International Journal of Science, Environment and Technology, Vol. 5, No 2, 2016, 625 – 631

ISSN 2278-3687 (O)
2277-663X (P)

ORGANIC LIGHT EMITTING DIODE – APPLICATIONS A GENERAL STUDY

R. Ciffee
Department of Electronics and Communication Engineering, BE-2ND Year,
Sri Sai Ram Engineering College, West Tambaram, Chennai-600044
E-mail: rethinabair@yahoo.in

Abstract: The improvement in display screens based on organic semiconductors which may be also regarded as one of the most energy efficient lighting systems is being discussed elaborately here. This study encompasses different types of OLED's based on their structural properties. The study mainly focuses over the improvement of the display features of OLED's. Today even foldable OLED displays are available for smart mobile phones.. But life time of these is incompatible with its other applications.
Keywords: Organic Light Emitting Diode, electroluminescence, pixel, phosphorescent organic light emitting diode, active-matrix organic light emitting diode.

INTRODUCTION

Organic Light Emitting Diode is a class of LED's that use organic resources for their proper functioning. These diodes work on principle of electroluminescence that we usually come across only in inorganic study. But here, the unique property of certain organic substances is being reviewed. Today they have been used in commercial applications such as flat panel displays, TFEL displays and even in foldable and curved displays. Their main attraction is their energy efficiency due to which it is now being expected that during the next few years this technology may be used by nearly seventy five percent of people using LED technology. It has thin layers of organic matters situated between layers of anode and cathode. They feature a high degree of color accuracy due to the properties of the organic substances. OLED lumiblades are produced today to show the creation and architectural design being developed. The OLED's produced today are bright, reliable and affordable .This is because of its stunning efficiency of energy usage. Technically the TFT technology being adopted here gives enhanced quality of images like contrast and address-ability. The TFT monitors are able to provide sharp and crisp text with increased response time.

Organic electroluminescent display is a solid state semiconductor LED display. It finds several applications in mobile phones, digital cameras, etc., .By the process of electro

*Received Mar 15, 2016 * Published April 2, 2016 * www.ijset.net*

phosphorescence when current passes through the organic layers present, emission of light takes place. The colors emitted are red, green, blue, white, etc., Polymer Light Emitting Diodes also called light emitting polymers contain an electroluminescent conductive polymer that emits light when external voltage is given as input. A report survey says that after 1000 hours, the blue luminescence degraded by 12% and red by 7% and green by 8%..Thus, the lifetime of these OLED is the real challenging task as far as concerned on the real time application of OLED. This study is a general study that reveals the all-around information about OLED and it mainly focuses on the OLED displays being used for various applications. The OLED applications even extend to various technologies like GPRS, GSM or SCADA based controls. The upcoming OLED technology is far better than LCD since LCD's work by blocking light but OLED's take the challenge of having much viewing range without having any backlight problem.

DESIGN

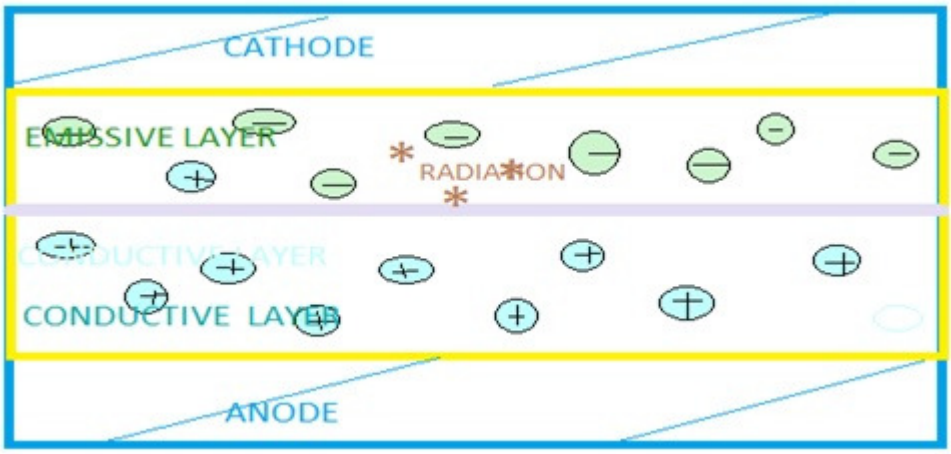
To know the design of OLED in simpler way consider a sandwich of thin layer of organic material made of aggregates of amorphous and crystalline molecules .The main principle of light emission occurring here is electroluminescense. Electro luminescence involves emission of light due to the current applied. Light gets emitted when charge carriers from anode and cathode are injected into the organic layers.

The SUBSTRATE layer used as base of OLED is probably a thin sheet of glass with transparent conductive layer made of clear plastic layer or foil. The ANODE layer is a thin active layer having its bottom made of Indium tin oxide from where electrons jump over towards the cathode. CATHODE layer is made of alkali metals like calcium, barium, magnesium, aluminium is the layer towards which electrons move. CONDUCTIVE and EMISSIVE layers made of organic plastics like light emitting polymers and polymers like polyfluorene and polyparaphynelene are used respectively.

Adachi has given a beautiful narration of how the electrons and holes interact in OLED. Accordingly consider organic semiconductor as a subway train with each people sitting over a seat .There are no empty seats. Consider the seat representing molecules and people representing energetic particles i.e., electrons. When people board the train from one end, they have extra energy and want to go to the relaxed state of sitting. As people board, some of the seated people rise and exit the train at the other end leaving empty seats, or 'holes,' for the standing people to fill. When a standing person sits, the person goes to a relaxed state and

releases energy. In the case of OLEDs, the person releases the energy as light

WORKING



The working of OLEDs is more-or-less similar to LEDs but the number of layers sandwiched in OLEDs bring about a difference all around. The anode and cathode are directly connected to the supply. These layers provide electrons and holed respectively. The conductive layer becomes positively charged and the emissive layer becomes negatively charged as the power is applied. The Due to the electrostatic force applied the electrons (negatively charged particles) move from the conductive to emissive layer.

STRUCTURE BASED TYPES

ACTIVE OLED

AMOLED design requires a thin-film transistor to place on top of anode layer that functions as a series of switches to control the current flow through individual pixels. They require less power and used in applications involving large screen displays such as smart watch, mobile devices, laptops and television

ACTIVE OLED PASSIVE OLED

(Image taken from sparkfunwebsite) (Image from densitron website)

PASSIVE OLED

The polymers used here include derivatives of poly (p-phenylene vinylene) and poly-fluorine and passive OLED's are nothing but the organic layer that runs between the strips of anode and cathode. They are used in mobile phones, handheld game consoles and PDA's.

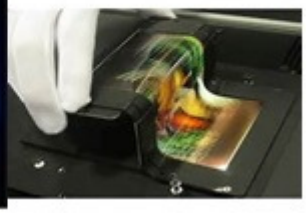

TRANSPARENTOLED (LG image) **TOP EMITTING OLED** (leds magazine)

TRANSPARENT OLED

Transparent OLED's can be used in broad displays on some offices or for display boards during night. Because the content displayed on such screens would be interactive with even the person walking by. Each pixel in transparent OLED is made up of 4 sub pixel. Color is created by combination of red, green and blue sub pixel and the remaining area is clear. They are used for heads up display, transparent projector screen and glasses.

4.TOP EMITTING OLED

Conventional OLED's are bottom emitting i.e., the display is viewed through then substrate that acts as the base. This type of OLED requires a transparent substrate, a high-transparency anode and a highly reflective cathode in order to yield high luminance efficiency devices. The OLED display is coupled with active matrix circuit to enhance its performance.

WHITE OLED (image from get domainvids) **FOLDABLE OLED** (image from nokia)

WHITE OLED

It is being preferred for its brightness, more uniform and energy efficient quality that matches the light being emitted by fluorescent lights. Recent research reports describe an OLED that

emits white light from a single molecule, and a hybrid emitter that combines an organic polymer with a quantum dot light-emitter that could potentially reduce the cost spent on energy obtained for fluorescent lightings normally used in our homes.

FOLDABLE OLED

This sort of OLED is going to be a breakthrough in the field where smart phones are used since during the next twenty-twenty's most mobiles are expected to have this technology being adopted them. Here the picture can be folded to an angle of 180 degree since the silicon base gives the screen a small bending radius of 1mm.They are made of flexible metallic foils and plastic substrates.

PHOSPHORESCENT OLED

PHOSPHORESCENT OLED (image from letsgodigital)

They emit light by both singlet and triplet excitons occurring due to recombination of particle in singlet and triplet excitation since electrons and holes are both fermions with half the integral spin according to quantum theory. This is used to achieve quantum efficiency of 100%.Large-screen displays such as computer monitors or television screens, as well as general lighting needs. One potential use of PHOLEDs as lighting devices is to cover walls with large area PHOLED light panels. This would allow entire rooms to glow uniformly, rather than require the use of light bulbs which distribute light unequally throughout a room.

APPLICATIONS

The effectiveness of OLED screen is shown by their larger screen version. They are known for their "color graphics". The following tremendous applications are involved with these OLED's in near future.

- Audio system also employ OLED for television audio by using bottom emission type of OLED structure.
- Network audio players with enhancement in sound have OLED devices.
- PHOLED's are being employed in large screen displays like computer monitors and TV screen.
- Driver ICs are used for video applications in portable devices.
- OLED Portable headphone amplifier with OLED color display.

- They are used in portable tape and digital recorder
- Now-a-days smart watches and even some other accessories employ OLED design.
- They are used in smart wrist bands that detect and synchronize health care statics.
- They are mainly used in places where uniform distribution of light is required.
- Today in foreign, OLED does have gained their importance in being as lighting panels.

FINIDNG

Though different OLED technologies are available the basic principle being used in each one is “electroluminescence”. Today power has become a scarce resource. Since this technology is being a good power saving one, this technology may be adopted to reduce the energy demands of the society. Massive energy saving is possible with development of OLED all around.

CONCLUSION

This study concludes that OLED technology being superior to most LED technologies the researcher anticipate that in the future 2020’s most of the world’s popular companies incorporate OLED technologies for their energy efficient application. Within few years the LED technology being adopted in day-to-day applications will move over to OLED technology due to the wide privilege of its better energy efficiency.

REFERENCE

[1] Adachi. C, Baldo. M.A, Thompson. M.E, Forrest. S.R. (2001)”Nearly 100% internal phosphorescence efficiency in an organic light emitting device”, Journal of applied physics, PP: 5048.

[2] Bernanose. A (1955)“The mechanism of electroluminescence” .J. Chim Phys.PP:396.

[3] Craig freudenrich, www.electronics.howstuffworks.com/oled.htm .

[4] D’Andrade. B.W, Forrest. S.R. (2004)“white organic light emitting devices”PP:1585-1595.

[5] Kallman. H, Pope. M, (1960),”positive hole injection into organic crystals”, The journal of chemical physics, PP:300.

[6] Samsung company, www.oled-info.com/samaung-oled.

[7] Sato. Y, Ichinosawa. S, Kanai. H. (1998),”operation characteristics and degradation of organic electroluminescent devices”, IEEE Journal of selected topics in Quantum Electronics.PP:40-48.

[8] Tang. C.W, Vanslyke. S.A. (1987)"Organic electroluminescent diodes", Applied physics letters. PP: 913.

[9] www.d.unn.edu/sbums/EE4611Spring2015ResearchPresenattions/OLED

[10] Yersin, Hartmut (Ed.),"Highly Efficient OLED's with phosphorescent Materials". Wiley-VCH(2007)