複晶矽薄膜電晶體之晶粒結構與光漏電之分析

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中文摘要

本論文主要探討複晶矽薄膜電晶體光漏電的現象。當複晶矽薄膜電晶體應用在主動式液晶顯示器時,會受到背光的影響產生光漏電，導致畫素電壓的下降和串音的增加。目前的研究上指出，複晶矽薄膜電晶體的光漏電主要在汲極空乏區產生，由於光子能量被矽膜吸收後，激發價帶電子躍遷到傳導帶形成電子電洞對，此電子電洞對在空乏區內建電場影響下，會分開向相反方向移動形成光電流。為了探討這樣的光吸收效應和矽薄膜品質有無關係，我們在實驗中特別利用雷射再結晶技術，改變雷射能量產生不同晶粒的複晶矽薄膜，這使我們可以進一步分析光電流在不同晶粒大小上的影響。同時，我們也調整複晶矽薄膜電晶體的通道長度、通道寬度以及輕汲極摻雜（LDD）長度來探討元件尺寸及空乏區變化對光漏電的影響，針對 LDD 長度對暗態漏電以及光漏電的不同影響，我們也提出討論以及定義出最佳的 LDD 長度。

另外，由於色序法技術的發展，背光將以紅綠藍色光依序發光，但對於不同色光產生的光漏電尚無人探討,我們預期這對複晶矽薄膜電晶體的光漏電會造成不同的影響,因此本論文也針對不同紅綠藍色光在複晶矽薄膜電晶體上造成的光漏電作研究。我們利用簡單的濾光膜產生紅藍綠不同色光的光源，調整光源強

度，然後計算其不同色光下的光子數目，可以更深入的探討光電流效應。

Grain Size Effect and the Photo Leakage Current of Poly-Si TFTs

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Abstract

In this paper, the photo leakage current of poly-Si thin film transistors (poly-Si TFTs) are studied. Since poly-Si TFTs are widely used in active-matrix liquid crystal displays (AMLCD), they usually will be exposed to the scattered light from the backlight system. The photon energy will be absorbed by the silicon film to excite the generation of electron-hole pairs. Under certain electric field such as the built-in electric field in the depletion regions, the electron and the hole will move toward the opposite direction and form the current. Compared to the generation current from the depletion region in the dark environment, this light-caused current is much larger and causes pronounced leakage current issues.

In our experiment, we try to study the influence of poly-Si film properties on the photo leakage current. We change the laser energy in the laser recrystallization process to obtain poly-Si films with various grain sizes. These films are used to serve as the active layer in the poly-Si TFTs. The influence of grain size on the photo leakage current is therefore can be measured. Also, various channel length, channel width and the lightly-doped drain (LDD) length are also designed. Their influences on the photo leakage current are also investigated.

Since the color sequential technology has been proved to be an effective method to

greatly improve the luminance of the displays, backlight system generates blue, red, and green light at different time is an unavoidable trend. However, the photo leakage current of poly-Si TFTs under different Red、Green、Blue light sources has not been studied before. In our experiment, we also try to produce the RGB light sources by using simple filtering films on the CCFL backlight system. The measured photo leakage current under different light sources are compared. The simulated results consider both the photon number per second and also the absorption coefficient are compared with the experimental results.

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口試結束後的驚喜與悸動，我想是我人生中不能忘懷的回憶，二年來的學習過程中，有歡笑也有挫折，在這過程當中，有許多人我要謝謝他們一路上的陪伴。首先我要感謝我的家人與指導教授 冉曉雯老師，在我學習過程及平日生活當中，所給于的關懷與鼓勵，讓我能夠逐一的解除迷惑。

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Calculated of Radiant Flux intensity

$$x = \frac{X}{X + Y + Z}$$
$$y = \frac{Y}{X + Y + Z}$$
$$\therefore X = x(X + Y + Z) = x(Y / y)$$
$$Y = Y$$
$$Z = z(X + Y + Z) = (1 - x - y)(Y / y)$$

Where X 、Y、 Z represents the tristimulus and x y is color coordinate.

$R(Yr, xr, yr)$、$G(Yg, xg, yg)$、$B(Yb, xb, yb)$

$$X = xr(Yr / yr) + xg(Yg / yg) + xb(Yb / yb)$$
$$Y = Yr + Yg + Yb$$
$$X + Y + Z = Yr / yg + Yg / yg + Yb / yb$$

Where *R(Yr,xr,yr) represents the*

Luminance of red: Yr

Color coordinate of red (xr,yr)

G(Ygr,xg,yg) represents the

Luminance of green: Yg

Color coordinate of green (xg,ygr)

Luminance of green: Yb

Color coordinate of blue (xb,ybr)

$$x = X /(X + Y + Z) = \frac{[xr(Yr / yr) + xg(Yg / yg) + xb(Yb / yb)]}{(Yr / yr) + (Yg / yg) + (Yb / yb)}$$
$$y = Y /(X + Y + Z) = \frac{(Yr + Yg + Yb)}{(Yr / yr) + (Yg / yg) + (Yb / yb)} \qquad (1\text{-}2)$$

And the color coordinate of the color addition as show in equation (1-2), it is dependence on the luminance of RGB color and color coordinate of RGB color.

Because the photo luminance has to transform the luminance (*lm/sr-cm*^{2}) in unit to the radiant flux (*Watt/sr-cm*^{2}), so the transform of radiant flux can be obtained from

equation (1-3).

$$Y = L = Km\int R_{\lambda}V(\lambda)d\lambda$$

$$where Km = 683 lm/W \qquad (1\text{-}3)$$

$$Km' = 1700 lm/W$$

As seen in figure 1, green light at the wavelength of 555nm defines the value of km which is equal to 683 (*lm/W*). So, the calculated of radiant flux was obtained in table IV

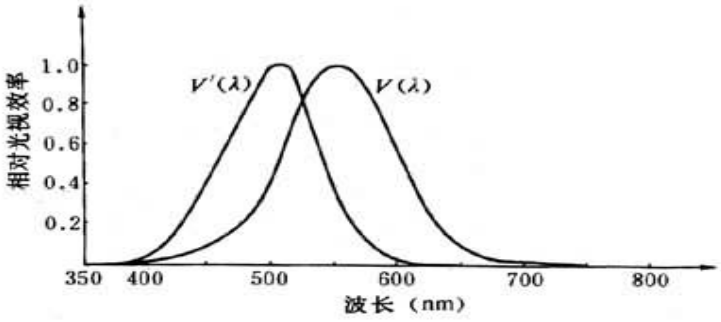

图 1 CIE 相对光谱光视效率曲线$V(\lambda)$(明视觉)和$V'(\lambda)$(暗视觉)