Study about high temperature operating test result For Thin Film-Transistor Electro Phoretic Display on plastic

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Abstract

A 14.1-inch reflective type Thin Film Transistor-Electric Phoretic Display was developed at the resolution of 1280 x 900 lines on plastic substrate. All of the processes of TFT were carried out below 100 ℃ on PES plastic films. The process conditions of TFT were optimized for large area TFT-LCD on plastic substrate. At 60℃ high temperature during 160hours, TFT does not delaminate and IV characteristic is also satisfied.

1. Introduction

The technology mega-trend of the mobile displays has been emphasized at the viewpoint of convenience, personalization, and connectivity as well as display performance [1]. The Internet is generalized and information is explosive enlarged, display is more important and wider for expressive the information. The technology mega-trend of the portable displays has been emphasizing at the viewpoint of convenience, personalization, and connectivity as well as display performance. The development of plastic display has progressed for such mobile appliances as hand-held phones, personal digital assistants (PDAs) and E-paper due to the distinguishable advantages of plastics with respect to glasses [2]. Because the plastic display is ultra slim and light-weight and unbreakable. So the plastic display is large area, low cost, easily getting material. Among others was EPD as large area, it is used e-book and e-paper.

Moreover, the needs of better features for plastic TFT-EPD were increasing to maximize the display performance such as low cost and easily portable for e-paper. To meet the needs it became necessary to adapt active matrix EPDs on plastic substrates. In the present study a large size a-Si TFT device was developed on a PES substrate. Main components TFT of the display were built on the plastic substrate.

An Electronic Paper Display is a display that possessed a paper-like high contrast appearance, ultra-low power consumption, and a thin, light form. It gives the viewer the experience of reading from paper, while having the power of updatable information.

EPDs are a technology enabled by electronic ink - ink that carries a charge enabling it to be updated through electronics. Electronic ink is ideally suited for EPDs as it is a reflective technology which requires no front or backlight, is viewable under a wide range of lighting conditions, including direct sunlight, and requires no power to maintain an image.

Samsung has successfully made transmit Full Color TFT-LCD under 150℃ on plastic substrate.

So using this low temperature, 14.1-inch black plane Flexible TFT-EPD is developed under 100℃.

This paper descript about the reliability of TFT characteristics at room and high temperature.

2. Experimental

14.1-inch TFT-EPD has made successfully, but High Operating Temperature test is progressed using 8.1-inch TFT-EPD. Because manufactured 14.1-inch panels were not enough to estimate.

We tested at normally Samsung Environment test condition. The test condition is 60℃High temperature during 160hours.

Fig.1 is shown the scheme of plastic handling for TFT array before descript test result.

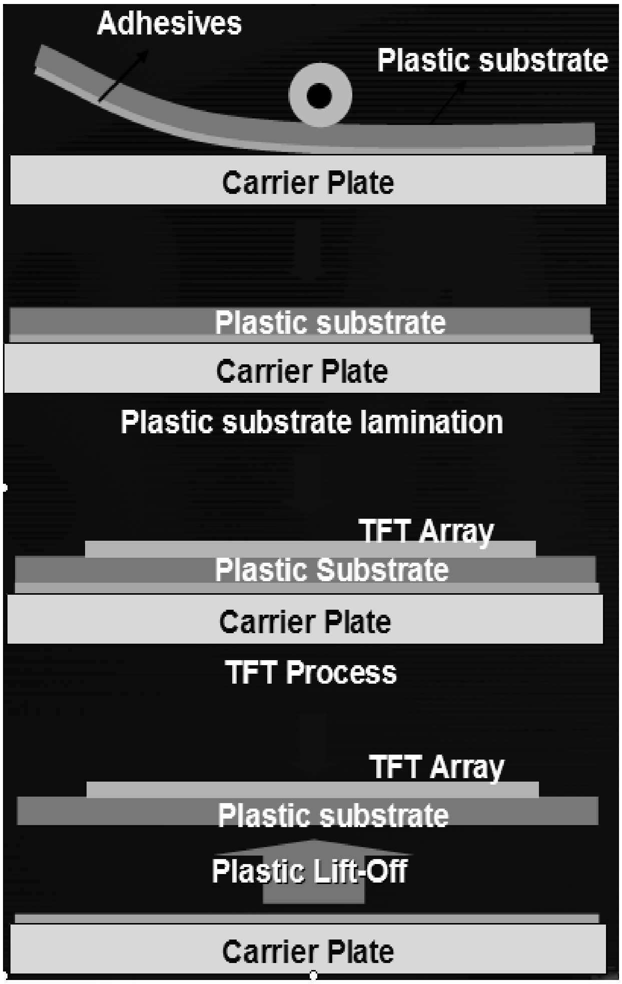

Fig. 1. Plastic handling scheme for TFT array

3. Results and discussion

14.1-inch size TFT process at 100℃ was developed, and TFT current-voltage characteristic obtained at low temperature process. The High Temperature Operating test is executed at 60℃ high temperature during 160hours.

For measuring TFT characteristics, input data voltage 10V, input gate voltage -20V ~ +20V, frame frequency 18Hz. During 160Hr high temperature operating test, DC stress time is shorter than TFT stress time.

After test, we found TFT I-V curve is very clear at room temperature, $I_{on}>10^5$, $I_{off}< 10^{-13}$.

After high temperature test, TFT I-V curve changed slightly. Also Vth shifted very slightly. It means on-current dropped very small. But the change level is not much.

At Fig.2, the black dot graph is I-V curve at room temperature. The red dot graph is I-V curve at high temperature 60℃. And the blue dot graph is I-V curve at low temperature 20℃.

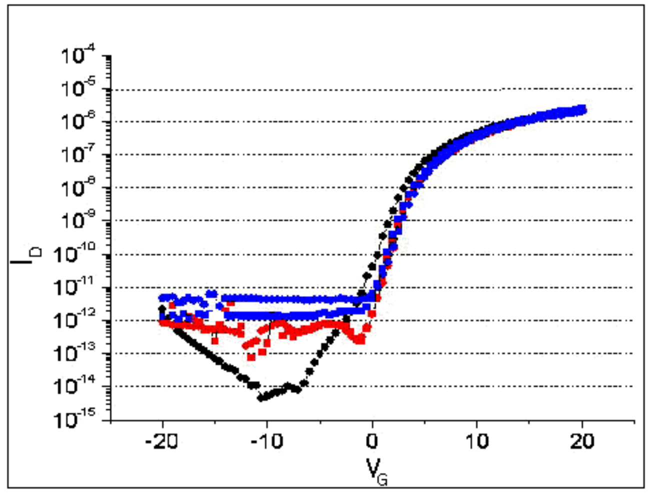

Fig. 2. TFT characteristics comparison room vs. Low vs. high temperature

The active temperature of E-ink ball made by E-ink is between 0 to 70 ℃. So we checked TFT I-V curve after low temperature operating test, but we could not see the EPD panel. Also, we found TFT I-V curve is very clear at room temperature, $I_{on}>10^5$, $I_{off}< 10^{-13}$. That means TFT's characteristics is assured at high and low temperature, but the display is not assured.
After test, image sticking and fade symptom show, so E ink balls material characteristics has to confirm.

4. Summary

We have optimized a-Si and SiNx properties for 100 ℃ deposition and demonstrated ability of high quality a-Si TFT fabrication on relatively large 14.1-inch PES substrates. It has been shown that TFT fabrication on the plastic requires optimization both materials properties for low temperature deposition and process architecture parameters in order to achieve required TFT performance. By appropriate control of thickness of PECVD films, we succeeded in high density TFT array on plastic substrates without any film failures. And TFT characteristic is also assured at room and high temperature.

Fig. 3. 14.1 inches TST-EPD

5. References

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