真空热处理对 AZO 膜结构及光电性能的影响 *

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摘 要: 采用直流磁控溅射法分别在预热的和室温下的玻璃衬底上制备了 AZO 薄膜, 并对室温下制备的 AZO 薄膜进行了真空退火。使用 X 射线衍射仪、四探针测试仪、紫外 - 可见分光光度计和霍尔测试仪对这两种工艺条件下制备的 AZO 薄膜进行了表征, 比较研究了两种热处理方式——衬底预热和真空退火对所制备的 AZO 薄膜结构和光电性质的影响。结果表明, 衬底预热条件下制备的 AZO 薄膜有效抑制了(101)多晶相的形成; 室温条件下制备的 AZO 薄膜有较多的(101)多晶相形成, 经过真空退火热处理后, 仍未能有效消除 (101) 多晶相。衬底预热制备出了厚度为 380nm、方阻为 20Ω/□的 AZO 薄膜, 400 ~ 1200nm 波段的平均透射率达到 81.45%。真空退火后的 AZO 薄膜厚度为 403nm、方阻为 33Ω/□, 400 ~ 1200nm 波段的平均透射率达到 81.9%。

关 键 词: AZO 薄膜; 真空; 热处理; 方阻; 光电性能
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Effect of Vacuum Heat Treatment on Structure and Photoelectric Properties of AZO Film

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Abstract: AZO thin films were respectively deposited on the preheated glass substrate and room temperature by DC magnetron sputtering, and AZO films prepared at room temperature were annealed in vacuum. X-ray diffractometer, ultraviolet-visible spectrometer, four-point probes and Hall tester were used to character the prepared samples. The effects of two heat treatment methods, i.e.substrate pre-heating and vacuum annealing, on the structure and photoelectric properties of AZO thin films were comparatively studied. The results show that AZO thin films prepared under substrate preheating condition effectively inhibit the formation of (101)polycrystalline phase. AZO thin films prepared at room temperature have more (101)polycrystalline phase formation, and after vacuum annealing heat treatment, the (101)polycrystalline phase cannot be well eliminated. AZO thin films with a thickness of 380 nm and a square resistance of 20Ω/□ were prepared under the substrate preheating condition, the average transmittance between 400 nm and 1200 nm wavelength is 81.5%. The vacuum-annealed AZO film with a thickness of 403nm and a square resistance of 33Ω/□ has an average transmittance of 81.9% in the 400-1200nm band.

Key words: AZO thin film; vacuum; heat treatment; sheet resistance; photoelectric properties

铝掺杂氧化锌(AZO)薄膜由于其高导电性、良好的透明性、廉价和无毒[1]等优点得到了广泛的研究。AZO 膜在可见光区内具有高的透射率和低的电阻率, 尤其是其光学带隙可以通过铝掺杂比例进行控制[2,3]。AZO 膜所具有的这些优良特性使其在太阳能电池、液晶显示器、热反射镜薄膜晶体管(TFT)、气敏元件、抗静电涂层[4,5]以及半导体/绝缘体/半导体(SIS)异质结[6]、现代战机和巡航导弹的窗口等[7]领域得到了广泛的应用。

目前, 制备 Al 掺杂 ZnO 透明导电薄膜的方

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