

氧气等离子体处理提升 InZnO 材料及 TFT 电学性能和稳定性研究 *

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摘 要: 氧化物薄膜晶体管 (TFT) 是有源矩阵有机发光二极管的核心驱动元件, 是现今开发新型显示器的关键技术, 在平板显示方面具有广阔的应用前景。但氧化物半导体中存在大量由氧空位引起的缺陷态, 从而影响了 TFT 器件的性能及稳定性, 成为其商业化进程的瓶颈。本文通过磁控溅射方法制备了 IZO TFT, 并将其进行 O₂ 等离子体处理, 研究了离子体处理对 IZO 薄膜及 TFT 性能的影响。结果表明: O₂ 等离子体处理后 IZO TFT 迁移率由 8.2 cm²/(V·s) 提高到 9.5 cm²/(V·s), 阈值电压由 -3.2 V 减小到 -5.1 V, 亚阈值摆幅由 0.45 V/decade 减小到 0.38 V/decade, 开关比由 2.3 × 10⁷ 提高到 4.4 × 10⁷; 在光照负偏压下, 器件的阈值电压漂移量从 7.1 V 降低到 3.2 V; 在 100 °C 老化条件下, 器件的阈值电压漂移量从 12.5 V 降低到 6.4 V; O₂ 等离子体处理可以有效提高 IZO TFT 的电学性能和稳定性。

关 键 词: 薄膜晶体管; 磁控溅射; O₂ 等离子体处理; 缺陷态; 稳定性

中图分类号: O539; TN386

文献标识码: A

文章编号: 1002-0322(2023)04-0024-05

doi: 10.13385/j.cnki.vacuum.2023.04.05

Improvement of the Electrical Performance and Stability of InZnO Material and TFT by Oxygen Plasma Processing

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Abstract: Oxide thin film transistors (TFT) are the core driving components of active matrix organic light-emitting diodes, and are the key technology for developing new displays today. They have broad application prospects in flat panel displays. However, there are a large number of defect states in oxide semiconductors caused by oxygen vacancies, which destroy the performance and stability of TFT device, and become a bottleneck technical problem for its commercialization. Therefore, IZO TFT was prepared by RF-sputtering and treated with O₂ plasma to study the effects of O₂ plasma treatment on IZO film and device performance and stability. The results show that after plasma treatment, the mobility of IZO TFT increases from 8.2 cm²/(V·s) to 9.5 cm²/(V·s), the threshold voltage changes from -3.2 V to -5.1 V, the sub-threshold swing decreases from 0.45 V/decade to 0.38 V/decade, and the switch ratio changes from 2.3 × 10⁷ to 4.4 × 10⁷. Under negative light bias, the threshold voltage drift of the device reduces from 7.1 V to 3.2 V. The threshold voltage drift of the device decreases from 12.5 V to 6.4 V when aging at 100 °C. O₂ plasma treatment can effectively improve the electrical performance and stability of IZO TFT.

Key words: thin film transistor; RF sputtering; O₂ plasma treatment; defect; stability

随着现代科技的发展, 平板显示器成为人们生活和工作中不可或缺电子产品。阴极射线管显示器 (CRT) 体积庞大、功耗高, 已经逐步被行业所淘汰, 现在人们更多的倾向于新型平板显示 (FPD) 技术。新型 FPD 技术以其较低的功耗、适

用于电路集成、小型且轻巧等优点而得到广泛的应用, 而薄膜晶体管 (TFT) 是有源矩阵 LCD (AMLCD) 和有源矩阵发光二极管 (AMOLED) 等 FPD 产业的基础和核心技术^[1-2]。

TFT 拥有近 100 年的发展历史, Lilienfeld 和

收稿日期: 2022-11-05

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* 基金项目: 山东省自然科学基金 (ZR2021QF081); 枣庄学院博士启动项目 (1020716)。