Extended Abstracts of the 2007 International Conference on Solid State Devices and Materials, Tsukuba, 2007, pp. 1106-1107

H-9-6L

OTFT-OLED Arrays using Screen Printing Process for Source and Drain Electrodes

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1. Introduction

There has been a great deal of interest in and research on AMOLED because of the possibility of thinner, lighter, faster more power-efficient displays. Several groups are working on OTFT-AMOLED. A meaningful result about AMOLED panel using pentacene TFT was reported by Pioneer group but the substrate was not plastic but glass, and the gate was also an inorganic material such as Ta_2O_5. LG electronic institute of technology demonstrated OTFT-AMOELD (12 x 12) on glass substrate. Samsung SDI and SAIT also fabricated OTFT-AMOLED (120 x 3 x 64). ETRI fabricated OTFT-AMOLED on plastic substrate (PC). And Penn State Univ. also reported OTFT-AMOLED (48 x 48) on plastic substrate (PET)[1]~[5].

In this paper, We fabricated OTFT-OLED display panel by using Ag-paste for source and drains electrode of OTFTs because of the possibility of extremely reduced processing cost. The panel was composed of 16 x 16 pixels on the substrate in which each pixel had 2 OTFT, 1capacitor and 1OLED.

2. General Instructions

The OTFT-AMOLED array was designed of 16x16 pixels. Each pixel had 2OTFTs-1Cap.-1OLED in the area of 2000μm x 2000μm. The OTFTs used the bottom contact structure. The fabrication process was as follows. The ITO pixel electrode was first patterned for the anode of OLED, and then the Al gate electrode was deposited on substrate and patterned by wet etching process. The CLA-PVP layer was spin-coated and annealed at 100℃ and 200℃, sequentially. The PVP organic gate material consisted of PVP polymer and cross-link agent (CLA), and Propylene glycol monomethyl ether acetate (PGMEA) as a solvent. We found that the optimum ratio of components was 10wt% of PVP mixed with 5wt% of CLA in 100wt% of PGMEA. The CLA-PVP was patterned by O_2 plasma after photolithography process. Subsequently, the Ag-paste solution was printed by screen printing process for source-drain electrodes. The pentacene semiconductor layer was deposited on the electrodes by thermal evaporation. For OLED, 2-TNATA (50nm), NPD (20nm) and Alq3 (50nm) were sequentially deposited through a shadow mask. Finally, the Al electrode was deposited for the cathode of OLEDs. Figure 1 shows the pixel cross-section of the fabricated device is presented.

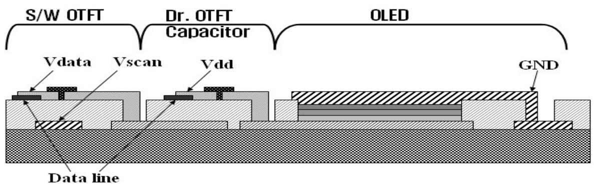

Figure 1. The cross section of pixel

In figure 2 a typical transfer and output curve of the OTFT by using Ag-paste are presented.

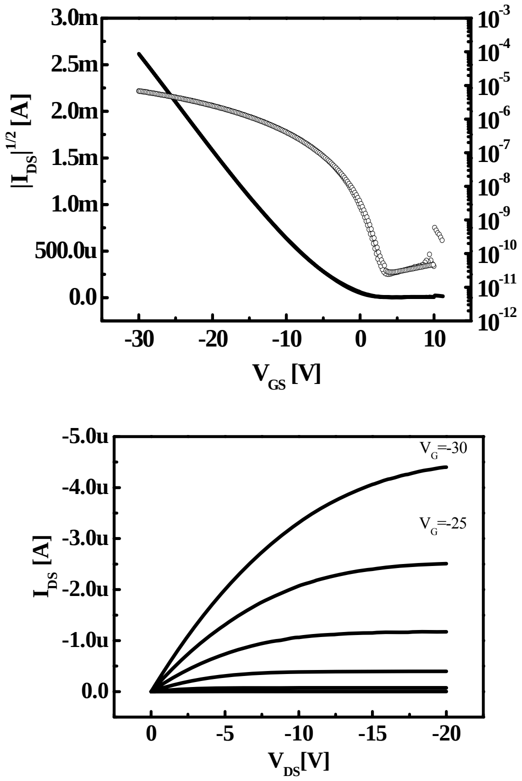

Figure 2. The electrical characteristics of printed OTFT

The OTFT produced the field effect mobility of 0.34 ± 0.018 cm^2/V.sec, off state current ~10^{-11}A, threshold voltage |2.68|± 0.35 V and on/off current ratio ~10^5. The performance of printed OTFT (Ag-paste) is comparable to those of vacuum deposited OTFT (Au-thin film)

In Figure 3, the final OTFT-OLED display panel with an array of 16 x 16 pixels and an enlarged view of the pixels is shown. The OTFT-OLED display panel generated green light in figure 3.

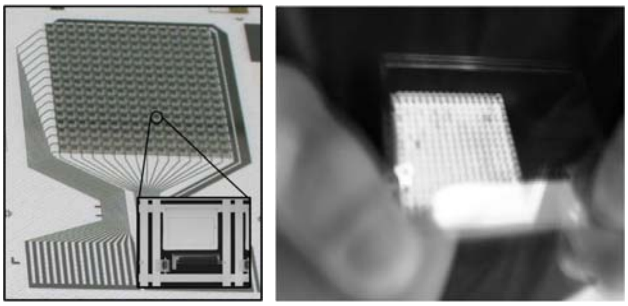

Figure 3. Images of fabricated printed OTFT-OLED array

3. Conclusions

We fabricated OTFT-OLED display panel by using Ag-paste for source and drains electrode of OTFTs. The OTFTs were fabricated by solution processes such as spin-coating for PVP gate dielectric and screen printing for S/D electrodes with Ag-paste, except pentacene active layer which was deposited by evaporation. The mobility was 0.343±0.018 $cm^2/V.sec$ and off state current ~10^{-11} A and on/off current ratio ~10^5. The panel consisted of 16 x 16 pixels on PEN substrate and each pixel consisted of 2 OTFTs, 1 Capacitor and 1 OLED. The pixels were successfully worked by supplying sufficient current to OLED under the control of driving and switching OTFTs.

Acknowledgements

This research was supported by a grant(F0004061) from the I nformation Display R&D Center, one of the 21st Century Frontier R&D Program funded by the Ministry of Commerce, Ind ustry and Energy of the Korean Government.

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