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OLED

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Abstract:
OLED's are simple solid-state devices (more of an LED) comprised of very thin films of organic compounds in the electro-luminescent layer. These organic compounds have a special property of creating light when electricity is applied to it. The organic compounds are designed to be in between two electrodes. Out of these one of the electrodes should be transparent. The result is a very bright and crispy display with power consumption lesser than the usual LCD and LED.

Keywords: ***Electrodes transparent; LED; LCD;***

Introduction

The discovery of the electroluminescence property in organic materials in 1950s is considered to be the stepping stone of OLED.

The first proper OLED was manufactured in 1980 by Dr. Ching W Tang and Steven Van Slyke. The OLED had a double layer structure [1].When the holes and electrons were transported separately and when combined together produced a light in the organic layer centre. This light was produced at a very low operating voltage with high efficiency [2-3]. Now more research is being done with the application of OLED on polymer so as to obtain a higher efficiency OLED [4].

Working principle

Schematic of a bilayer OLED:

- Cathode (−).
- Emission of radiation.
- Conductive Layer.
- Anode (+).

A typical OLED is composed of a layer of organic materials situated between two electrodes, the anode and cathode, all deposited on a substrate. The organic molecules are electrically conductive as a result of delocalization of pi electrons caused by conjugation over all or part of the molecule.

Components in an OLE:

The components in an OLED differ according to the number of layers of the organic material. There is a basic single layer OLED, two layer and also three layer OLED's [5-6]. As the number of layers increase the efficiency of the device also increases. The increase in layers also helps in injecting charges at the electrodes and thus helps in blocking a charge from being dumped after reaching the opposite electrode [7-8]. Any type of OLED consists of the following components [9].

- An emissive layer
- A conducting layer
- A substrate
- Anode and cathode terminals.

Working of OLEDs:

OLEDs are solid-state devices composed of thin films of organic molecules that create light with the application of electricity [10-11]. OLEDs can provide brighter, crisper displays on electronic devices and use

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less power than conventional light-emitting diodes (LEDs) or liquid crystal displays (LCDs) used today.

OLED Components:

Like an LED, an OLED is a solid-state semiconductor device that is 100 to 500 nanometers thick or about 200 times smaller than a human hair. OLEDs can have either two layers or three layers of organic material; in the latter design, the third layer helps transport electrons from the cathode to the emissive layer. In this article, we'll be focusing on the two-layer design.

An OLED consists of the following parts:

Substrate (clear plastic, glass, foil) - The substrate supports the OLED.

Anode (transparent) - The anode removes electrons (adds electron "holes")when a current flows through the device.

Organic layers- These layers are made of organic molecules or polymers.

Conducting layer- This layer is made of organic plastic moleculesthat transport "holes" from the anode. One conducting polymer used in OLEDs is polyaniline [12].

Emissive layer- This layer is made of organic plastic molecules(different ones from the conducting layer) that transport electrons from the cathode; this is where light is made. One polymer used in the emissive layer is polyfluorene.

Cathode (may or may not be transparent depending on the type of OLED) - Thecathode injects electrons when a current flows through the device.

How do OLEDs Emit Light:

OLEDs emit light in a similar manner to LEDs, through a process called **electro phosphorescence**.
The process is as follows:

1. The battery or power supply of the device containing the OLED applies a voltage across the OLED.
2. An electrical current flows from the cathode to the anode through the organic layers (an electrical current is a flow of electrons).
3. The cathode gives electrons to the emissive layer of organic molecules.
4. The anode removes electrons from the conductive layer of organic molecules. (This is the equivalent to giving electron holes to the conductive layer.)
5. At the boundary between the emissive and the conductive layers, electrons find electron holes.
6. When an electron finds an electron hole, the electron fills the hole (it falls into an energy level of the atom that's missing an electron).
7. When this happens, the electron gives up energy in the form of a photon of light (see How Light Works).
8. The color of the light depends on the type of organic molecule in the emissive layer. Manufacturers place several types of organic films on the same OLED to make color displays.
9. The intensity or brightness of the light depends on the amount of electrical current applied: the more current, the brighter the light.

Conclusion

OLEDs offer many advantages over both LEDs and LCDs. They are thinner, lighter and more flexible than the crystalline layers in an LED or LCD. They have larger fields of view as they produce their own light. Research and development in the field of OLEs is proceeding rapidly and may lead to future applications in heads up displays, automotive dash board type displays etc. Because OLEDs refresh faster than LCDs, a device with OLED display cloud change information almost in real time.

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