CITY UNIVERSITY OF HONG KONG
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Studies the Effect of Degradation in Indium Tin Oxide Thin Film on the Liquid Crystal Display Module Performance
影響氧化銦錫薄膜在液晶顯示屏組件性能退化之研究

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ABSTRACT

Indium tin oxide (ITO) thin films as-deposited on glass are widely used as transparent and conductive electrodes for liquid crystal display (LCD) devices by the chip-on-glass (COG) process with the use of anisotropically conductive adhesive film (ACF) in order to provide the highest possible interconnection density. However, contamination and moisture have proved to have an adverse effect causing ITO corrosion. Moreover, in order to be compatible with the advanced COG technology, pitch and space between the ITO tracks becomes ultra fine, making serious failures, reduction in conductivity and transparency to visible light, occur in ITO. Consequently, the problem of ITO corrosion and degradation influence device reliability which have drawn industrial concern.

In order to understand and tackle the problem thoroughly, a focus on examining the root causes of ITO corrosion and performance degradation. Moreover, it is well-known that various properties of the ITO strongly depend on the preparation method and conditions of production. Therefore, knowledge gained from determining the relationship between crystalline properties of ITO and corrosion on ITO can be applied in future designs to prevent device failure.

In this study, the crystalline properties of ITO thin films were investigated by focusing on surface hardness and the morphological structure to see if soft surface would lead to ITO performance failure. Moreover, scratching of the ITO surface, simulating manual mishandling, and the width of ITO tracks would also examine if these were the

factors that lead to ITO corrosion. Simultaneously, anisotropic conductive adhesive film (ACF) was also added to the ITO surface to see if there was any resulting effect on corrosion. Accelerated reliability tests and failure analysis were performed to gain an insight of the failure causes and mechanisms.

It was found that the time to corrosion was faster if the ITO was scratched and the width of ITOs was reduced. A direct relationship was developed between the crystalline properties of ITO thin films and their performance degradation. By applying the knowledge and experience gained in the above testes, an economic and effective preliminary test was developed to act as a guideline for quality checking of the surface hardness of incoming ITO as-deposited glass by cleaning in deionized (DI) water baths with different ultrasonic powers as cavitation bubble implosion takes place during the cleaning processes cause substrate damage at certain levels, especially with the poor material hardness properties

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