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Analysis on Printed Electronics Circuit Design

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Abstract

With the development of technologies in printed electronics, the products are more low cost and convenient. Nowadays, technologies have solved many problems such as performance, functional inks, printing technology, substrate, etc. The focus is how to design the best efficient circus that suit the Electroluminescent (EL) displays.This study attempts to tell the important ways on designing circus with multiple layers products,to help optimize ways to build a printed circuit.

Introduction

Many famous companies such as IDTechEx、PolyIC、NanoMarkets predict that the printed electronics(PE) products will have huge profits of 30 million dollars[1].The whole printed electronic products include designed image, circus line, printing output, cell or paper battery and OLED, etc. The printing technologies include screen printing, gravure printing, inkjet printing and so on. Screen printing currently is the traditional and first print choice for PE.

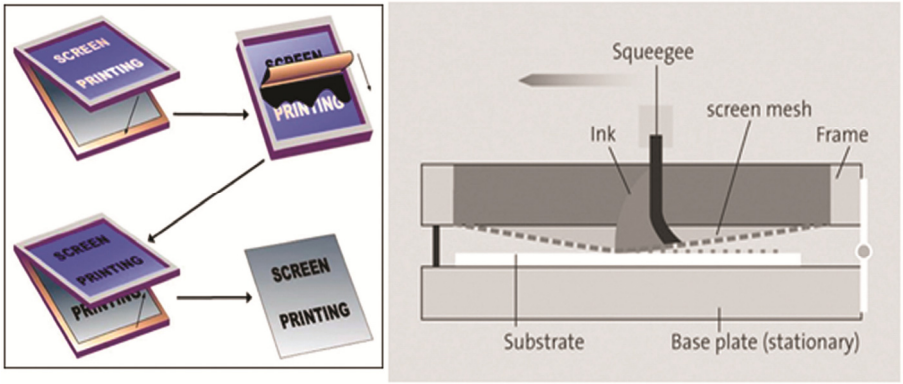

Fig. 1 Different printing processes (screen printing left inkjet right)

One benefit of screen printing is the ability to create uniform ink films, however the process must be monitored closely to ensure the functionality of the inks. Another advantage is the ability to print on a variety of substrates, such as the flexible films necessary for printed electronics.Ink-jet printing is another way that used widely on printed electronics circuits.Since an inkjet print-head can put an ink droplet of a fixed volume at a decided place, inkjet printing technology[10] can be applied to the manufacturing of printed electronic circuits. Ink-jet printing technology can output the fine lines and low viscosity. It has many benefits. One of the advantages is fine images printed even on a curved surface. Another advantage is it can print out the products very fast with simple process. It is possible to produce flexible electronic circuits at low cost by using this technology.

Printed electronics is an innovative and growing technology that requires more research and development. Although there are many applications, electroluminescent displays are particularly for consumer products and displays. Electroluminescent (EL)[2] displays produce a visible light by releasing photons by exciting a substance, like phosphor, and returning it to its ground state. EL displays are used for applications such as background displays[3], control panels, and consumer packaging[4].It needs designer to design multiple layers circuit.

This study was performed to discuss a).The key parameters that will influence luminescent and light continuous.b).The difference between multiple layers in design displays;

Preliminary Testing

In order to test the different parameters of designing product, a preliminary test was conducted at Shanghai Publishing & Printing College. The test consisted of varying line width, the distance from the power supply, the area of the luminescent. The following procedure was used to conduct the preliminary testing:

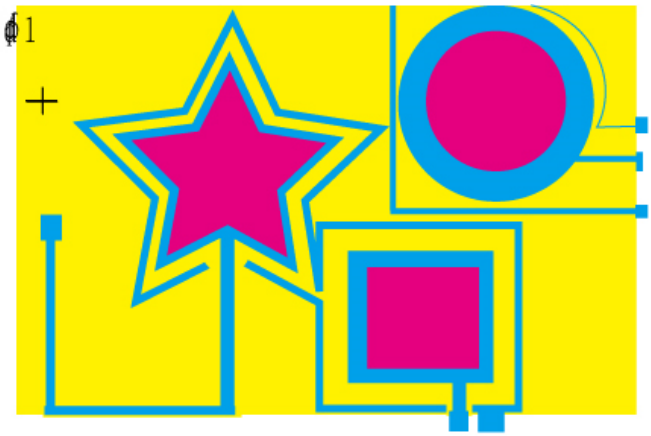

Fig. 2. *Preliminary test file*

1. Using Adobe Illustrator, construct a test file in Fig 2.In this test, the trace line widths are different. The different bus bars of the lines to power are to test the light efficient from the power.
2. The test design in Fig 2 shows multiple layers with phosphor, silver layer, dielectric and front bus bar. The design was printed by layer to layer with screen printing technology. EL displays consist of a layered structure with a front and rear conductive electrode with phosphor and dielectric layers in between[5]. When an electrical current is applied to the circuit, particles in the phosphor emit light. The front conductive electrode typically is composed of a transparent film coated with ITO [6](Indium Tin Oxide), which acts as the substrate. Functional inks that contain phosphor and dielectrics are then printed onto the ITO to complete the printed circuit[7]. The dielectric acts as an insulator layer that is used to prevent arcing between conductive layers.
3. Print the silver layer, dielectric layer, phosphor layer and onto the ITO transparent film[8].Keep all the layers in register. Run the film through the oven.
4. Once the printing is completed test the functionality and conductivity of the different segments and record.

Results and Discussion

The test design [10] was created to test different variables of a printed circuit. Three different aspects were tested: area conductive, length conductive, and width of line. The differences in area tested were to see the size possible to be illuminated. The length test was to see how the lengths of the silver traces could be effective. Finally, the width test was to test if the width of the trace line affects the performance of the circuit. Figure 2 includes labels of all test segment.

In the next test in Fig 3, the main areas of focus were the development of a graphic design that included multiple circuits. The ITO creates an electrical field wherever phosphor (black)is layered. Due to the original design being the inside letters this Cyan front electric bus bar and the Magenta silver trace should be isolated by the dielectric. A possible solution would be create special layer of dielectric to create a “bridge” that would prevent the silver trace from supplying power to unwanted section of the display. One layer of yellow rectangle with dielectric produced between bus bar layer and silver trace layer in Fig4.

Fig 3. Three layers

Fig 4. Four layers

In some case like Fig 5, the issue of silver trace lines passing through phosphor to supply power to inner circles. If a silver line crosses through an outer circle it would then light up both the inner and outer circles.

Fig 5. Three layers design

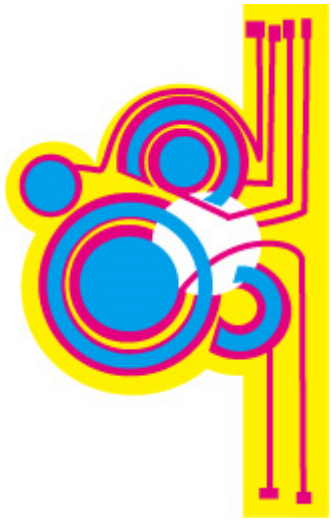

Fig6. Four layers design with a "bridge"

A solution would be to create multiple layers of dielectric to create a special bridge that would prevent the silver trace from supplying power to unwanted sections of the display. In order to ensure a functional display, the idea of removing a few displays to create room for silver trace lines to pass through was created in Fig6.

The EL display was able to successfully light up 4 of the 6 segments in the two designs. The failed segments were probably due to a lack of a secure connection between the wire and the trace.

Conclusion

The intent of this study was to explore the design and production for a segmented electroluminescent display and provide recommendations for the growing field of printed electronics. The area of a display and the proximity of the common are all important variables to take into consideration when designing a segmented display. Some ways to build a printed circuit there are some recommendations that could help in the future development of printed electronics. Results or the methods from the segmented display design provided a functional display that concluded in multiple recommendations for future experiments.

Acknowledge

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Keywords:

Printed Electronics Electroluminescent Multiple layers

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