以準分子雷射結晶與非晶矽間隙壁結構製作高遷移率複晶矽薄膜電晶體之研究

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摘　要

以準分子雷射結晶製作的低溫複晶矽薄膜電晶體已經被視為目前最有潛力去實現在一塊平面顯示器的玻璃基板上，整合進包含平面顯示器驅動電路、電源供應、輸入輸出介面及訊號處理電路等數位邏輯。毫無疑問地，這將導致外部元件的數量和面積驟減，因此整個系統的重量可以更輕，厚度可以更薄。然而，由於隨機的成核點和雷射能量密度的製程窗口很窄，以準分子雷射結晶製作的傳統式低溫複晶矽薄膜電晶體在元件特性方面，特別是小尺寸元件的均勻性表現很差。除此之外，準分子雷射波與波的變異性亦造成元件跟元件間有著極大的差異。傳統式元件的場效遷移率太低以致於在高電流應用方面不敷使用也是另外一個需要改善的問題。

因此，在此論文中我們想出一些新的方法去解決上述的問題，亦即以準分子雷射結晶分別與兩種非晶矽間隙壁結構製作複晶矽薄膜電晶體。由可控制的成核點所形成的週期性晶粒成長同時實現了高場效遷移率和好的均勻性。由於大尺寸晶粒的均勻分佈，新的非晶矽間隙壁結構不但能增進小尺寸元件的特性，也能適用於製作大尺寸元件。

Study on High-Mobility Polycrystalline Silicon Thin Film Transistors Fabricated by Excimer Laser Crystallization with Amorphous Silicon Spacer Structure

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ABSTRACT

Low temperature polycrystalline silicon thin film transistors (LTPS TFTs) fabricated by excimer laser crystallization have been regarded as the most promising way to achieve digital logic, including flat panel display driver and power supplies, I/O interfaces, and signal processing circuitry, to be integrally formed on the same glass substrate as a flat panel display. The foregoing fulfillment, undoubtedly, will result in dramatic reductions in component mounting area and the number of external parts, and is also expected to contribute to lighter weights and thinner profiles in assembled systems. However, the conventional ELC LTPS TFTs are poor in uniformity of device characteristics especially for small dimension devices owing to the random nucleation sites and the narrow process window of laser energy density. Besides,

the pulse-to-pulse variation of excimer laser also led to device-to-device variation. And the field effect mobility of conventional device is too low to be high current applications.

In this thesis, we devised novel methods of solving the problems above-mentioned, that is, poly-Si TFTs fabricated by excimer laser crystallization with two kinds of a-Si spacer structures. High field effect mobility combined with good uniformity was achieved by periodic grain growth of controlled nucleation sites. Owing to uniform distribution of large grain size, the novel a-Si spacer structures can not only improve performance of small dimension devices but also apply to fabrication of large dimension ones.

誌　謝

首先，感謝我的父母二十多年來對我的栽培，由於他們無怨無悔的付出，使我能夠順利完成碩士學位，僅以此論文獻給我最敬愛的雙親，呂禮興先生與蘇麗雲女士。

感謝我的論文指導教授鄭晃忠博士，在論文研究與為人處世方面的指導，都使我獲益良多。

感謝實驗室學長、同學與學弟妹們的陪伴，使我兩年的碩士生涯過得可以說是多彩多姿。其中特別感謝常鼎國學長於實驗上的幫忙，許多困難棘手的問題都因此迎刃而解。另外感謝蔡春乾學長於實驗中的熱心協助，在最後的緊要關頭實為天降甘霖。

感謝林家彬學長於製程上的幫忙，使我的實驗結果可以更加地完善。另外對於曾經在國立交通大學奈米中心與國家奈米元件實驗室一同打拼的學長、同學們，感謝你們的相互砥礪，此論文才能如期完成。

感謝國立交通大學奈米中心與國家奈米元件實驗室提供優良的設備與研究環境，尤其要感謝徐台鳳小姐、林傳丁先生、彭兆光先生、蔣秋芬小姐及徐秀鑾小姐在製程與設備上的鼎力相助。

最後再次感謝所有曾經幫助過我、支持過我或關心過我的學長、同學及朋友們，你們的恩惠我都會點滴在心頭。

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