

# 低溫複晶矽薄膜電晶體應用於 光感測之可行性研究

研究生：鄭枷彬

指導教授：戴亞翔 博士

國立交通大學

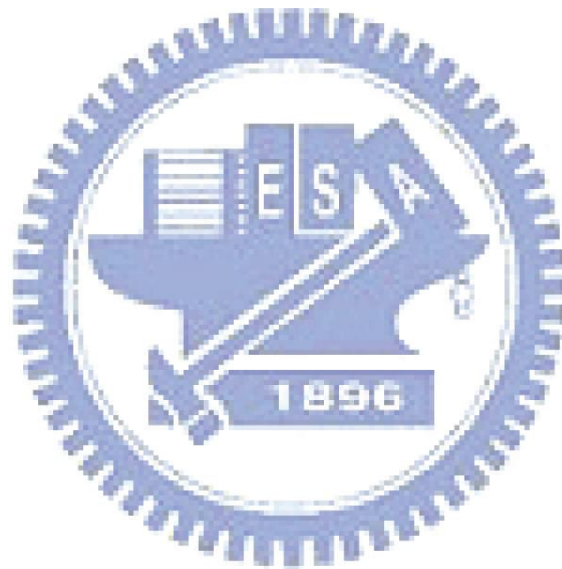
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## 摘要

低溫複晶矽薄膜電晶體(poly-Si TFTs)最近在液晶顯示器(AMLCD)及有機發光二極體(AMOLED)顯示器的周邊電路整合應用上，之所以會是眾所注目的焦點，是因為其優於非晶矽薄膜電晶體(amorphous silicon TFTs)的電流驅動能力，而將顯示器周邊電路整合於同一片玻璃基板周圍，也已經被廣泛地研究了。為了實現所謂的高附加價值以及有輸入功能的薄型化面板，除了將這些周邊電路整合至玻璃基板外，將一些電路整合至畫素上已是必要的考量，尤其是應用於行動裝置上。從各式各樣的不同高階功能如：環境光感測器、影像掃描、觸控式面板等，整合一個低溫複晶矽光感測器似乎是一個最重要的關鍵技術。在這些高附加價值的機能之中，環境光感測器可以藉由偵測面板週遭環境光強度來控制背光源的亮度，進而達到降低功率消耗並且改善螢幕的清晰度。

在本篇論文中，我們先針對低溫複晶矽薄膜電晶體在鹵素燈照射下的光特性做仔細的研究，並進一步確認元件在不同的操作區域內的光效應。我們還提出一種利用相同於低溫複晶矽薄膜電晶體製程的新型光感測電路，故可在不變動製程步驟和不增加成本的情況下達到整合的目的。這個含有源極隨耦器的新型電路，

可以感測到不同光照強度下的光漏電流訊號，將此電流訊號轉換成類比的電壓訊號，並將之數位化。根據實際電路在環境光 0~31320 lx 下的量測結果，我們確定此光感測電路可以準確地完成感測和讀出訊號。然而，在考慮到元件變動性包括臨界電壓的漂移以及漏電流大小變動對光感測的影響，我們還提出了校正方法，將元件變動性所產生的量測光強誤差從 4700 lx 降至 1200 lx，並且補償了臨界電壓漂移的變動性。



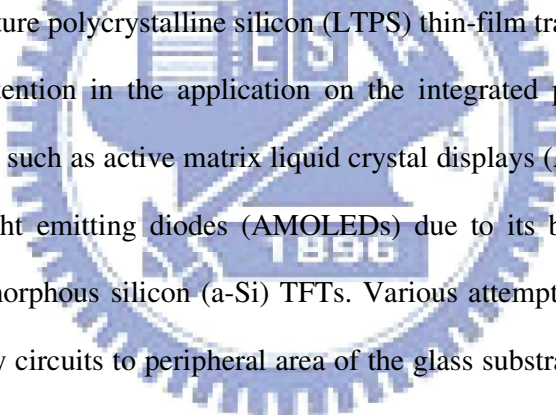
# **Study on the Feasibility of LTPS TFTs for Light Sensing Application**

Student : Chia-Pin Cheng

Advisor : Dr. Ya-Hsiang Tai

**Department of Display Institute  
National Chiao Tung University, Hsinchu, Taiwan**

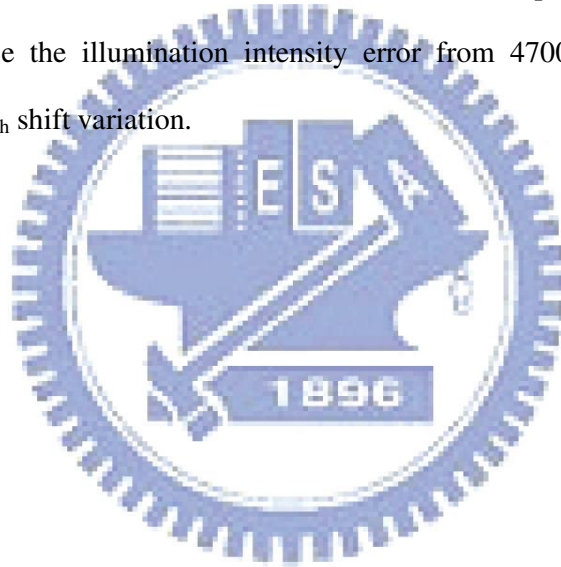
## **Abstract**



Low temperature polycrystalline silicon (LTPS) thin-film transistors (TFTs) have attracted much attention in the application on the integrated peripheral circuits of display electronics such as active matrix liquid crystal displays (AMLCDs) and active matrix organic light emitting diodes (AMOLEDs) due to its better current driving compared with amorphous silicon (a-Si) TFTs. Various attempts have been reported to integrate display circuits to peripheral area of the glass substrate. In addition to the peripheral area integration, circuit integration to pixel is considered to be required to realize so-called high-value added display or sheet computer having input function, especially in mobile equipments. Integration of LTPS optical sensor is considered to have a potential to be a key technology for various kinds of advanced functions such as ambient light sensors, image scanners, touch panel, etc. An ambient light-sensing function, which is one of several high-value added functions, can contribute to low power consumption and improve visibility by detecting ambient light around the display panel and controlling the brightness of the display panel.

In this thesis, we present a detailed experimental study of the LTPS TFTs

behavior under halogen lamp illumination and identify the different TFT operating regimes. We also propose a light-sensing circuit using the identical LTPS TFTs fabrication processes without any extra cost. The proposed circuit, which has a source follower, can sense the photo leakage current under different illumination intensities and convert the current to analog voltage signal and then digital one. Through the measurement of the proposed circuit under light variation from 0 to 31320 lx, we confirmed that the proposed light-sensing circuit can perform sensing and readout operations accurately. However, we also consider the device variations such as threshold voltage ( $V_{th}$ ) shift and OFF current variation and propose the calibration methods to reduce the illumination intensity error from 4700 lx to 1200 lx and compensate the  $V_{th}$  shift variation.



# Acknowledgements

首先我要感謝我的指導教授 戴亞翔博士，在求學的兩年期間提供豐富的資源，讓我無後顧之憂的專心於研究中。老師積極認真的研究態度、大膽前瞻的眼光、講求效率的處事原則及謹慎周全的思慮，是我這兩年中感受最深刻的。感謝老師總是鼓舞我們、激發我們，用心的指導我們，並且提供許多新穎的研究想法，讓我受益良多，有所成長。而在做研究之餘，老師也不忘提醒大家做人處事的態度，不論在言教還是身教，都給予我們最好的榜樣。在此，對我敬愛的戴老師致上最誠摯的謝意。

感謝士哲學長、彥甫學長在研究方面給予我很多的指導，助我解決研究過程中的諸多疑惑；謝謝畢業的學長姐們：娟姐、俊文、育德、偉倫、晉煒、振業、憲哥、曉嫻、龍哥，在我茫然的研究路上提供寶貴的意見，使我成長茁壯；更要感謝的是一起奮鬥的同學漢清、允翔，研究所兩年裡共同解決課業上的疑惑，也一起為了實驗忙的焦頭爛額，這份成果值得與你們一起分享；也要感謝學弟妹們：游博、歐趴、紹文、國珮、耿維，隔壁實驗室的竹博、阿貴、巍方，謝謝你們豐富了我的生活、也擴展了我的視野。也因為有了你們，實驗室時常充滿了歡笑，兩年的碩士生涯有了大家的陪伴，使我的碩士生活既充實也充滿了溫馨。

感謝我的好朋友們，依倩、美慧、冠翰、小平、貞儀，感謝你們長久以來的扶持與關懷，在我需要幫忙的時候從來不缺席。最後，感謝我的家人總是在背後默默的支持及鼓勵，給予我高度的肯定，才有今日有所成長的我，如果我有一點點成就，都是因為你們真誠無私的愛與無可替代的存在，在此向他們送上最真摯的感謝。

枷彬 2007.06.09

# Contents

<b>Chinese Abstract</b> .....	<b>I</b>
<b>English Abstract</b> .....	<b>III</b>
<b>Acknowledgements</b> .....	<b>V</b>
<b>Contents</b> .....	<b>VI</b>
<b>Figure Captions</b> .....	<b>VIII</b>
<b>Table Lists</b> .....	<b>XII</b>
<b>Chapter 1 Introduction</b>	
1.1 Background .....	1
1.2 Motivation .....	1
1.3 Thesis Organization .....	3
<b>Chapter 2 Photo Effect on Device</b>	
2.1 Fabrication Procedures of LTPS TFTs .....	6
2.2 Photo Effect of Front Light Illumination .....	6
2.3 Photo Effect of Back Light Illumination .....	7
2.4 Channel Width Effect .....	9
<b>Chapter 3 Light-Sensing Circuit (LSC)</b>	
3.1 Introduction .....	18
3.2 Sensor Structure and Operation Principle .....	19
3.3 Source follower.....	20

3.4 Simulation and Experiment .....	21
3.4.1 Simulation .....	21
3.4.1.1 Simulated Method .....	21
3.4.1.2 Simulated Results .....	22
3.4.2 Experiment .....	22
3.4.2.1 Experimental Conditions and Results .....	22
3.4.2.2 Discussion about Experimental Results .....	23
3.4.3 Discussion about Simulated and Experimental Results .....	24
3.5 Digitization .....	25
<b>Chapter 4 Assessment of LSC</b>	
4.1 Device Variation .....	37
4.2 Error of LSC from Device Variation .....	37
4.2.1 Threshold Voltage Shift .....	38
4.2.2 OFF Current Variation .....	38
4.3 Calibration Methods .....	39
4.3.1 OFF Current Variation Calibration Method .....	39
4.3.2 Threshold Voltage Shift Compensation Circuit .....	40
4.4 Application Assessment .....	41
<b>Chapter 5 Conclusions</b> .....	51
<b>References</b> .....	53

# Figure Captions

## Chapter 1

Fig. 1-1 The roadmap from 2002 to 2008 [Ref. *Y.Nakajima et al.,SID' 06*] ..... 5

## Chapter 2

Fig. 2-1 The cross-section views of N-channel LTPS TFTs with LDD structure ... 10

Fig. 2-2(a) LTPS TFT transfer characteristics in the dark and under illumination  
at  $V_{ds}=0.1V$  including regions (i) ON (ii) subthreshold (iii) OFF ..... 11

Fig. 2-2(b) LTPS TFT transfer characteristics in the dark and under illumination  
at  $V_{DS}=10V$  including regions (i) ON (ii) subthreshold (iii) OFF ..... 11

Fig. 2-3(a)  $I_D-V_D$  characteristics of ON region in the dark and under illumination ... 12

Fig. 2-3(b)  $I_D-V_D$  characteristics of subthreshold region in the dark and  
under illumination ..... 12

Fig. 2-3(c)  $I_D-V_D$  characteristics of OFF region in the dark and under  
illumination ..... 12

Fig. 2-4 The comparison of the  $R_{L/D}$  under illumination and in the dark among  
ON, subthreshold, and OFF region and that of current level (inset) ..... 13

Fig. 2-5(a) LTPS TFT transfer characteristics in the dark and under FL  
and BL illumination at  $V_{DS}=0.1V$  ..... 14

Fig. 2-5(b) LTPS TFT transfer characteristics in the dark and under FL  
and BL illumination at  $V_{DS}=10V$  ..... 14

Fig. 2-6(a)  $I_D-V_D$  characteristics of OFF region in the dark and under FL



and BL illumination .....	15
Fig. 2-6(b) $I_D$ - $V_D$ characteristics of Sub. region in the dark and under FL	
and BL illumination .....	15
Fig. 2-7(a) The OFF current versus FL illumination intensity .....	16
Fig. 2-7(b) The subthreshold current versus FL illumination intensity .....	16
Fig. 2-8 Dependence of $I_{photo}$ on channel width (W) .....	17

### Chapter 3

Fig. 3-1 (a) Schematic of proposed 1T1C light-sensing circuit	
and (b) timing sequence .....	26
Fig. 3-2 (a) Schematic of proposed 2T1C light-sensing circuit	
and (b) timing sequence .....	27
Fig. 3-3 (a) Schematic of conventional source follower (b) Wave form of the	
output signal when the input triangular signal is 2V to 9V (c) Frequency	
response of the source follower .....	28
Fig. 3-4 The source follower input and output wave forms under (a) dark	
and (b) illuminated (31320 lx) conditions .....	29
Fig. 3-5 Illumination dependence of $I_D$ - $V_D$ characteristic and its fitting formula ...	30
Fig. 3-6 SPICE simulation results of TFT (W/L=20um/5um) .....	30
Fig. 3-7 (a) The modified 2T1C light-sensing circuit model for simulation	
(b) its time diagram .....	31
Fig. 3-8 Simulation results under illumination and in the dark .....	31
Fig. 3-9 Photograph of the fabricated 2T1C light-sensing circuit .....	32
Fig. 3-10 Measured waveforms of output voltages of proposed 2T1C light-sensing	

circuit under halogen lamp illuminative variations from 0 to 31320 lx on	
(a) subthreshold region and (b) OFF region .....	33
Fig. 3-11 Measurement results of the 2T1C circuit under different illumination	
intensity on (a) subthreshold region and (b) OFF region .....	34
Fig. 3-12 Comparison with simulated & experimental results at $V_{GS}=0.5V$ .....	35
Fig. 3-13 (a) Simplified block diagram of digitization circuit and (b) its signal	
diagrams .....	36

## Chapter 4

Fig. 4-1 The transfer characteristic curves of 200 LTPS TFTs at $V_{DS}=10V$ :	
(i) initial OFF current variation (ii) threshold voltage shift .....	42
Fig. 4-2 Photo current variations of ten LTPS TFTs .....	42
Fig. 4-3 The influence of $V_{th}$ shift $\pm 0.3V$ based on $V_{GS}=0.5V$	
(Operated in subthreshold region) .....	43
Fig. 4-4 The influence of $V_{th}$ shift in OFF region .....	43
Fig. 4-5 Measured output slopes of fifteen proposed light-sensing circuits	
in OFF region .....	44
Fig. 4-6 Measured output slopes of fifteen proposed light-sensing circuits	
in OFF region (dash line) and their average curve (solid line) .....	44
Fig. 4-7 Divided the fifteen samples into several groups: (a) two samples,	
(b) three samples, and (c) five samples average for a unit .....	45
Fig. 4-8 Standard deviations versus the units .....	46
Fig. 4-9 (a) Schematic of our proposed light-sensing circuit with	
compensation part and (b) time diagram .....	47
Fig. 4-10 Fifty times of Monte Carlo simulation results of the proposed 2T1C	
light-sensing circuit when $V_{th}$ shift is $\pm 0.5V$ (a) in the dark and	

(b) under 31320 lx illumination intensity ..... 48

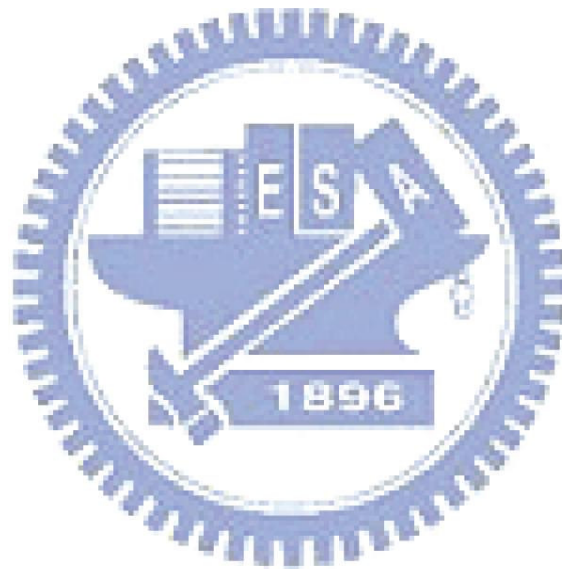
Fig. 4-11 Fifty times of Monte Carlo simulation results of the proposed 4T2C

light-sensing circuit when  $V_{th}$  shift is  $\pm 0.5V$  (a) in the dark and

(b) under 31320 lx illumination intensity ..... 49

Fig. 4-12 Layout configuration of our threshold voltage shift compensation

circuit ..... 50



# Table Lists

## Chapter 3

Table 3-1  $I_0(L)$  and  $R_0 = I/A_0(L)$  at  $V_{GS}=0.5V$  with the illumination  
intensity variation ..... 30

Table 3-2 Experimental conditions ..... 32

## Chapter 4

Table 4-1 Comparison results ..... 46

## Chapter 5

Table 5-1 Merits and drawbacks of Sub. region & OFF region ..... 52

