

薄膜電晶體應用在塑膠基板上之研究

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摘要

使用塑膠基板或是其他曲撓式基板來取代傳統的玻璃基板已經是目前及平面顯示器的發展趨勢，在本論文中我們試了許多方法藉以在克服在塑膠基板上製作的種種困難。

首先，我們先研究塑膠基板主動式元件的低溫製程技術，研究結果分為兩部分，一是低溫覆蓋層(hard coating layer)薄膜的製作 (100°C)，另一為低溫(100°C)製作薄膜電晶體。我們利用電漿輔助化學氣相沉積系統(PECVD)低溫成長SiCN薄膜，並探討SiCN薄膜對塑膠基板的影響。我們發現SiCN薄膜需要有不錯的附著性，並利用調變薄膜厚度，可以達到良好的透光效果。在塑膠基板蓋上SiCN薄膜後明顯會改善製程腔體真空度；此外，我們成功地在 100°C 環境中，以SiON為閘極介電層在塑膠基板上製作出TFT元件。另外在high-K閘極介電層薄膜的研究，我們也研究了室溫製程的電子束蒸鍍high-K介電層的絕緣特性，應用於電晶體的閘極介電質，但由於漏電的問題導致元件整體的特性仍不佳，此部分仍有待改善。

最後，我們也針對有機電晶體進行相關研究。使用

poly(3-hexylthiophene) 高分子半導體材料製作有機電晶體元件，經由不同的表面處方式改質二氧化矽介電層表面極性，而改善電晶體元件特性。研究結果顯示使用HMDS、OTS與TMS等自組物質表面處理二氧化矽介電層後，可使元件之載子傳程輸速率提升至 $10^{-2} \text{ cm}^2/\text{V. s.}$ 。



Investigation of the thin film transistor applied for plastic substrate

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Abstract

There is a tendency to fabricate the active matrix liquid-crystal display (AMLCD) on the plastic or flexible substrates. Nevertheless, the limitation in process temperature for the low-melting substrates is an important issue. In this thesis, we have studied and fabricated the thin film transistor on the plastic substrate by using several methods at low temperature (100°C).

We focused on the hard coating layer, SiCN, and active layer, a-Si, deposited by plasma-enhanced chemical vapor deposition (PECVD) at 100°C . The vacuum of chamber was promoted after the SiCN coated on plastic substrate. With the SiCN hard coating on the plastic substrate, we successfully fabricated the TFT devices on plastic substrate. We also take high-K materials as gate dielectric of TFT deposited by e-gun, such as TiO_2 and Al_2O_3 . However, the TFT devices were failed due to the leaky high-K material.

In addition, the organic thin film transistor of poly (3-hexylthiophene) has been investigated. It is found that the surface treatments of gate insulator influence the performance of organic thin film transistors. The use of the self-assembly materials (hexamethyldisilazane, octadecyltrichlorosilane, and chlorotrimethylsilane) for chemically modifying the surface of silicon dioxide gate insulator prior to the

deposition of the organic semiconductor is effectively enhance the field effect mobility to $10^{-2} \text{ cm}^2 / \text{V.s}$.



誌 謝

在兩年的碩士生涯中，首先我要感謝我的指導教授曾俊元博士和張鼎張博士，由於兩位老師在研究上給予我細心的指導及教誨，讓我在學術及研究上都有莫大的收穫。更感謝兩位老師在生活上及待人處事方面給我的幫助及啟發，讓我受益良多並更加成長，在這裡對兩位老師致上內心最誠摯的敬意與謝意。

此外，我要感謝國家奈米元件實驗室的劉柏村博士，和工業技術研究院化學工業研究所的陳國裕博士，謝謝你們提供我諸多的專業指導及協助，並不厭其煩的幫助我解決實驗上的問題，讓我能順利地完成研究。還有蔡宗鳴、陳紀文、顏碩廷、涂俊豪、王敏全諸位學長，謝謝你們的鼓勵及協助，並在我實驗遇到困難的時候，給予我正確的前進方向，沒有你們的幫助這篇論文是沒辦法順利完成的，謝謝你們。同時，也要感謝曾經一起同甘共苦的同學們：元均、注宏、稚軒、興華、瓊怡、堡安、炳麟、世仰，謝謝你們在精神上給我的鼓勵及安慰，也感謝你們豐富了我的生活。另外，我要感謝國家奈米元件實驗室(NDL)與交大半導體中心提供良好的設備與研究環境，讓我能順利的完成實驗。

最後我要感謝我的父母多年來辛苦的栽培與教誨，提供我自由的成長空間，並給我最大的關懷與支持，使我無後顧之憂的完成我的碩士學位。在此獻上內心最深的謝意：爸、媽，謝謝你們～。

2004 年六月

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