

多晶矽薄膜電晶體在關閉區閘極脈衝電壓操作下的劣化行為研究

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摘要

多晶矽薄膜電晶體(poly-Si TFTs)在顯示器中已被廣泛地使用，在三階驅動的應用上，由於電路結構的關係，會使得元件操作於閘極關閉區(Gate AC OFF)中；另外在更廣泛被採用在主動式矩陣(Active matrix)驅動的面板上，我們發現每個畫素上的電晶體，會長時間地處於汲極信號的關閉區操作情況。

在本論文中，主要是針對閘極關閉區的元件劣化行為做進一步的探討。並藉由和其他劣化條件的交叉比較。發現劣化原因主要是來自於靠近汲極的大電場造成的劣化行為，這些劣化條件之間的差異，主要是在劣化電流的來源與大小不同。並且由於電流大小的差異，造成劣化的程度也會不一樣。

最後，為了了解在動態操作下元件的劣化行為的細節，我們考慮了許多不同的波形條件，並且探討他們與劣化趨勢之間的相依性。我們試著使用 RC 充放電的概念去解釋這些行為，並設計了幾個小實驗確認我們的想法。

藉由這些新發現，期望以後在設計元件或是驅動電路上，能夠把這些劣化行為考慮進去，以增加元件的可靠度。

Degradation Mechanism of Poly-Si TFTs Dynamically Operating in the OFF Region

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Abstract

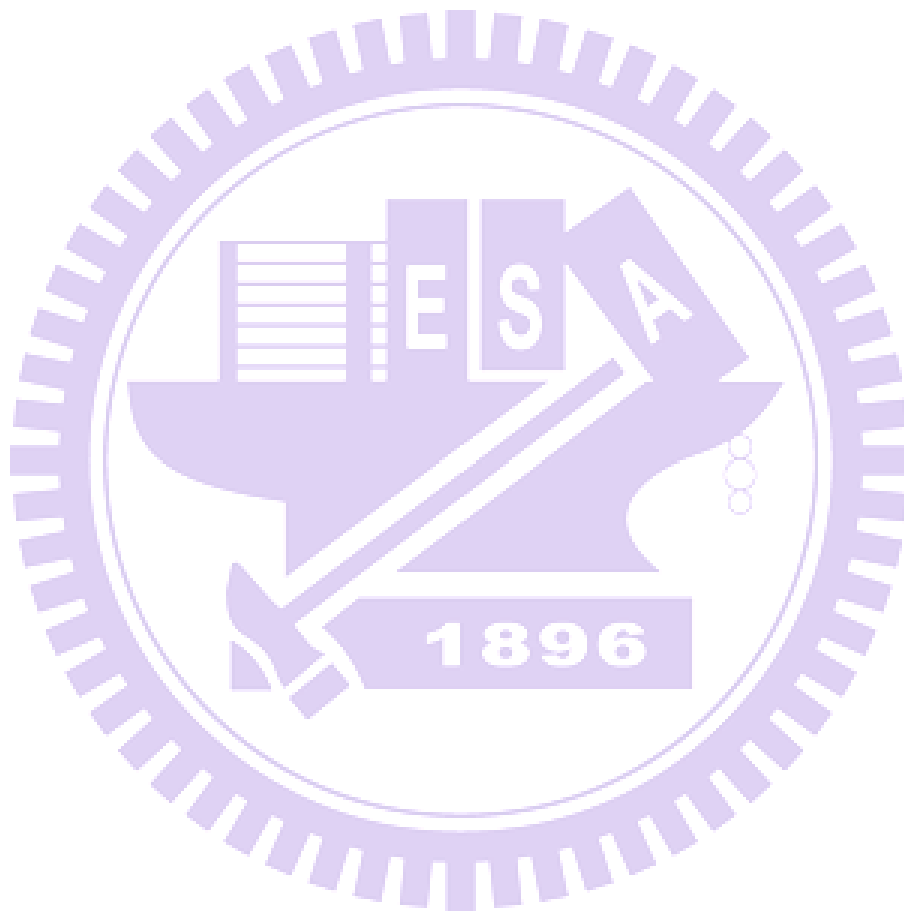
Poly silicon TFTs are widely used in LCD panels. In the storage-on-gate array structures, each pixel TFT would be under Gate AC Off region operation. In active matrix addressing method, we found that each TFT is most of time under drain off region dynamic operation.

In this thesis, we want to focus on the degradation mechanism while devices are operated in off region. By the similar behavior of other three stress conditions, we found the degradation behavior is from the large electric field near drain electrode. In addition, the degradation rate is also from the amount of stress current. In general, degradation rate of on region stress is much larger than off region stress because of the on current is larger then leakage current under off region operation.

In order to know the detail of the device under dynamical operation, we then consider the waveform parameters and its dependence with the degradation rate. However, we try use the concept of RC charge and discharge model to explain the

waveform parameters dependence.

By this study, we are expected designer could consider these degradation behavior and do the drain engineering to enhance device reliability.



Acknowledgements

在 DADS 也待兩年了，現在要畢業了，留下了這本論文。這記載的是一個解謎的過程，從一開始很無法解釋的現象開始出發，利用之前的研究當作後盾，一步一步地發展成現在的這個樣子。我原本不想像得獎一樣不停的念感謝名單，但我發現很難辦到。在這個過程中，首先要感謝戴亞翔老師的指導，老師一直很照顧我們，也給了許多方向。謝謝幾位口試委員的指導與意見：張鼎張、冉曉雯、劉漢文老師。另外也要謝謝士哲，一提到可靠度就會熱血起來的阿宅學長，在許多的討論中給我很多寶貴的意見。還有同學們，游博、紹文、國珮、耿維，謝謝你們的陪伴，還有機會可以一起去香港玩，還有謝謝游騰瑞的孔雀魚，雖然你們沒有逆流而上抵勵我的鬥志，不過沒事逗弄一下，心情都會變好。還有已經畢業的學長姐們與學弟們的幫忙，明憲、長龍、曉嫻、翔帥、漢清、小黑、兄貴哥哥、趴趴、小瓜呆、少宏。謝謝穎書，你的陪伴和意見都很有幫助。最後要謝謝我的父母，他們都是善良可愛的人，辛苦的把我養大。一路走來都受到眾人的幫助，還有太多人沒謝到，所以就謝天吧；論文其實還有許多要改，所以就…改天吧。

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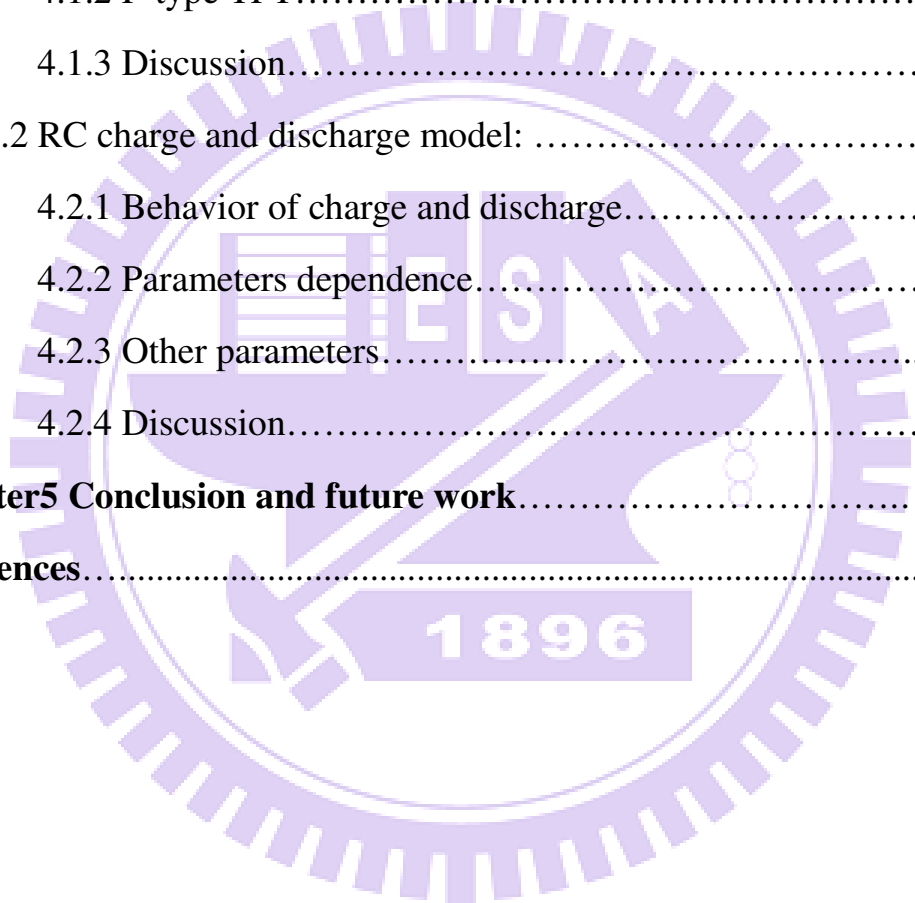


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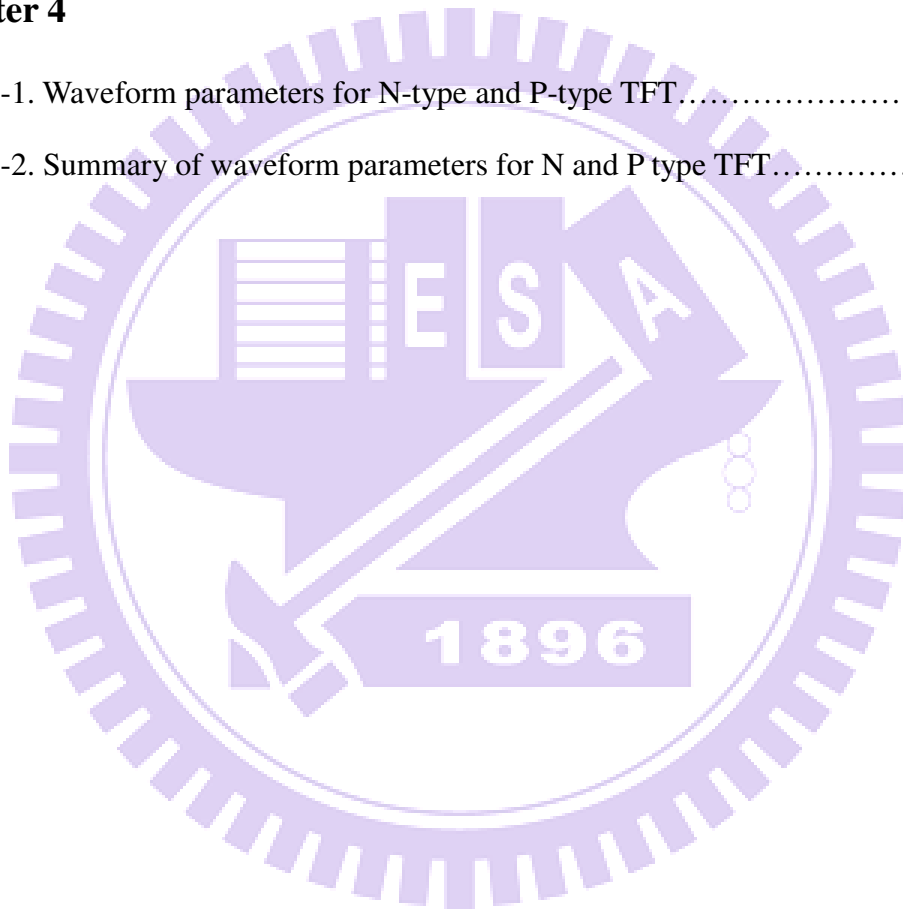


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