以閘極間隙型非晶矽薄膜電晶體實現
內建光學式觸控面板之可行性研究

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摘 要

非晶矽薄膜電晶體(a-Si TFTs)最近在液晶顯示器(AMLCD)的周邊電路整合上，因為其具有較低的製造成本而成為眾所注目的焦點。而將顯示器周邊的電路整合於同一片玻璃基板的周圍之技術也已經被廣泛的發表。為了實現所謂的高附加價值以及有輸入功能的薄型化面板，除了將這些週邊電路整合至玻璃基板外，將一些電路整合至畫素上已經是必要的考量，尤其是應用於行動裝置上。在各式各樣的不同高階功能如：環境光感測器、影像掃描等技術中，觸控面板已經漸漸成為相當關鍵的一項技術趨勢。以最新最著名的作業系統 window 7 為例也已經內建支援多點觸控的功能.

在本篇論文中，一開始我們介紹觸控面板的演進，包含電阻式、電容式、紅外線光學式及內嵌光學式。內嵌光學式觸控面板藉由光路的建立以及傳統非晶矽薄膜電晶體在關閉區電流的光敏感特性來實現觸控功能，但是由於此區的電流太小導致我們必須使用一個額外放大電路來讀取信號。為了避免這個額外的成本，我們提出利用另一種非傳統型的閘極間隙型薄膜電晶體來取代原本的電晶體。閘極間隙型薄膜電晶體的關閉電流跟傳統電晶體一樣會隨著光強而變，但是其特性更好。更令人驚訝的是，閘極間隙型薄膜電晶體在導通區一樣會有照光的效應，而此區的電流夠大到可以直接讀取而不需要任何的放大電路幫助；不過也因為長時間照光的關係此區會有令人困擾的可靠度問題產生。因此，我們提出了

一個校正方法來解決此可靠度問題使得感測的程度能夠達到很好的準確性(誤差小於 20%)，因此我們傾向於利用閘極間隙型薄膜電晶體的導通區做為光學式觸控面板的設計。另外，我們也為了操作在此導通區設計了一個改良過的讀取電路，此電路被整合在面板當中並且可以節省相當程度的製造成本.

Study on the feasibility of using gap-gate type a-Si TFT to implement integrated optical touch panel

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Abstract

Amorphous silicon (a-Si) thin-film transistors (TFTs) have attracted much attention in the application on the integrated peripheral circuits of display electronics such as active matrix liquid crystal displays (AMLCDs) duo to its lower manufacturing cost. Various attempts have been reported to integrate display circuits to peripheral area of the glass substrate. In additional to peripheral area integration, circuit integration to pixel is considered to be required to realize so-called high-value added display or sheet computer having input function, especially in mobile equipments. The touch panel is considered to have a potential to be a key technology for various kinds of advanced functions such as light sensor, image scanner, etc. For example, the latest computer operating system (OS) well-known as window 7 has also built-in multi-touch function to support the touch panel.

In this thesis, in the beginning we introduced the evolution of touch panel including resistive type, Surface Capacitive type, infrared optical type, and embedded optical type. The embedded optical touch panel realizes the input function by establishing the photo path and using the sensitivity of the current in the off region of conventional a-Si TFTs, which is so small that a additional an amplifying circuit is needed to read out the signal. In order to avoid this excess cost, we propose to use another non-conventional structure called Gap-Gate type TFTs as photo sensors in the touch panel instead of conventional type ones. The current in the off region of Gap-Gate TFTs vary with the intensity of illumination just like the conventional TFTs but the characteristic is better. More surprisingly, the similar photo effect also exists in the on region of Gap-Gate TFTs where the current is large enough to read out directly without any amplifying circuit; but the reliability of this region becomes a disturbing issue due to the illumination for a long time. As a result, we propose a correction method to solve this problem of reliability to provide good sensing accuracy (error < 20%) and therefore prefer the on region of Gap-Gate TFTs to be the sensing region in our design of optical touch panel. In additional, an improved readout circuit is also proposed for operating in the on region, which is integrated in the panel and can reduce the manufacturing cost to a degree.

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