오엘이디의 단일 소자분리 구조를 위한 이미지 리버셜 감광제

Image Reversal Photoresist for the Single Isolation Structure of OLEDs

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Abstract

We have developed an image reversal photoresist with high thermal stability and electric insulating properties for the single isolation structure of OLEDs. The thermal stability and electric insulating properties are investigated and compared with those of conventional insulator and cathode separator materials. The single isolation structure using the image reversal photoresist reduces the fabrication process steps and cuts down the manufacturing cost.

Introduction

In previous works, we developed a single isolation structure for OLEDs where an insulator and cathode separators were formed simultaneously by a single layer of image reversal photoresist (IR-PR) to reduce the process steps and to increase an aperture ratio, as shown in Fig. 1.[1-4] In the single isolation structure, the IR-PR is used because the insulator is required to have a positively tapered edge profile while the cathode separators are required to have a negatively tapered edge profile. Moreover, the IR-PR is required to have thermal stability over 200 ℃ and electrical insulating properties for OLED applications, so we have developed an IR-PR based on a polyhydroxystyrene resin. In this study, we present its electrical and thermal properties, and discuss its applicability to OLEDs.

Experiments and Results

As shown in Fig. 1, the IR-PR is cured over 200 ℃ after a development process to remove a solvent completely. The SEM image of the single isolation structure cured at 230 ℃ for 60 min in a convection oven and its process conditions are shown in Fig. 2. Its shape and taper angle are not changed during the curing process. TGA measurements show that the IR PR is thermally stable up to ~300 ℃.

The breakdown voltage, specific resistance and dielectric constant of the IR-PR were measured and compared with those of a conventional insulator material, as shown in Figs. 3 to 5. Both of the IR-PR and the conventional insulator material have a breakdown voltage over 3.5 MV/cm. Even though the specific resistance of the IR-PR is bigger than that of the conventional insulator

material, it is acceptable since they are of the same order of magnitude. The dielectric constant of the IR-PR is 3.8 at 1 MHz while that of the conventional insulator material is 3.5 at 1 MHz.

Using the single isolation structure formed by the IR-PR, 1.17" 96xRGBx96 PMOLEDs were fabricated. The display performance and reliability were equivalent to those of conventional ones.

Conclusions

We have developed an IR-PR with high thermal stability and electric insulating properties for OLED applications. This IR-PR makes the single isolation structure applicable to OLEDs, thereby reducing the fabrication process and cutting down the manufacturing cost.

References

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2. K.-H. Choi, S.-W. Youn, B.-H. Byun, S. J. Yi, D.-H. Choi, T.-H. Yeo, H.-J. Lee, S.-G. Choi, and H.-M. Yoon, SID '06 Symp. Dig., 429 (2006)
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4. Y.-H. Lee, S.-W. Youn, K.-S. Kim, K.-H. Choi, S. J. Yi, and D.-H. Choi, Proc. IDW '06, 1303 (2006)

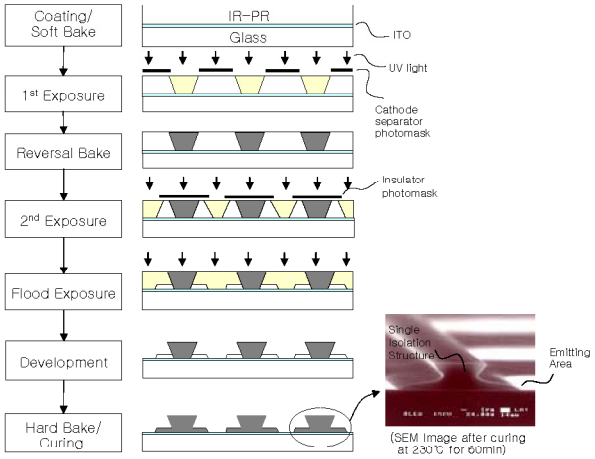
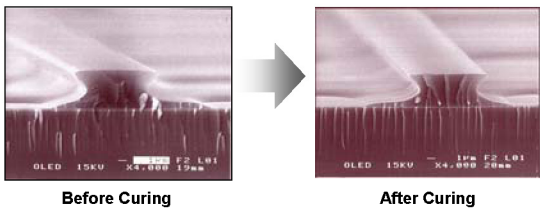


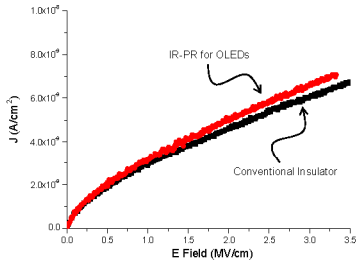
Fig. 1 Single Isolation Structure



[Process Conditions]

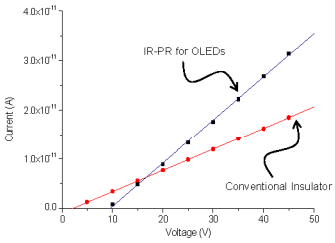
Substrate	: ITO patterned glass
Coating thickness	: 5.5 ㎛
Soft bake	: 90 ℃, 90 sec
1st Exposure	: 110 mJ/cm²
Reversal bake	: 100 ℃, 150 sec
Flood Exposure	: 70 mJ/cm²
2nd Exposure	: 300 mJ/cm²
Development	: 2.38% TMAH (23 ℃) 70 sec
Rinse	: DI water shower (23 ℃) 30 sec
Oven Curing	: 230 ℃, 60 min

Fig. 2 SEM Image after curing



	Breakdown Voltage	Thickness	Remark
IR-PR	> 3.5 MV/cm	0.30 ㎛	- Sample Area: 6.95x10⁻⁴ cm² - Oven Curing: 230 ℃, 60 min
Conventional Insulator	> 3.5 MV/cm	0.26 ㎛	

Fig. 3 Breakdown Voltage



	Specific Resistance	Thickness	Remark
IR-PR	1.12 x 10¹⁴ Ω cm	1.07 ㎛	- Sample Area: 1.05x1.0 mm² - Oven Curing: 230 ℃, 60 min
Conventional Insulator	2.47 x 10¹⁴ Ω cm	0.99 ㎛	

Fig. 4 Specific Resistance

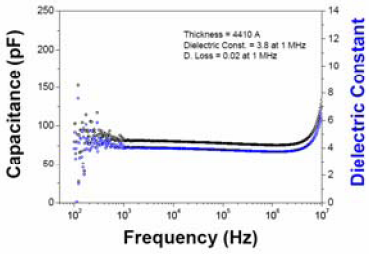


Fig. 5 Dielectric Constant