Flexible Organic Light Emitting Diodes

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Abstract:
Flexible displays are those that can be fabricated on plastic substrates, metal flexible foils or even on very thin sheets of glass [1]. The use of these type of substrates assign various characteristics to the displays such as very thin thickness, light weight, and the ability to be bent, flexed, conformed or rolled to a radius of curvature of a few centimeters without losing its functionality [1, 2]. Also, flexible displays can be cut into a variety of shapes allowing greater freedom in product design. Organic Light Emitting Diodes (OLEDs) are being considered good candidates for a new generation of displays and lighting applications due to properties such as low-power consumption, excellent image quality, fast response time and high brightness [2]. The use of flexible substrates to manufacture displays demand the establishment of new tools and processes due to its lower thermal, mechanical and dimensional stability when compared to rigid substrates. In this contribution, we present the process steps developed to obtain flexible OLEDs.
Flexible Organic Light Emitting Diodes

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ABSTRACT

Flexible displays are those that can be fabricated on plastic substrates, metal flexible foils or even on very thin sheets of glass [1]. The use of these type of substrates assign various characteristics to the displays such as very thin thickness, light weight, and the ability to be bent, flexed, conformed or rolled to a radius of curvature of a few centimeters without losing its functionality [1, 2]. Also, flexible displays can be cut into a variety of shapes allowing greater freedom in product design. Organic Light Emitting Diodes (OLEDs) are being considered good candidates for a new generation of displays and lighting applications due to properties such as low-power consumption, excellent image quality, fast response time and high brightness [2]. The use of flexible substrates to manufacture displays demand the establishment of new tools and processes due to its lower thermal, mechanical and dimensional stability when compared to rigid substrates. In this contribution, we present the process steps developed to obtain flexible OLEDs.

METHODOLOGY

Flexible OLEDs with 1 mm² structures were prepared according to the following configuration:

PET-ITO/HIL/EL/Cathode

PET-ITO substrate (Rs = 60 ohms/square, Sigma-Aldrich) was fixed to a silicon wafer using kapton adhesive tape on the edges. The silicon wafer was used as a carrier leaving the substrate flat after all the processes steps. The kapton adhesive withstood all the processes steps, including wet processing, and allowed the substrate to be easily removed at the end without being damaged.

In order to obtain flexible OLEDs with 1 mm² structures, the conventional photolithography process used to pattern the ITO was replaced with a cathode patterning step using a shadow mask at the end of the process. This is because the photolithography steps involved with ITO patterning – coating, baking, exposing, developing and stripping of photoresist, and etching of ITO film – expose the substrate to heat and solvents which have a significant impact on the flatness and dimensional stability of the substrate. Also, this process might damage the ITO layer, which is very brittle.

RESULTS

Figure 1 shows the first process step for flexible OLED fabrication. The PET-ITO substrate was fixed to a 3 inch silicon wafer using kapton adhesive tape on the edges. The silicon wafer was used as a carrier leaving the substrate flat after all the processes steps. The kapton adhesive withstood all the processes steps, including wet processing, and allowed the substrate to be easily removed at the end without being damaged.

Fig 1. PET-ITO substrate fixed on a silicon wafer.

In order to obtain flexible OLEDs with 1 mm² structures, the conventional photolithography process used to pattern the ITO was replaced with a cathode patterning step using a shadow mask at the end of the process. This is because the photolithography steps involved with ITO patterning – coating, baking, exposing, developing and stripping of photoresist, and etching of ITO film – expose the substrate to heat and solvents which have a significant impact on the flatness and dimensional stability of the substrate. Also, this process might damage the ITO layer, which is very brittle. Figure 2 shows the flexible OLED with patterned aluminum layer (1 mm² structures).

Fig 2. Flexible OLED with 1 mm² structures emitting light @ 15V.

CONCLUSION

Flexible organic light emitting diodes were successfully fabricated on PET substrates. A silicon wafer was used as a carrier and the conventional photolithography process to pattern the ITO was replaced with cathode patterning.

REFERENCES