Single Isolation Structure of High Aperture Ratio for a PMOLED

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Abstract

We have developed a self-aligned single isolation structure (SIS) and an asymmetric single isolation structure with an image reversal photoresist to increase the aperture ratio in a passive matrix organic light emitting display (PMOLED). Compared to the conventional structure, the fabrication process is reduced by about 17% and the aperture ratio is enlarged over 4%.

1. Introduction

PMOLED displays utilize a simple structure well suited for information displays of low cost. In PMOLED displays, the individual pixels are defined by the overlap of ITO columns (anodes) and metal rows (cathodes). The anode strips are generally formed by photolithography and etching. However, it is very difficult to create fine definition patterns for the cathode by photolithography and etching because developer and etching solution damage the underlying organic compounds. Therefore, a cathode separator is formed on an insulator as a stripe pattern with a negative taper angle using a negative photoresist for the separation of cathode electrodes. And, using a positive photoresist, the insulator is formed as a lattice pattern with a positive taper angle before the formation of the cathode separator to prevent electric shorts between the anode and cathode electrodes on their edges. In general, the layers of cathode separators and insulator called isolation layers have a two-layered structure formed by two photo-lithographic processes [1], and have the limitation in minimizing their widths because of the overlay tolerance and adhesion in the interface.

The limitation caused by the adhesion in the interface has been improved by forming the insulator and the cathode separator with a single layer called a single isolation structure using an image reversal photoresist [2, 3]. However, the single isolation structure also has the limitation caused by the overlay tolerance.

To overcome the limitation caused by the overlay tolerance, we have developed a self-aligned single isolation structure and an asymmetric single isolation structure using an image reversal photoresist.

2. Results

The image reversal photoresist (IR-PR) is used as a positive photoresist in normal photolithographic processes, and is used as a negative photoresist by adding a reversal bake and a flood exposure to the normal processes [4]. We have developed two types of single isolation structures using image reversal photoresist.

The first type is a self-aligned SIS (single isolation structure) where a trench having a negative profile is self-aligned and formed in the middle as shown a SEM image in Figure 1. The self-aligned SIS processes do not require an exposure for the trench, the cathode separator. The self-aligned SIS is fabricated by the following process sequence: cleaning → coating of IR-PR → soft bake → exposure for an insulator pattern and exposure for a cathode connection → 1'st developing (2.38% TMAH) → reversal bake → flood exposure → 2'nd developing → curing. The schematic drawings of the self-aligned SIS processes are shown in Fig. 2. Even though an exposure for the trench is not carried out, the sides of the insulator pattern are cross-linked after the reversal bake because a certain quantity of the exposure dose remains in the sides after the first developing for the insulator pattern as shown in Fig. 2. Compared with the conventional structure, the fabrication processes are reduced by about 17% (from 12 to 10 process steps). And, the aperture ratio is enlarged over 1% because it doesn't need an alignment margin.

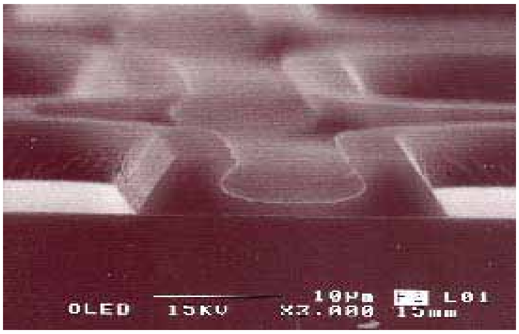

Figure 1. Self-aligned SIS (SEM image)

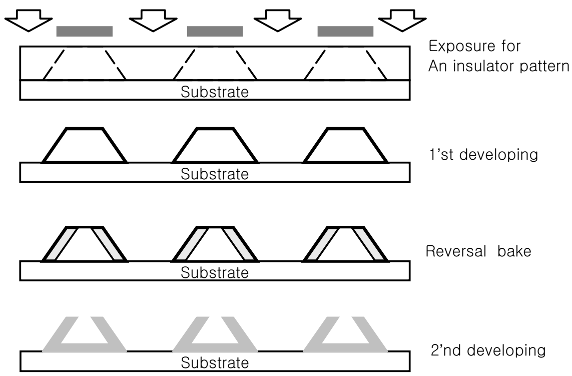

Figure 2. Schematic drawings of self-aligned SIS processes

The second type is an asymmetric SIS. In this asymmetric SIS shown in Figure 3, the negative profile is formed in one side of the cathode separator.

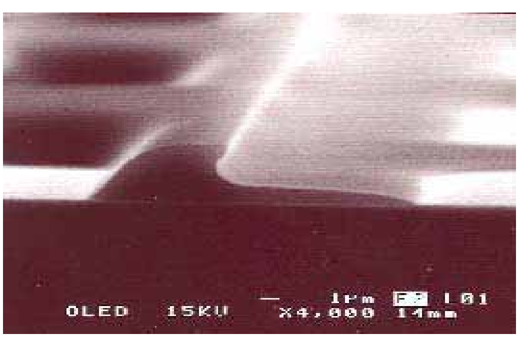

Figure 3. Asymmetric SIS (SEM image)

The asymmetric SIS is fabricated by the following process sequence: cleaning → coating of IR-PR → Soft bake → exposure for an insulator pattern → 1'st developing (2.38% TMAH) → exposure for an asymmetric cathode separator pattern → reversal bake → flood exposure → 2'nd developing → curing. The schematic drawings of the self-aligned SIS processes are shown in Fig. 4. Compared with the conventional structure, the fabrication processes are reduced by about 17% (from 12 to 10 process steps). And, the aperture ratio is enlarged over 4% because it minimizes the width and alignment margin.

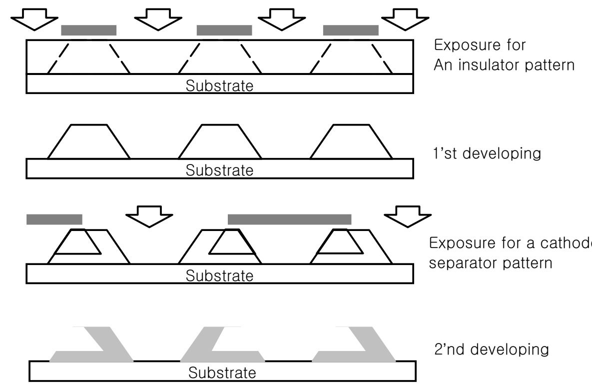

Figure 4. Schematic drawings of asymmetric SIS processes

3. Conclusion

A self-aligned single isolation structure (SIS) and an asymmetric single isolation structure have been developed to increase the aperture ratio and to simplify the fabrication process in a PMOLED. Compared with the conventional structure, the fabrication process is reduced by about 17% and the aperture ratio is enlarged over 4%.

4. References

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