Extended Abstracts of the 2004 International Conference on Solid State Devices and Materials, Tokyo, 2004, pp. 690-691

P13-10

The Analysis of Corelation between Pentacene TFTs and OLEDs

Gi Seong Ryu, Kyung,Soo Pyo, Chung Kun Song*

Division of Electrical & Electronics & Computer Engineering Dong-A University
840 Hadan-dong, Saha-gu, Busan, 604-714, Korea
Phone: +82-51-200-6965 E-mail: gsryu@ donga.ac.kr

1. Introduction

Especially, Active-Matrix Organic Light Emitting Diode (AMOLED) that is easy to materialize flexible display has being lively studied nowadays. The hydrogenated amorphous silicon thin film transistor (a-si: H TFT), polycrystalline silicon thin film transistor (poly-si TFT) is mainly used for deriving devices for AMOLED. But these deriving devices that are based on silicon have low compatibility with OLED, and are difficult application to plastic substrate. Therefore, we propose Organic Thin Film Transistor (OTFT) for deriving devices instead of TFT based on Si to overcome those problems and analyze OTFT for driving transistor through an experiment. We experiment on fabricating OTFT, OLED, Test panel on glass and pet substrate, and analyze the characteristics.

In this paper, we analyze the deriving of OLEDs by OTFTs prior to the research of OTFT-OLED (organic thin film transistor – active matrix organic light emitting diode). At first, we look into each device characteristics of OTFTs and OLEDs, then fabricate test panel and confirm substantial deriving. We fabricate each device on glass and plastic (PET) substrate to analyze the characteristic of OTFTs and OLEDs.

2. General Information

OTFT is fabricated by top contact (inverted staggered) structure that has good current characteristic. At first, we pattern gate electrode. The gate electrode is patterned ITO and fabricated by two-story structure evaporating Al two times to enhance conductivity. The gate insulator is cross-linked PVP that can be lithography process. The patterning of gate insulator layer is dry etched using O_2 plasma treatment after lithography. Next, we make pentacene thin film as active layer. Pentacene thin film is vacuum deposited and substrate temperature is kept up at 80℃. After then, we finally evaporate Au as contact metal. The designed OTFT' L(channel length) is 50㎛, 60㎛, 70㎛ and W(channel width) at each L is made up of 0.5~ 4.0mm changing per 0.5mm. We obtain about 0.3cm/V•sec mobility and about 10^5 on/off ratio. Moreover, we can observe a linear increase current when W is increased. We expect that we can derive 1㎟ OLED when L is 70㎛, W is over 2.5mm and gate voltage is -15V. *[Fig1, Fig2]*

To make OLEDs, we pattern ITO coated on substrate and use as plus electrode, and TPD (HTL) and Alq3 (EML) as active layer are deposited sequently. The thickness of deposited organic materials is each 350Å. We evaporate Al using shadow mask for minus electrode. We can observe the light using the fabricated device at about 5V and the current is about 1uA/mm. The observed light has 530nm wave length and shows normal green color. *[Fig3]*

We fabricate Test panel to confirm the deriving of OLEDs by OTFTs. Test panel is composed with several kinds of OTFTs and OLEDs that have various sizes. The process is that first fabricate of OTFTs and make OLEDs later. We inter-connect OTFTs and OLEDs using Al that is minus electrode of OLEDs. The main reason that OTFTs process is earlier then OLEDs is that the organic materials using OTFTs are more stable than those of OLEDs, and OTFTs process need more higher substrate heating than OLEDs. We can verify the deriving of OLEDs by OTFTs using fabricated Test panel and also confirm the changing of luminance by gate voltage. *[Fig4~ Fig6]*

3. Conclusion

In this paper, we can confirm the deriving capacity of OTFT about OLED. We calculate W/L ratio of OTFT according to the Pixel area of OLED. We need more study about matrix panel using OTFT.

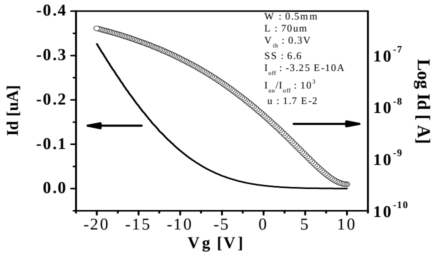

Fig1. Transfer characteristic of OTFT
(Vg : 10 ~ -20V, Vds : -20V)

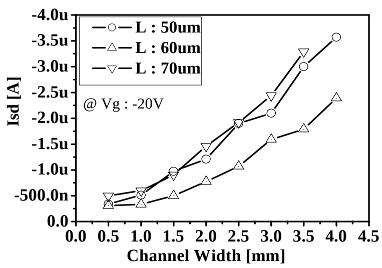

Fig2. Channel dependence of I_{ds}

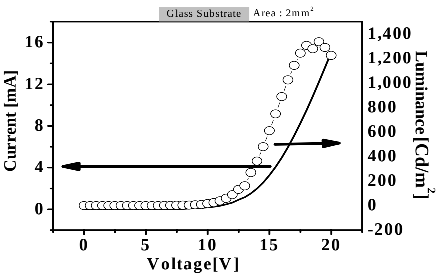

Fig3. I-V-L characteristic of *OLED*

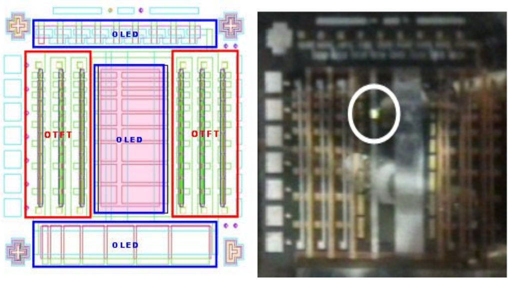

Fig4 Layout of Test Panel

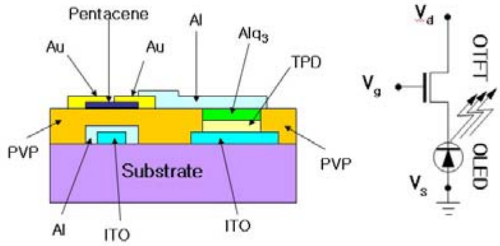

Fig5. Structure and Equivalent circuit of a pixel

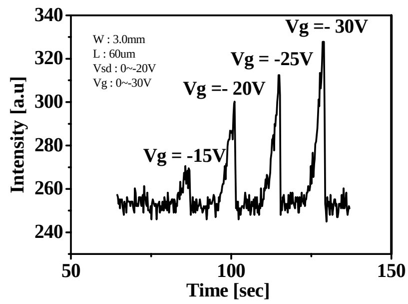

Fig6. Gate voltage dependence of luminance of OLED

Acknowledgment

This work was supported by grant No.(R05-2000-000-00271-(2002)) from the Basic Research Program of the Korea Science & Engineering Foundation

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