A Survey on Stunning IGZO Technology

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Abstract

Higher resolution in a small screen, lower power consumption, more accurate touch panels these things in high-demand by the gadget industry this will be fulfill by IGZO technology made from alloy of Indium Gallium Zinc Oxide material will enable even higher resolutions, lower power consumption, and higher performance touch screens, as well as narrower bezel widths for LCD display panels used in mobile devices such as Smartphone's, it can also be adapted for use in organic EL displays which hold out high expectations for the future ,this paper will describing why IGZO seems to be the way to go for the next generation of iOS devices, and LCD panel Based on past research paper.

Keywords

4K2K, TFT; Thin-film transistor, Ultra-High Definition (UHD.

1. Introduction

Liquid crystal display (LCD) performance is about to take another leap forward. Existing LCDs have given us remarkable quality in HDTV, tablets and Smartphone's, as well as reasonably low power consumption. But Sharp Corporation is on the verge of delivering a new technology that will enable much higher resolution and significantly lower power consumption. This new technology is the result of breakthroughs in basic research, material science and display panel fabrication, and it's based on a compound that replaces silicon in the manufacture of thin-film transistors. It's called IGZO, for Indium Gallium Zinc Oxide (In Ga Zn O). Thin-film transistors are at the heart of every LCD, and IGZO improves the performance of LCD panels in three significant ways: lower power consumption, higher resolution and a new operating mode for touch-sensitive displays.

2. History of IGZO

Indium Gallium Zinc Oxide has been known for its semiconductor properties for years [1]**.**when fabricated on a thin-film transistor, has an electron mobility one digit higher than that of amorphous silicon TFT, and the results of their studies were reported in the science technology magazine, Nature, in Nov 2012[2].Since then, many universities, companies and research institutions started their research and development, conscious of its application to flat panel displays and other electronic devices. Sharp is the first to successfully mass produce oxide semiconductors for use in liquid crystal display panels.

2.1 Features of IGZO

The thin-film transistors that power LCD displays act as switches, delivering an electrical charge to each liquid-crystal cell that flips it from opaque to transparent..

Higher resolution: IGZO transistors have high electron mobility and much lower leakage current characteristics than the two dominant silicon TFT processes. IGZO TFTs are smaller, so displays can have higher resolution with less loss in light transmission [4][5]

Low power consumption: Low power consumption is critical for portable devices. IGZO TFTs have dramatically lower leakage current when the TFT is off. When static, non-video content is being displayed, IGZO can also operate in a mode where pauses are inserted between the drive/refresh cycles; with almost no flicker result is further reduction in power consumption. Designers can then build devices with increased battery life, smaller size or both.

Portable Devices: Devices enabled by IGZO enable portable devices to have resolution that rivals that of a sheet of paper. Further, operation in the drive/pause mode allows greater touch sensitivity and accuracy for fingers and styluses on touch-operated devices. IGZO also enables Ultra-High Definition monitors, also known as Ultra HD or Quad Density Full Definition.

Less Noise Influence.

3. Literature Survey

The hunger for display resolution will probably never be satisfied until displays are indistinguishable from a printed page and as nuanced as a watercolor. IGZO takes a large step in that direction by enabling very high pixel-per-inch counts on small displays and Ultra-High Definition on larger monitors, while retaining brightness[6]. Your HDTV has approximately two million pixels, each made up of a red, blue and green sub pixel, and each sub pixel has a TFT transistor that causes the sub pixel to change from opaque to transparent. UHDTV has four times the resolution, which requires four times as many pixels, approximately 4000 across and 2000 down. And yes, three sub pixels per pixel.

An IGZO TFT can pass 20 to 50 times more electrical current than equivalent amorphous silicon TFT. That's far more than the LCD cell actually needs, so it can be much smaller. Smaller size is essential to retain brightness, or the body of the transistor would block too much light in a smaller LCD cell[6]. The required current to operate each TFT is lower too, so the mesh of printed wiring that interconnects the transistors and defines the walls of the cells can be thinner. This contributes to overall brightness, as well.

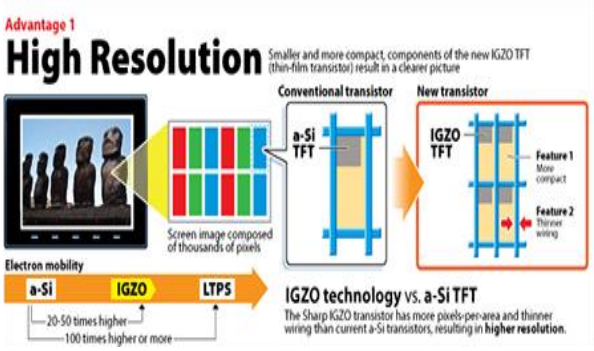

Fig 1: High resolution of IGZO compare with a-Si

Although a UHDTV(The next step beyond current HDTV standards. Two standards have been defined, 4K and 8K. 4K displays have approximately 4000 horizontal pixels and 2000 vertical pixels, while 8K displays will have approximately 8000 horizontal and 4000 vertical pixels.) might still be workable with larger transistors and lower transmittance, it would require a brighter backlight, which in turn consumes more power.

Higher resolution in portable devices can be very costly in terms of power consumption. Consumers always want the least weight and the greatest battery life. IGZO is the ideal solution.

The fig 2. Below shows the dramatic benefits of IGZO compared to the other competing TFT technologies. The curves illustrate the amount of current flowing as the gate voltage, which switches the transistor from its off state to its on state, is increased [7].

Amorphous silicon (a-Si) has a respectable difference in on-current to off-current, roughly a million to one, or 10^6. But it has relatively high leakage, which increases power consumption.

Low-temperature polysilicon (LTPS) excels at delivering high current; it has excellent electron mobility. Unfortunately, it also has higher leakage. Its ratio of on-current to off-current is 10^7, somewhat better than a-Si.

IGZO has electron mobility nearly as high as LTPS, but its leakage current is vastly lower. The ratio of on-current to off-current is a phenomenal 10^9, essentially a billion to one. Low leakage current, combined with physically smaller size, makes it a clear winner for Smartphone's and tablets.

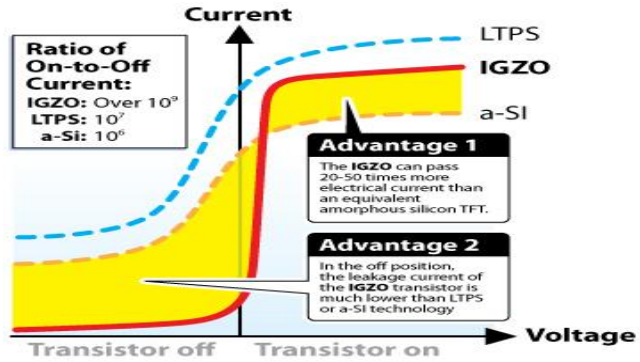

Fig 2: Benefits of IGZO compared to the other competing TFT technologies.

Low leakage current creates the potential for a new operating mode for LCD panels. Currently, the panel needs to be refreshed or "driven" continually because leakage current causes the cell to discharge. Too long a delay in refreshing the image would cause undesirable effects such as flicker or color shift. Although video images need to be refreshed continually, static images such as menu screens, documents and still photographs don't. Because IGZO LCD panels can retain their active state longer, it's possible to save additional power by skipping drive cycles. The benefits for tablets and phones, which often display static menus and pages, are obvious[8].

Although preliminary, this chart illustrates the potential for power savings, because the drive need not be continuous in an IGZO display, touch-sensitive displays can become more sensitive. Noise is a natural byproduct of any transistor switching on and off, and the millions of them in a display create a steady background noise, as shown in the graph on the left, below. The voltage spike caused by touching the panel is hard to detect. By interleaving the drive and touch detection cycles, touches are much easier to detect, as shown in Fig 3. For conventional finger-detection displays, the touch-sensing layer of the panel can be thinner. Touch panels tend to have difficulty detecting stylus input because the signal generated by the stylus tip is small compared to that of a fingertip. With the pauses, however, stylus detection becomes easier and more accurate, which is critical as resolution and display density increase.

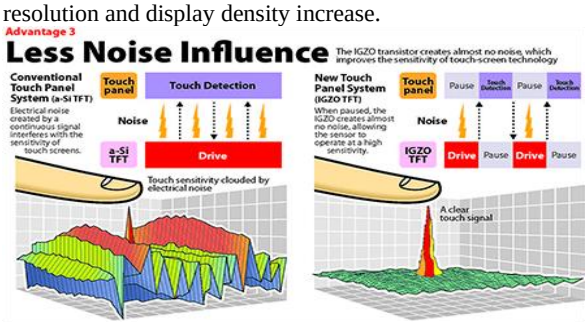

Fig 3: Less Noise Influence of IGZO.

4. Application

Sharp and its partners are already delivering and will soon deliver IGZO-based Smartphone's, tablets and monitors. Some existing and forthcoming models are describe as follow,

(1) For higher-resolution displays and better battery life for Smartphone's and tablets is already in market using IGZO and users are reaping the benefits. KDDI, a Japanese telecommunications company, has just released the AQUOS Pad, which uses a 7-inch IGZO display. Preliminary testing suggests that its low power consumption gives as much as three times the battery life of previous model tablets[9]

(2) The Aquos Phone Zeta, released from NTT Docomo, is the first Smartphone with an IGZO display. Now shipping in Japan, it has a 4.9 inch 1280 x 720 display and equally rich camera, processor and memory features to make it a premium phone with excellent battery life, over four and a half times more than a previous year's model.

(3) Softbank Mobile will also be releasing a Smartphone in Japan with an IGZO display

(4) Users of professional monitors are a breed apart from most business users. They include photographers, graphics designers, engineers using CAD, radiologists, video editors, and even analysts with complex charts and high-density numeric data. Some of these users employ multiple monitors when what they really need is higher display density. Sharp has unveiled its landmark PN-K321 monitor, a 32-inch (31-1/2 inch diagonal) 4K (Ultra-High Definition) monitor, with QFHD 3840 x 2160 resolution. It will be available in Japan.. This new monitor applies IGZO's smaller device geometry to

a current problem, a real product when many others are just showing very limited products.

(5) In 2012 Sharp displayed a 6.1-inch LCD with an astounding 498 pixel-per-inch resolution, 50 percent greater than one of the most highly touted displays of 2012. They also displayed a 13.5 OLED inch screen with the same 3840 x 2160 resolution as the 32-inch (31-1/2 inch diagonal) monitor above. On the smaller screen, that's 326 pixels per inch, a resolution that has to be seen to be appreciated [10].

(6) Sharp has also demonstrated flexible displays, using IGZO to drive OLED (organic light-emitting diodes). OLEDs don't require backlight and their application overlaps with LCD in some areas, but each has specific strengths. Remarkably, IGZO improves the performance of both technologies.

(7) The demand for resolution in all applications, from Smartphone's to wall-sized displays, is strong and getting stronger every day. Sharp has equipped its world-renowned Kameyama plant to produce IGZO panels, in ever-increasing size and volume.

The products mentioned above are manufactured by Sharp Corporation.

5. Future Scope

(1) Any working surface in your home or office can be both a display and touch-sensitive input device. Your bathroom mirror (or any room or appliance) can recognize you and adapt or adjust itself to your needs or preferences. Because IGZO lives behind glass, has extremely low quiescent power requirements, and can work cooperatively with sensitive measurement and sensing technologies, your environment can monitor your health and welfare as never before. An area on the floor can replace your bathroom scale; it can check your pulse, your temperature, calculate your body mass index, and more[11].

(2) A table is no longer a table. It's a newspaper, it's a magazine, and it's a TV. It's a research library, it's a homework station. It's a telepresence device, it's an artist's canvas, and it's a display for your favorite photos and images.

(3) A myriad of IGZO transistors and sensors woven into a fine, fabric-like mesh can become part of our clothing. It can monitor our workout and help to diagnose our illnesses. Sensors in the kitchen can verify the freshness of our food and give us real-time information on nutrition.

(4) The low power requirements of IGZO make self-powered devices more of a practical reality. Small devices may be solar-powered, running on ambient light. Devices that require more power may be charged wirelessly.

6. Conclusion

In this survey paper we try to inspect the features of IGZO display technology, there present Application and future Scope. During the survey we find that IGZO seems to be exciting feature in entertainment world as it not only replace Silicon in many existing application ,but also enable forward looking product that cover lifestyle ,workspace & quality of life devices. Sharp's bold step into large-scale production of IGZO places it squarely on the path to the future.

7. References

[1] Dr. Noboru Kimizuka and his colleagues at National Institute for Research in Inorganic Materials (Japan) were the first in the world to succeed in the synthesis of IGZO crystal in 1985, and they actively studied various homologous structures such as IGZO for more than 10 years.

[2] In 2004, Prof. Hideo Hosono and his team at Tokyo Institute of Technology.

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