸发速率为 2.5nm/s 时薄膜应力最小。

**关 键 词**:蒸发速率;ZnS;薄膜;折射率;应力

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## Effect of Evaporation Rate on the Properties of ZnS Films

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**Abstract**: This work aims to study the effects of evaporation rate on refractive index, surface morphology and stress of ZnS films. Electron beam evaporation was used to prepare the ZnS films. Firstly, the film was deposited on K9 substrate and the transmittance curve was tested by spectrophotometer. The refractive index of the film was obtained by spectral inversion method and the surface morphology of the sample was characterized by atomic force microscope. The film was also deposited on PI substrate and the stress of the film was calculated by Stoney formula. With the increase of evaporation rate, the refractive index first increases and then decreases. At the wavelength of 2000 nm, the maximum refractive index was 2.21, and the minimum was 2.07. The higher the evaporation rate, the looser the surface structure of the film sample is. The films prepared at different evaporation rates all show compressive stress. Increasing the evaporation rate can significantly reduce the stress of films. The performance of ZnS film was significantly affected by the evaporation rate. When the rate was 1.5 nm/s, the refractive index can reach the maximum value. When the rate was 2.5 nm/s, the stress can obtain the minimum value.

**Key words**: evaporation rate; ZnS; film; refractive index; stress

ZnS 薄膜具有宽光谱透射带,在 0.4μm~12μm 波段透射率高,是可见和红外光学滤光片中常用的薄膜材料,可以与低折射率的 $YF_3$ 相组合,也可与高折射率的 Ge、PbTe 等材料相组合,构成不同类型的滤光片,也可用于各种红外窗口的增透膜、反射膜等膜层结构[1-4]。ZnS 的带隙相对较宽,约为 3.68eV,因此一些发光器件中,ZnS 也是常用的薄膜材料[5-6]。ZnS 薄膜的制备方法多种多样,可采用电子束蒸发、磁控溅射、脉冲激光沉积、化学浴沉积、原子层沉积等方法制备[7-11]。这些制备工艺方法各有优缺点。电子束蒸发镀膜技术具有沉积速率高、薄膜均匀性好等优点,因此本文采用电子束蒸发镀膜技术进行了 ZnS 薄膜的制备。

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