INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211 (Online)

Organic Light Emitting Diodes

Badisa Sai Ram Krsihna
Final Year B.Tech, Dept. of ECE, KL University, Vaddeswaram, AP, India
Angadi Suresh
Associate Professor B.Tech, Dept. of ECE, KL University, Vaddeswaram, AP, India
Karavadi Siva Karthik
Final Year B.Tech, Dept. of ECE, KL University, Vaddeswaram, AP, India

Abstract:
OLED'S are simple solid state devices that work on the principle of electro-luminescence. They comprise 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 electrodes. Out of these one of the electrodes should be transparent. The result is very bright and crispy display with power consumption lesser than usual LCD and LED. OLEDS emit light through a process called as electrophorescene every at low operating voltages through high efficiency .Like an LED, an oled is solid state semiconductor that device that is 100 to 500 nanometers thick or 200 times smaller than human hair. OLEDS can have either two layers or three layers of organic material. More the number of organic layers greater will be the efficiency. Like an lcd, the OLED does not require a backlight for its normal working. This makes them more advantageous in saving space and also weight. It also helps them in displaying deeper black levels than LCD's. Oled is also capable of making high contrast ratio when it is displayed in a dark room than LCD as well as LED. An oled mainly consists of cathode anode and a organic layers. Based on the arrangement of cathode and anode OLEDS are divided into two type's active and passive OLED.
OLEDs are used in small screen devices such as cell phones, PDAs and digital cameras. Research and development in the field of Oleds is proceeding rapidly now and may lead to future applications in heads- up displays, automotive dash boards etc.

1.Introduction

OLED is devices consisting of thin organic layers placed between the two electrodes.These layers have the property of producing light when electricity is passed through them. Out of these electrodes one must be transparent. The work functions of the both cathode and anode must be entirely different. When holes and electrons were Transported separately and when combined together produces a light in organic layer center.

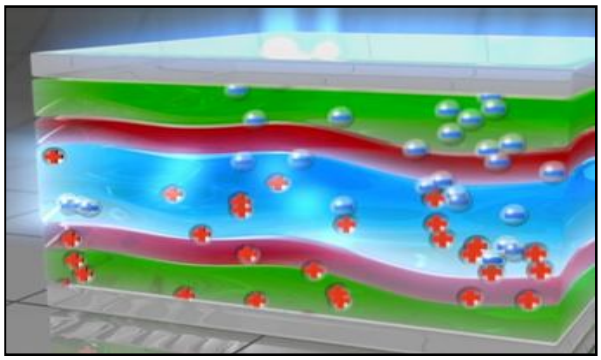

Figure 1

2.Comparison With LCD And LED

Like lcd OLED does not require a backlight for its normal working. This makes them more advantageous in saving space and also weight. It also helps them in displaying deeper black levels than lcds. OLED is also capable of making high contrast ratio when it is displayed in a dark room than lcd as well as led An LED TV uses less power, provides a brighter display with better contrast, a thinner panel, and lesser heat dissipation than a conventional LCD TV. This is because an LED TV uses light-emitting diodes for backlighting versus CCFLs used by conventional LCD TVs. The display of an LED TV is not an LED display, so a more technically correct name for it would be "LED-backlit LCD television".

Figure 2

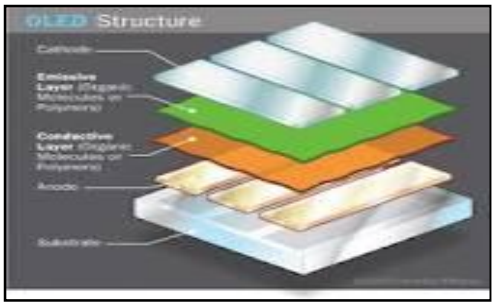

Figure 3

3.Components

The components in an OLED differ according to the number of organic layers. There is a basic single layer oled, the two layer oled and also three layer oled's. as number of layers increase efficiency increases and helps in injecting charges at the electrodes and thus help in blocking a charge from being dumped after reaching the opposite electrode. Any oled mainly consists of

- An Emission layer
- A Conducting layer
- A substrate
- Anode and cathode terminals

Emissive and conducting layer is made up of organic molecules,oled is considered to be an organic semiconductor. The organic molecules have the property of conducting electricity and their conducting levels range from insulators to conductors.

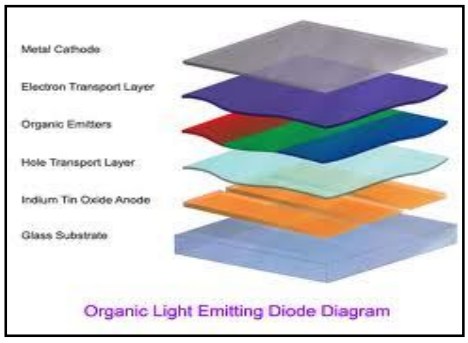

Figure 4

The emissive layer used in an oled is made up of organic plastic molecules, out of which the most commonly used is polyflourene. The conducting layer is also an organic

molecule,and the commonly used component is polyaniline The substrate commonly used may be a plastic, foil or even glass.The anode component must eb transparent. Usually indium titanium oxide is used. This component is transparent to visible light. It also has greater work function that helps in injection of holes easily into different layers The cathode component depends on type of oled required. Even a transparent cathode can be used. Usually metals like calcium aluminium are used as they low work functions which helps in injecting holes into different layers.

4.Impalantation

Emissive and conductive layers are implanted on to the substrate mainly through three processes they are

- Ink jet printing
- Organic vapour phase deposition(OVPD)
- Vaccum thermal evaporation(VTE)

Among the above three ink het methos is very cheap and most commonly used technique.

5.Working

An oled works on the principle of electroluminescence which is the property to produce light when electricity is passed though them . It was found that this light producing property came from the movement of delocalized electrons in thr pi bond of the organic molecule.

Substrate supports the oled. The anode is used to inject more holes when there is a patho of current. The conducting layer is used to carry the holes from the anode.The cathode is used to produce electrons when current flows through it path. The emissive layer is the section where the light is produced. This is used tocarry electrons from the cathode.

First the anode is kept positive w.r.t cathode. Thus there occurs an electron electron flow from the cathode to anode. This electron flow is captured by the emissive layer causing the anode to withdraw electrons from the conductive layer. As the process continues,the conductive layer becomes positively charged anf the emissive layer become negatively charged.

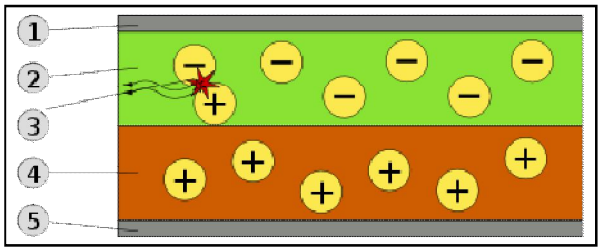

Figure 5

A combination of the holes and electrons occur due to electrostatic forces. As the electrons are less mobile than the holes,the combination normally occurs very close to the emissive layer. This produces light in the emissive region after there has been a drop in the energy levels of the electrons. The emissive layer got its name as the light produced in the emissive region has a frequency in the visible region. The colour of the light produced in the emissive region has type of organic molecule used for its process. To obtain colour displays,a number of organic layers are used.a nother factor of the light is its intensity .if more current is applied to the OLED, the brighter the light appears.

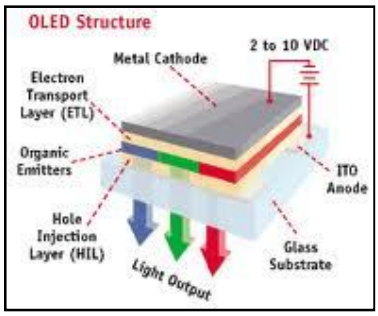

Figure 6

Now consider the process when the anode is negative w.r.t the cathode. This wont make the device work as there will not be any combination of the holes and electrons. The holes will move towards the anode and the electrons to the cathode.

6.Types Of Oleds

6.1.Active Matri Oled (AMOLED)

This type of oled is suitable for high resolution and large size display. Though the manufacturing process is the same, the anode layers have a thin fil transistot(TLT) plane

in parallel to it so as to form a matrix This helps in switching each pixel to it's on or off state

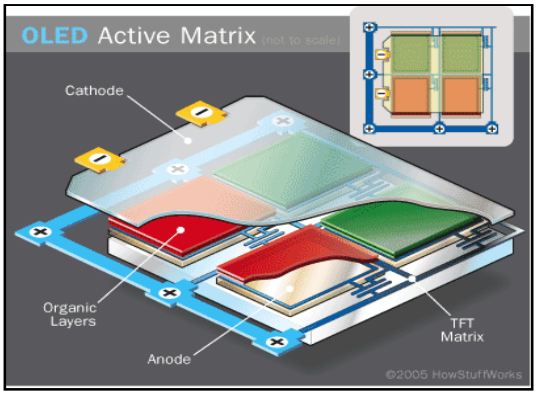

Figure 7

as desired, thus forming an image. This is the least power consuming type among the others and also has quicker refresh rates which makes them suitable for video as well.

6.2.Passive Matrix Oled (PMOLED)

The design of this type of OLED makes them more suitable for small screen devices like cell phones, MP3 players and so on. Though this type is less power consuming than an LCD and LED , it is the most power

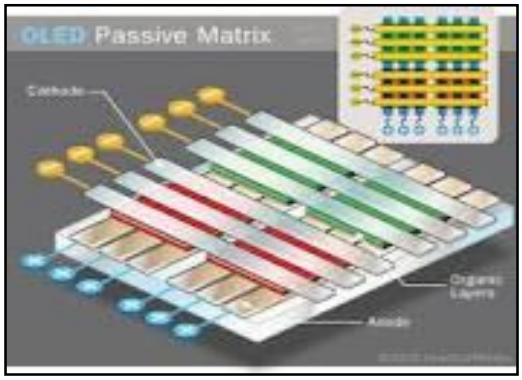

Figure 8

Consuming comparative to other OLEDS's. this type is very easy to make as strips of anode and cathode are kept perpendicular to each other When they are both intersected light is produced . As there are strips of anode and cathode, current is applied to the selected strips and is applied to them. This helps in determining the on or off pixels.

7.Inverted Oled

This type uses a bottom cathode, which is connected to the drain end of an n-channel TFT backplane. This method is usually used for producing low cost OLED with little applications.

8.Advantages

The manufacture of oled is higly economical and is more efficient than LCD and flat panel screens.

These oleds can be incorporated into our clothing.

Contrast ratio of oled is more so that it can be watched from an angle of about 90 degrees without any difficulty.

No backlight is produced by this device and the power consumption is also very less.

OLED has refresh rate of 100,000 Hz which is almost 9900 Hz greater than Lcd display

The response time is less than 0.01ms which is 1/100 th part of time of LCD

9.Disadvantages

- Power consumption increases as the brightness of the light increases so not advantageous for mobile applications.
- With time the brightness of the OLED pixels will fade.
- Commercial availability is very less
- This device is not water resistant
- Life time of OLED is much lesser than that of LCD and LED

10.Applications

- Stack OLEDS are used as television screens
- White OLEDS can be used as fluorescent lamps
- Pmoleds are for cell phones, mp3 players.
- Foldable OLEDS are used in PDAs computer chips.
- Top emitting OLEDS are used in smart cards
- Transparent OLEDS can be used in head-light displays

11.Conclusion

The Organic Light Emitting Diode forms of display still have many obstacles to overcome before its popularity and even more importantly, its reliability are up to par with standards expected by consumers. Although the technology presents itself as a major player in the field of displays, overcoming these obstacles will prove to be a difficult task. However, the OLED's advantages over LCD's and future outlook have many in the industry goggle-eyed at the realm of possibilities. For all we know and can hope for…OLED's could change the ways in which we see things.

12.Reference

1. http://impnerd.com/the-history-and-future-of-oled
2. http://en.wikipedia.org/wiki/Organic_light-emitting_diode
3. http://www.oled-research.com/oleds/oleds-history.html
4. http://www.voidspace.org.uk/technology/top_ten_phone_techs.shtml#keep-your-eye-on-flexible-displays-coming-soon
5. http://www.pocket-lint.com/news/news.phtml/23150/24174/samsung-say-oled-not-ready.phtml