Fabrication of Test Panel for AMOLED driven by Pentacene TFTs

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Abstract

In this paper we fabricated a test panel for AMOLED on glass and PET substrate. The test panel consisted of the various size of OTFTs and OLEDs and the current driving capability of OTFTs for OLEDs has been investigated. OTFTs were made of the inverted staggered structure and employed polyvinylphenol (PVP) as the gate insulator and pentacene thin film as the active layer. The OTFTs produced the filed effect mobility of 0.3㎠/V.sec and on/off current ratio of 10^5. OLEDs consisted of TPD for HTL and Alq3 for EML with 35nm thick, generating green monochrome light. We found that OTFT with channel length of 70㎛and channel width of over 3.5mm provided the sufficient current to OLED to generate the luminescence of 0.3Cd/㎡.

1. Iintroduction

The information-oriented society bring growth of market nowadays, lots of researches into new display are carried out to get the ascendancy in display market. The requisites for normal new generation display have light-thin form, and are possible to low-consumption electricity and application to various areas. Also, there are required to low price and color expression get near to natural color.

Organic LED (OLED) is new remarkable thing in display market. OLED is light and cheap because it is fabricated on single substrate by deposition. Also, it is suitable for portable due to low consumption electricity. It has flexibility because of variety process possibility. Furthermore, it is possible to make flexible display because it can be apply to plastic substrate by low temperature process.

OLED is studied for two types. The one is Passive Matrix OLED (PMOLED). This is simple structure and easy to process. But, it is not suitable for fast data like as large area and movement image. To assist these demerits, Active Matrix OLED (AMOLED), the other type, is studied

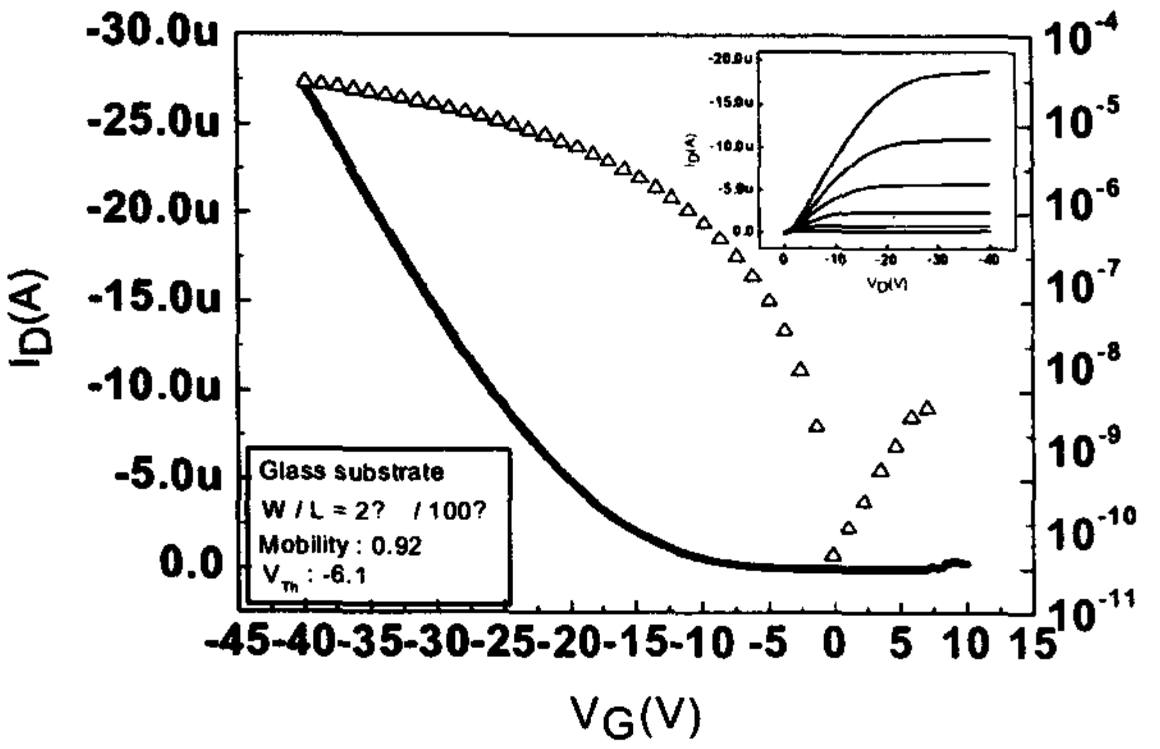
AMOLED is mainly studied to application to a-Si, Poly-Si TFTs that show technical stability in AM-LCD nowadays. However, it has a difficult point of process temperature for application to plastic substrate for flexible display that is the greatest merit of OLED. Using both organic and inorganic material is primary factor of rising of manufacture unit cost because it is drop alternative possibility for manufacture equipment and process. Therefore, it is need to research about organic TFTs that is possible to low temperature process to show AMOLED's characteristics.

In this paper, we confirm drive of the unit pixel fabricating test panel by OTFT before making ALOLED panel using OTFT.

2. Experiment

2.1 Pentacene TFTs

We fabricate OTFTs that have a variety of length(L) and Width(W) to show capability according to channel. L is fabricated in 50 ㎛, 60 ㎛, 70 ㎛ using shadow mask. W is made from 0.5 ㎜ to 4 ㎜ increased 0.5 ㎜ following each L. We fabricate OTFTs as inverted staggered that is good at current property. The process order is that we patterned ITO as electrode and deposited Al again to enhance conductivity. The gate insulator that is made by the solution with poly 4 – vinylphenol (PVP) and melamine-co-formalde hyde (poly) in propylene glycol monomethyl ether acetate (PGMEA) is spin-coated. After lithography process, we patterned gate insulator using O_2 plasma. Pentacene as active layer is deposited by organic molecular beam deposition (OMBD), and the temperature of deposited substrate is heated at 80℃. Au is used by contact metal, and it is deposited by evaporator equipment and shadow mask is used. The fabricated OTFTs are show that mobility is about 0.3 ㎠/V.sec. and on/off ratio is about 10^5 .



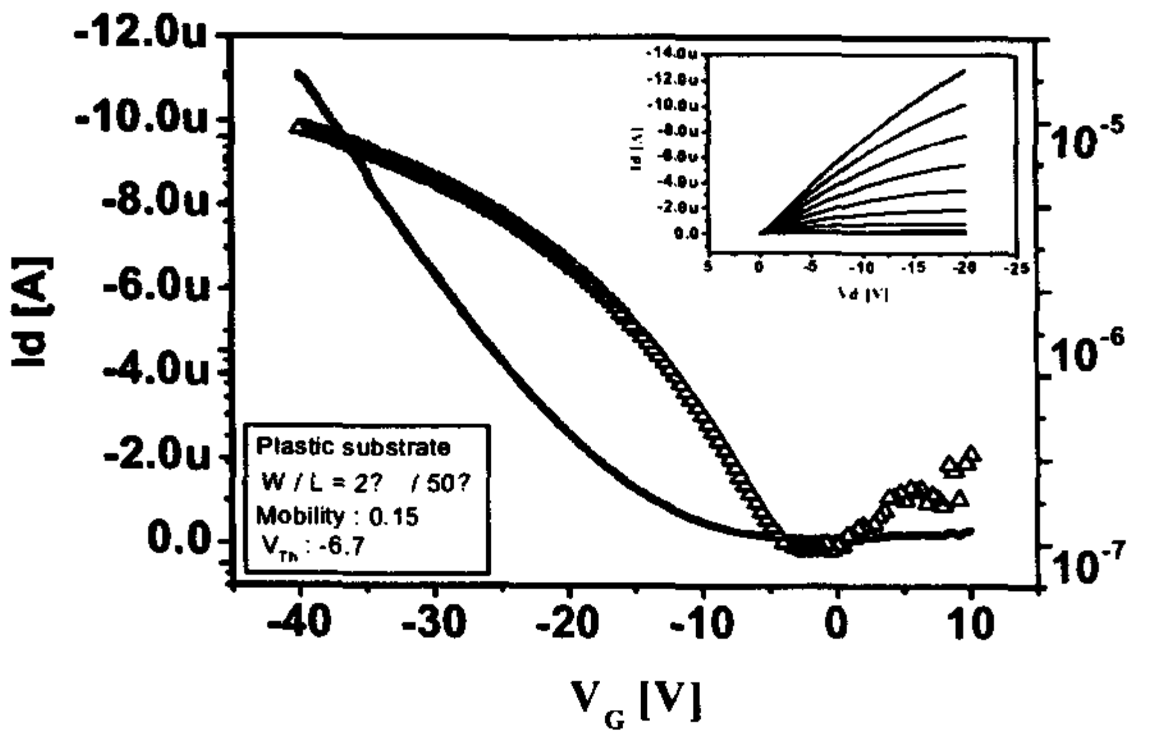
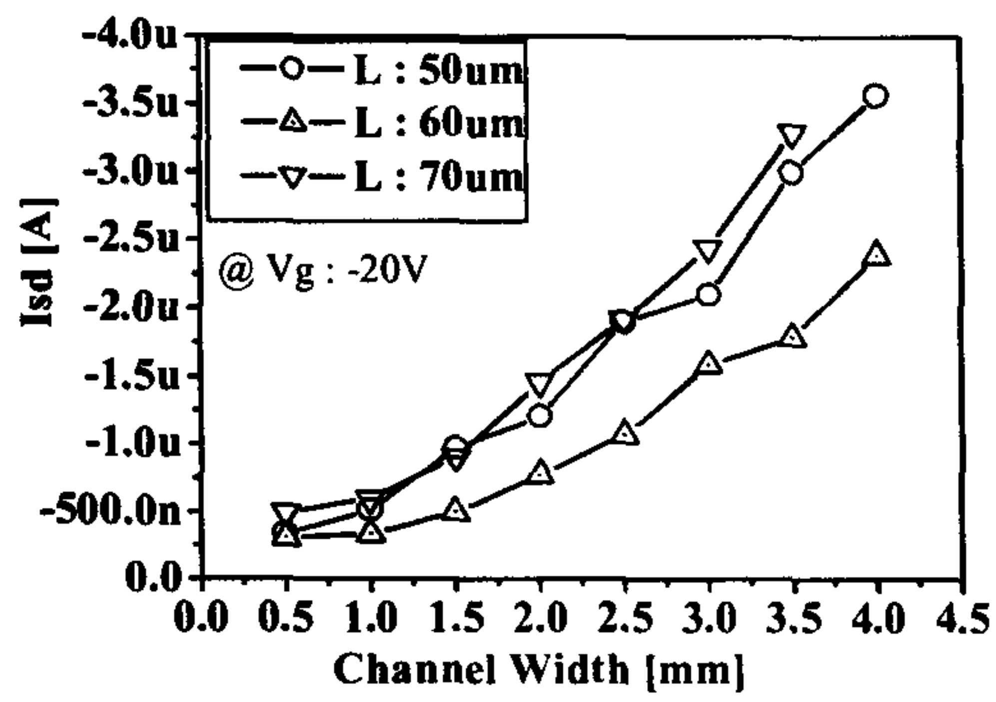


Fig1. Transfer characteristic of OTFT (Vg : 10 ~ -20V, Vds : -20V)



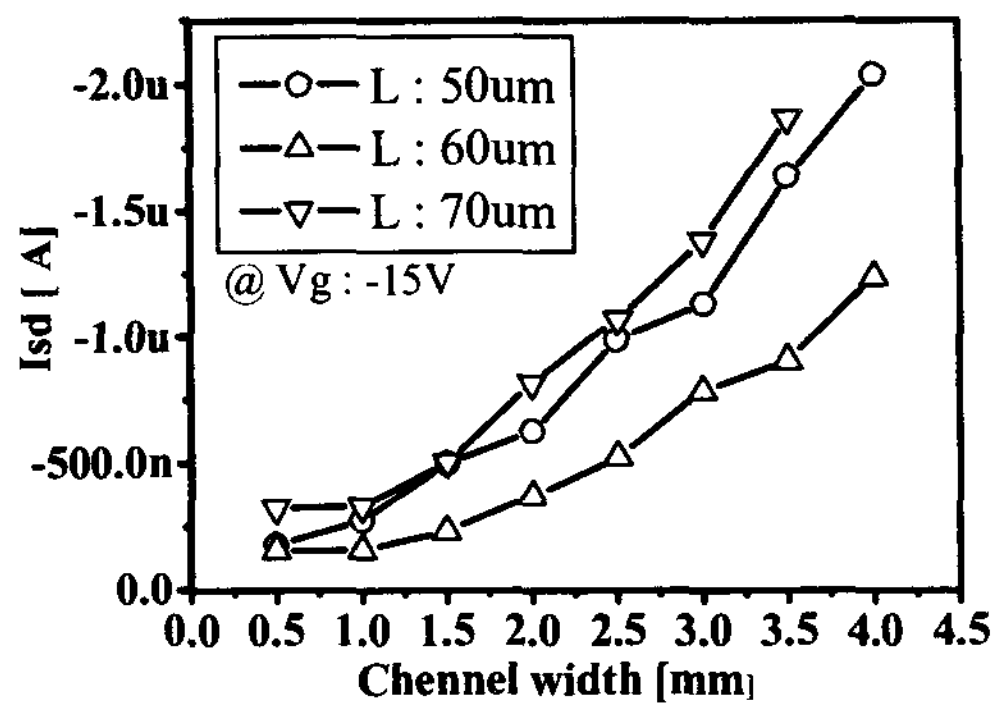
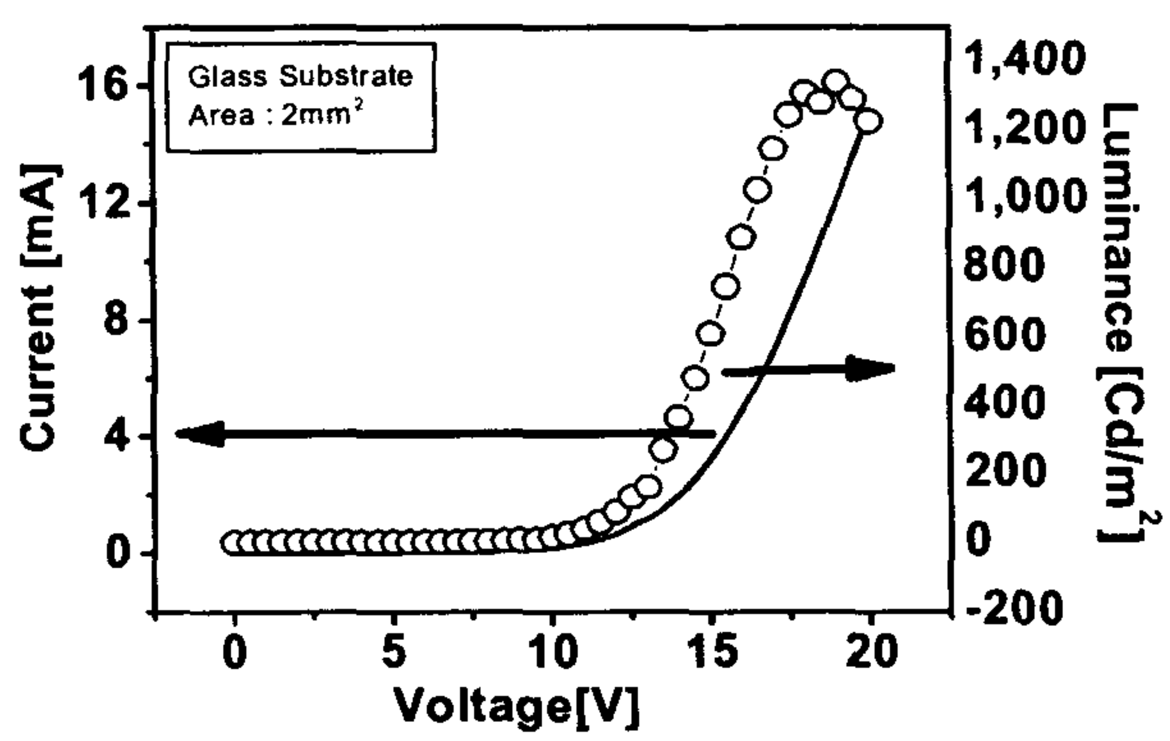


Fig2. Channel dependence of I_{ds}

2.2 Organic LEDs

OLED use patterned ITO as anode and deposited organic matter is two-story (HTL, EML) structure. HTL is deposited using 35 nm TPD and EML is also deposited 35 nm Alq3. Al as cathode is thermal evaporated.

The characteristics of fabricated OLED are shown as graphs and I-V characteristic is shown like typical diode property, and we can confirm that luminosity is increased in proportion to current. The light has about 530nm wave length and radiate typical green color. Especially, we can observe light using the naked eye when the voltage is about 5V(1.35μA/mm^2 in glass substrate, 1.93μA/mm^2 in plastic substrate). It is applicant to output current value that is required by OTFTs



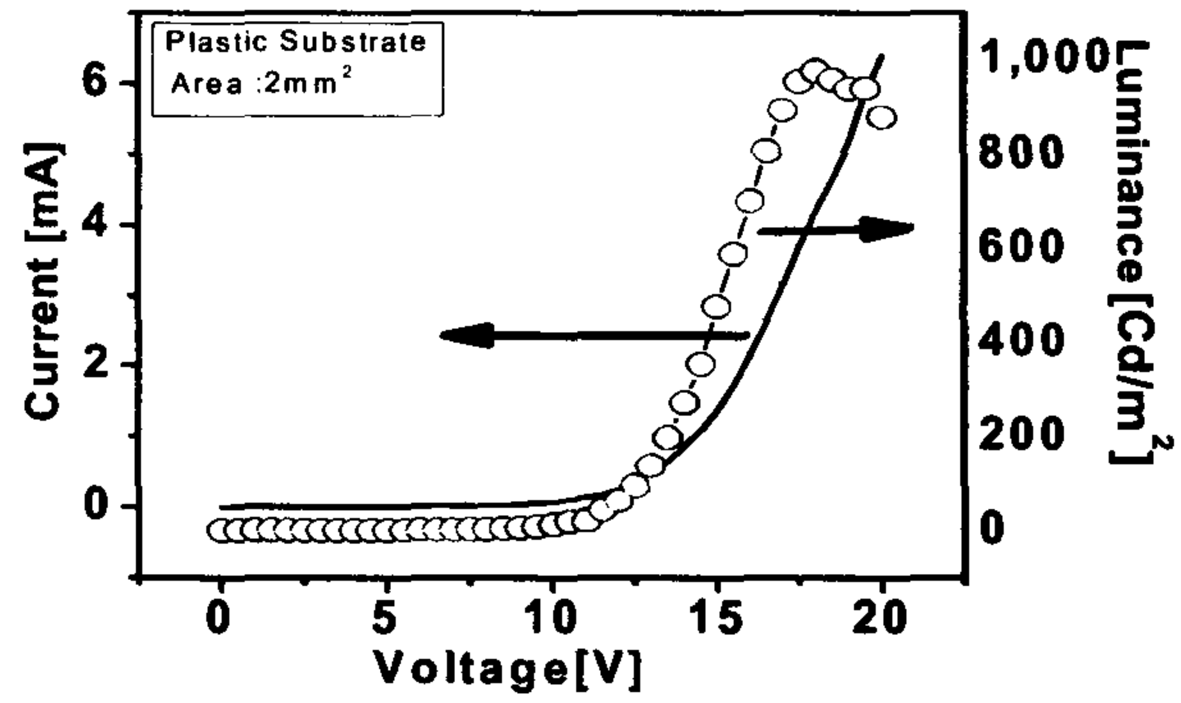
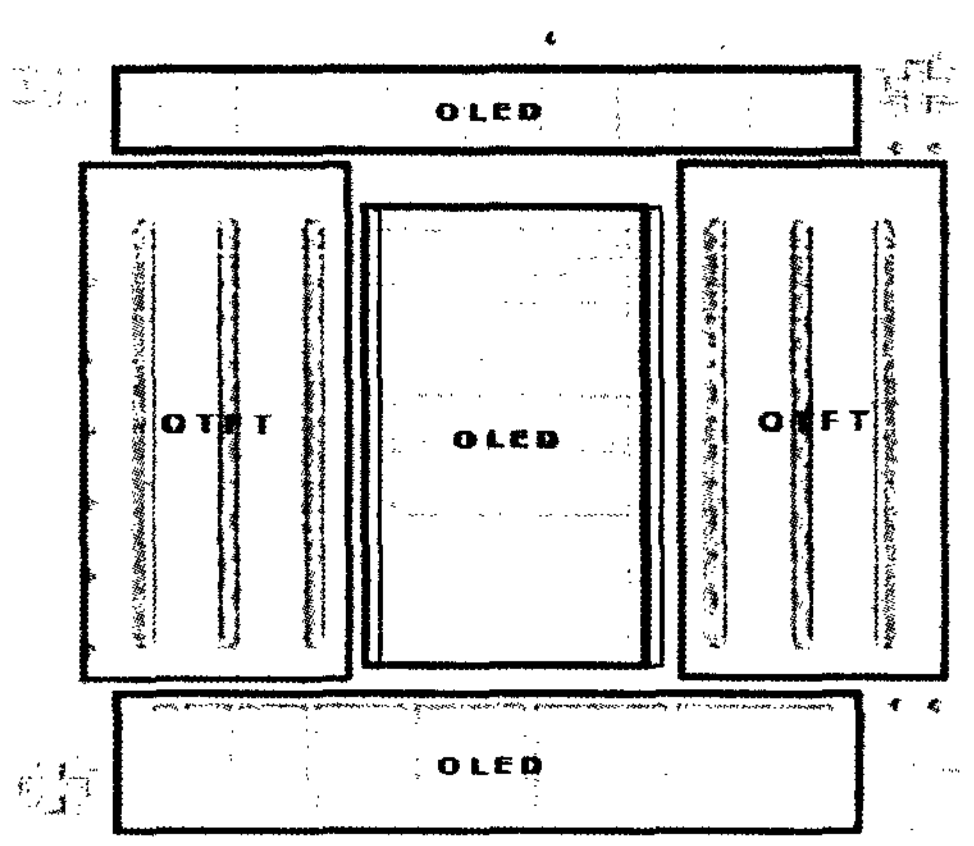


Fig3. I-V-L characteristic of OLED

2.3 Test panel for AMOLED

We fabricate test panel to confirm the drive ability of OLED by OTFTs. Each side of test panel is located various OTFTs and fabricated with equal process. 1 ㎜ × 1 ㎜ sized OLEDs are series connected on the upside of panel and OLEDs that is formed from 1 ㎜ × 1 ㎜ are constituted on middle and bottom side of panel. Each OLED is confirmed by each OTFT. The first of process is that gate electrode of OTFTs and ITO as anode of OLEDs is patterned and cross-linked PVP as gate insulator is coated. Then, pentacene as active layer of OTFT is deposited by OMBD and contact metal(Au) is evaporated using shadow mask. After then, organic of OLEDs is deposited, and cathode of OLEDs and inter-
connect metal, Al, is thermal evaporated using evaporator. During fabrication process, when we made active layer of OTFT, it is necessary to heat substrate until 80℃. We made OTFTs before OLEDs process because active layer is more stable than deposited organic of OLEDs. We can confirm drive of fabricated davice from shown graph.



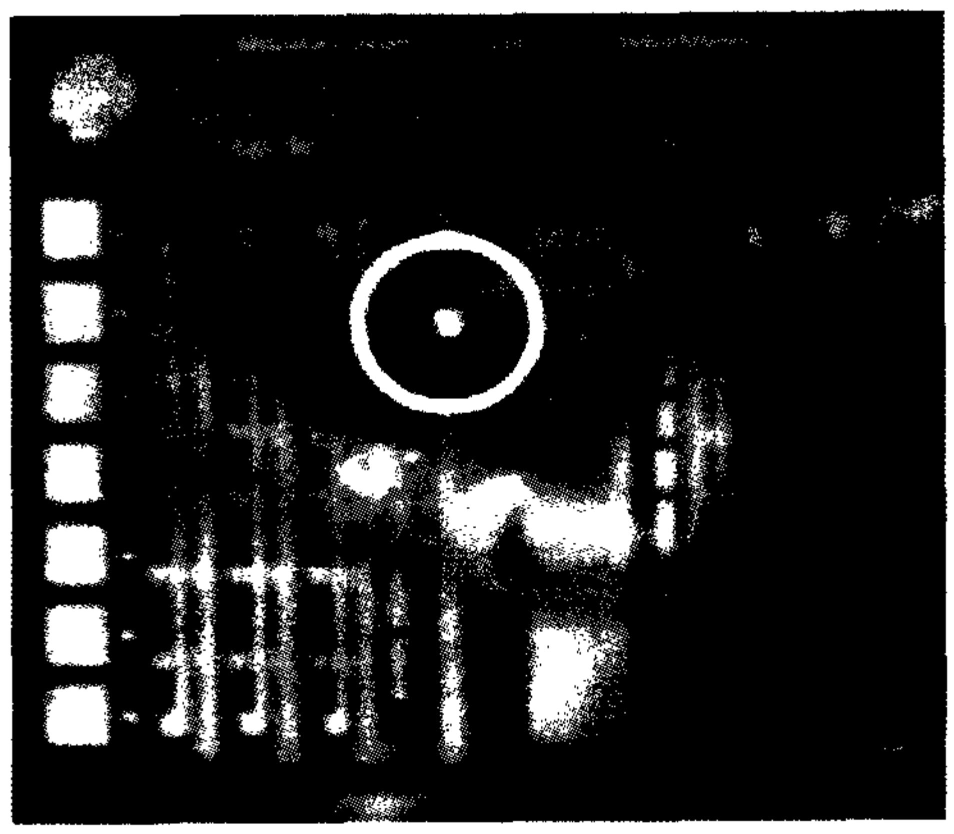


Fig4 Layout of Test Panel

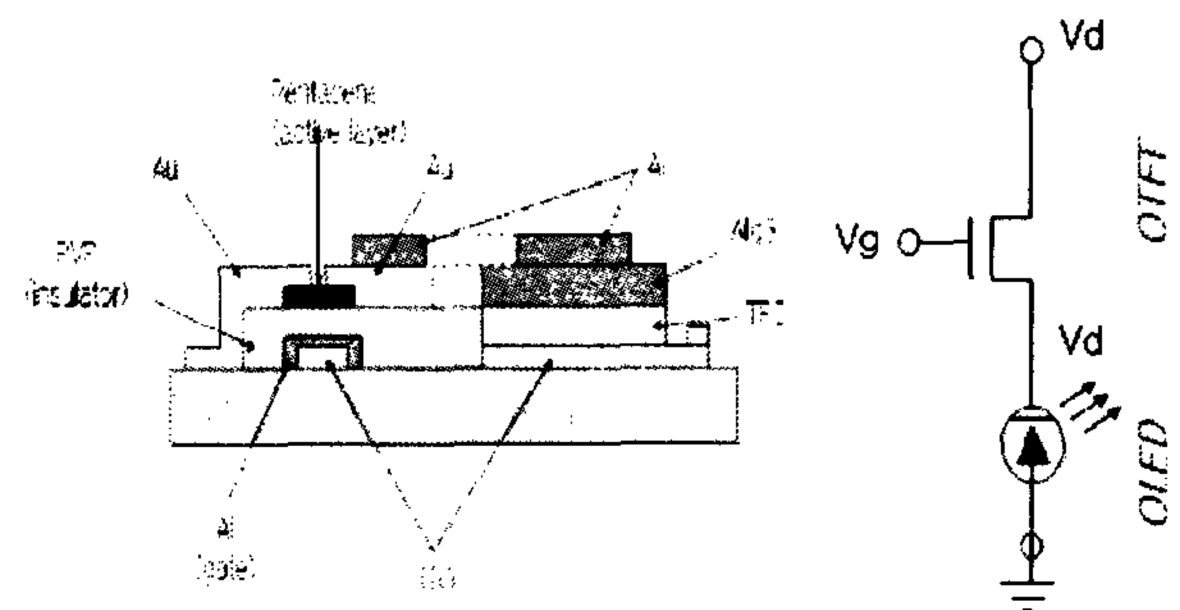


Fig5. Structure and Equivalent circuit of a pixel

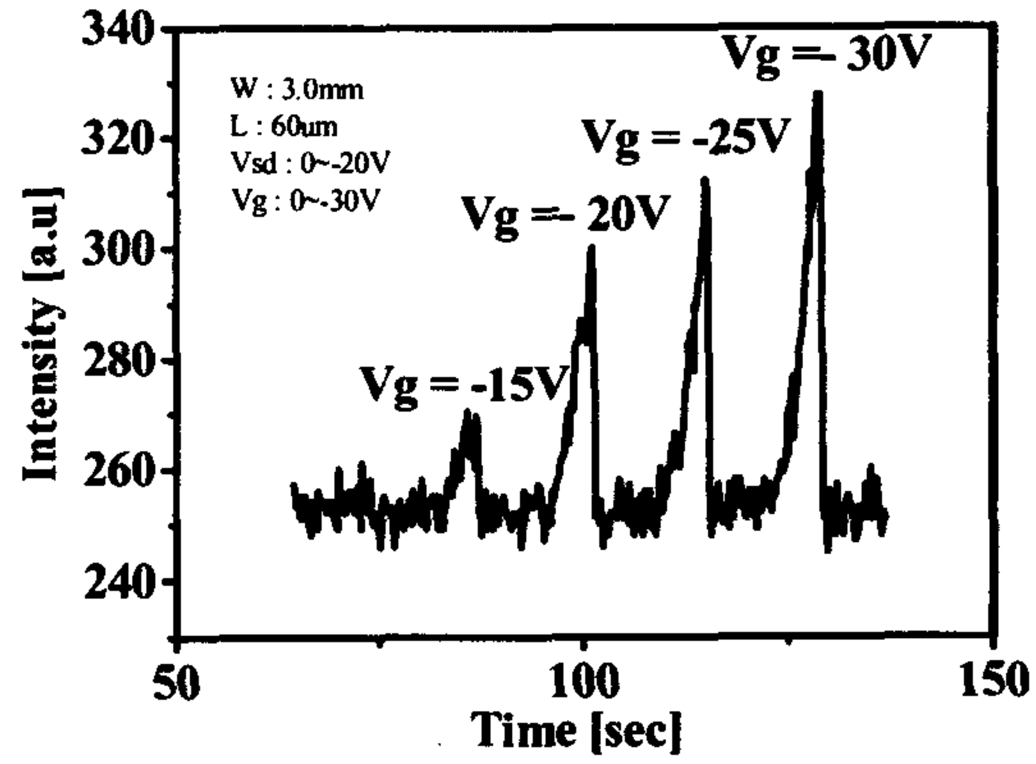


Fig6. Gate voltage dependence of luminance of OLED

3. Results

The characteristics of fabricated OTFTs is that mobility is 0.3㎠/V.sec and on/off current ratio is 10^5, and OLEDs have 530㎚ typical LED property. To observe light of fabricated OLED, the current of 1.35㎂/mm^2 in glass substrate and 1.93㎂/mm^2 in plastic substrate is required. The necessary condition of OTFT to satisfactory these figures is that W is more than 3㎜ and L is 70㎛ at 30V of gate voltage. It can be confirmed practice drive using test panel. However, the observed light has low luminosity. But, this can be raised by improving of process and structure of OLED. We can also confirm the change of luminosity in proportion to gate voltage

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4. Rferences

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