

# 低溫複晶矽薄膜電晶體藉由直流偏壓製造 缺陷態之光漏電特性分析

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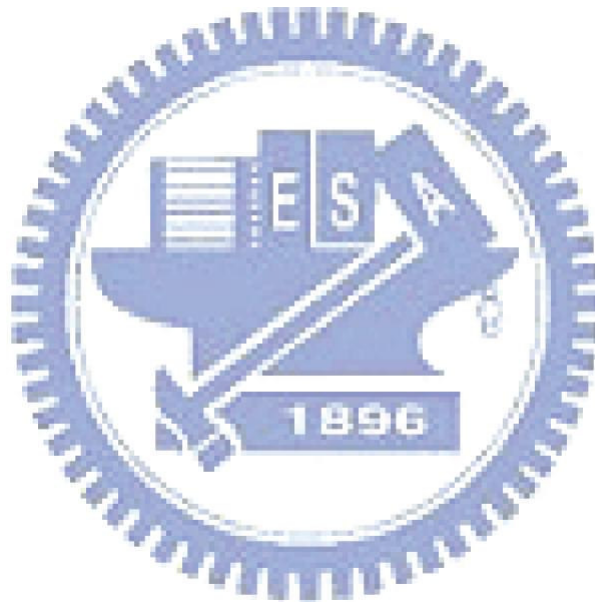
## 摘 要

近年來，由於其良好的電流驅動能力，低溫複晶矽薄膜電晶體(LTPS TFTs)已被廣泛的運用在主動式矩陣液晶顯示器(AMLCD)上。許多研究團隊研究了LTPS TFTs 的光效應，因為在高亮度的背光照明下，光漏電的存在容易造成畫素電壓的下降而導致串音(Cross talk)的產生。另外許多高附加價值的機能像光感測器、觸控式面板、影像掃描等等，都被試著整合至顯示器電路週邊的玻璃基板上，因此 LTPS TFT 的光效應是值得我們探討的。

研究結果顯示光漏電的大小與光強度呈現良好的線性正相關，且只要是在元件關閉區，不論量測條件為何，線性關係都是成立的。因此此線性曲線的斜率被我們定義為討論光效應的一個重要參數。在此篇論文中，我們將討論影響光漏電的重要因素如電壓條件、溫度，以及多晶矽薄膜中的缺陷對其所造成的影響，並提出一經驗公式預測光漏電在不同汲極與閘極電壓以及不同溫度下的變化。

另外，我們也研究了製造額外缺陷態對於光效應的影響。熱載子效應(Hot Carrier effect)以及自發熱(Self Heating effect)效應提供了兩種不同的手段，讓我們可以製造在能帶中不同種類的缺陷，並對光效應產生截然不同的影響。而且，我

們還以正向以及反向汲極電流量測，來辨別劣化區域在多晶矽薄膜中的位置以及它對光電流的效應。我們並提出了一個簡單的模型來解釋這些不規則的光電流變化與缺陷態的關係。



# **Study on the Photo Leakage Current of LTPS TFTs by Extra Defect Creation with DC Stress**

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## **Abstract**

Recently, due to the excellent current driving ability, low temperature polycrystalline silicon (LTPS) thin-film transistors (TFTs) have been widely used on the active-matrix liquid-crystal displays. Several groups had paid their attentions on the photo current characteristics of LTPS TFTs because high illumination intensity from back light increases the leakage current of LTPS TFTs and results in the decrease of pixel voltage and the increase of cross talk. In addition, all kinds of attempts of high added value functions like light sensor, touch panel, image scanner, etc. have been reported to integrate display circuits to peripheral area of the glass substrate. Therefore, photo effect on LTPS TFTs is worthy of investigation.

It was found that photo leakage current has good linear dependence on the illumination intensity. As long as in the off region, whether the measure condition is, this good linearity is always tenable. Therefore, the slope of the curve has been defined as an important index about the photo effect for our study. In this thesis, we present detailed studies on the factors that affect the photo leakage current like bias

conditions, temperature, and defect states in the poly-Si thin film, and propose an empirical model to describe the behavior of photo leakage current under different drain and gate biases and temperatures.

Furthermore, photo current behaviors affected by extra defect states creation have been also investigated. Hot-Carrier and Self-Heating effects afford different types of defect states creation in the energy gap and change photo leakage current. In addition, forward and reverse measurements can distinguish the location of damage regions in the poly-Si thin film and their effects on photo leakage current. A model considering the relation between photo leakage current and defect is proposed to explain the anomalous illumination behaviors after device degradation.



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