以細微結構與光學系統調變誘發側向結晶

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摘要

在平面顯示器中，多晶矽薄膜電晶體的效能會被元件通道中的晶粒邊界劇烈地影響。這些晶粒邊界會降低載子遷移率並讓漏電流上升，為了減少這個效應，我們使用側向結晶的方式來控制通道中的晶粒邊界。在我們的研究中，使用三種側向結晶方式來控制晶粒大小，結晶方向與成核點位置，預期會得到較大的晶粒大小，晶粒排列方向一致性高以及成核點位置的精準控制。

第一種方式是金屬層反射層，它能有效的讓結晶方向垂直於金屬側邊。第二種方式是奈米洞結構，它能有效的將成核點控制於奈米洞側壁邊緣，並且在晶粒成長的過程中，讓晶粒互相碰撞，有效的把晶粒邊界控制在兩個奈米洞之中間區域。第三種方式，單狹縫繞射，這可以調變雷射光的空間強度來誘發側向結晶，並將側向結晶長度拉長至1.3微米，配合熱儲存槽結構，更可以將側向結晶長度拉長到2微米，這會是原本的1.5倍。在論文中，我們將三種雷射誘發側向結晶方法的熱流模擬結果與實驗結果還有熱儲存槽效應做討論與比較。

Lateral grain growth induced by microstructure and optical system modulation

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Abstract

The performance of poly-Si TFT devices in panel display is severely influenced by grain boundaries in the channel region. The boundaries would decrease the mobility and increase the leakage current. In order to reduce these effects in poly-Si TFTs, the grain boundaries would be controlled by lateral laser crystallization methods. In our research, there are three methods to control grain growth direction, lateral grain size and nucleation positions. We expect to obtain larger grain growth length, well-aligned crystallization direction and more precise nucleation position by lateral laser crystallization methods.

The first method metal is reflection layer, which could well arrange the grain growth direction perpendicular to edges of metal patterns. The second method is nano-hole structure, which could control the nuclei at the sidewall of nano-holes and the grain boundaries would exist in the middle region between nano-holes due to grain growth colliding to each other. The third method single-slit diffraction, which modulates the laser intensity distribution to induce lateral grain growth could enlarge lateral grain growth size to 1.3μm without any additional structural design. With a SiO_2 capping layer lateral grain length would be enlarged to 2μm, which is about 1.5 times that without a heat reservoir layer. The relationship between heat flux simulations, and experimental results of three lateral crystallization methods and the effect of heat reservoir layer would be discussed and compared.

Acknowledgements

在論文的完成中，我首先要感謝我的家人，在我的碩士生涯中，給了我無數的加油與打氣，並且在我最失意的時後扶持我，在開心的時後與我共同分享喜悅，不論是在物質或精神上，都是生活中最佳的支柱。我的指導教授李柏璁老師在研究期間給予的指導與協助，以及研究方向的指引，都讓我在這過程中，受益匪淺，在此致上最誠摯的謝意。

在這個實驗室中，我首先要感謝跟我同梯的同學們，首先是陳書志同學在我的研究中，給予了相當大的助力，不管是在實驗上幫助或是想法的提供，都是不可或缺的。陳鴻祺同學讓我在實驗室生活中，陪著我渡過碩士生涯中的許多低潮期，讓煩悶的新竹生活注入了清新空氣。范峻豪同學跟我一起在碩士谷底胼手胝足共同奮鬥，在研究室裡的相互鼓勵打氣，終於兩個人一起邁向畢業的大門。感謝蔡豐懋同學總是帶給我們最新的國外資訊與美食，陪著我們一起熬夜看世足，在畢業前夕更留下美好的回憶。而實驗室的學弟們曾仲銓、游嘉銘、陳佳禾、陳思元在我碩二時加入了實驗室，為我的研究生生活增添了許多樂趣，江俊德學弟則是永遠都抱持著強烈求知欲望，跟我討論研究上的問題，並且在我最忙碌的時後，幫我分擔這實驗重擔。張資岳學長，感謝你在過去我們共同分擔計畫時，你總是付出較多的心力。另外要感謝卓龍材同學，在我的實驗中，給予我相當的協助，並且一起在夜深人靜的無塵室中奮戰。最後要感謝台科大的莊淳鈞同學在我實驗上不厭其煩給予的協助，並且共同討論研究實驗上的缺失與改進方式。因為有以上這些人，讓我滿佈荊棘的畢業之路，得以順利路的走過，在此獻上由衷的感恩。

2006/08/10 于新竹 國立交通大學

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