OLED: New Generation Display Technology: A Review

Lokesh Kumar Sahu[1], Vaishali Soni[2], Tithi Karmakar[3]
[1,2,3]SoS in Electronics and Photonics, Pt. Ravishankar Shukla University, Raipur (C.G.) India.

ABSTRACT
OLEDs are a breakthrough technology in display technology. with a high expectation Profitability on the display market. They show low driving voltage in combination Unlimited viewing angles, high colour-brilliance, light weight, short film-thickness and low production cost. First a small LED came in this area then after CRT (Cathode Ray Tube) which is used in today's time but due to its heaviness we do not carry it from one place to another. Organic Light Emitting Devices (OLEDs) work on the principle of converting electrical energy into light, as time has progressed, many changes have occurred happened in the field of revolution. For example, light emitting diodes (LEDs) and liquid Crystal displays (LCDs) are already used but they have some problems. As a result, OLED's Revelation Some Electronic Devices Are Sandwiched Between Two Thin Conductive cathode films that generate light by applying power. OLED is a self-brighter as it is Made from thin flame of natural mixture. The substrate can be rigid such as glass or Metallic or flexible using polymer plastics. The number of emitting layers depends on the desired light output of the device. OLED technology has great potential for new uses such as in the form of flexible paper-thin OLED panels and transparent OLEDs.

Keywords: Light Emitting Diode, Cathode Ray Tube and Liquid Crystal Display

I INTRODUCTION

The Organic Light Emitting Diode is another innovation that relies on electroluminescence. OLED has attracted a lot of attention around the world as it is the only display device that removes all the problems related to previous display devices. Basically, OLED is an energy conversion device i.e. converts electrical energy into light energy. OLED based on electroluminescence. Electroluminescence is the emission of light from a solid through which an electric current is passed. Unlike CRT (Cathode Ray Tube), OLED manufacturing process is easier and the devices are thinner and lighter. Unlike LCD (Liquid Crystal Display), OLED has a different viewing angle and we don't need any kind of backlight. So the power consumption and drive voltage is low. The first commercial OLED display was introduced by Pioneer Electronics in 1997 as the front panel of car stereos. In OLEDs, layers are a type of flat panel display made by sandwiching a layer of electroluminescent material such as GaAs between two layers of electrons. OLED is used to make digital displays in devices such as television screens, computers, portable systems such as mobile phones, etc. OLED displays can use either passive-matrix OLED (PMOLED) or active-matrix (AMOLED) addressing schemes.

II LITRATURE SURVEY

If we talk about organic light emitting diode, then it is a light emitting diode whose emissive electroluminescence layer is filmed of organic compound which emits light in presence of electric current. This is a layer that is located between two electrodes, one of which is transparent. OLED is used in many areas, such as digital display in devices, it is done through OLED and talking about similar devices, it is used for television screens, computer monitors, portable systems like mobile phones etc. OLED is used. If we go to the research field, then OLED is considered a very good area, in which a lot of research is done in the development of white OLED devices. If we talk about LED or any such device which used backlight to emit light, due to which the size of the LED becomes very big and thick, but in OLED we do not need backlight, due to which it is thinner and lighter. This happens and this is one of the reasons why we see the screen blacker and dark in the dark, that is, these devices contain more contrast.

III WORKING PRINCIPLE AND STRUCTURAL ASECTS

Before discussing how OLED works, first let's discuss about the basics of OLED;

(a) OLED are solid state devices that produce light.
(b) It is very efficient and does not contain any bad material, so it is referred as Organic light emitting diode.

Whenever we talk about OLED, we should first understand what is LED. Because both are same in working principle but there is a difference that in LED, we generate electrons and holes by using of p-layer and n-layer but in OLED we generate electrons and holes by using of organic layer. let's take a look about LED here we take two semiconductor material like silicon or germanium one will rich in electrons we call it n-type layer and one will rich in holes we call it p-type layer as shown below:

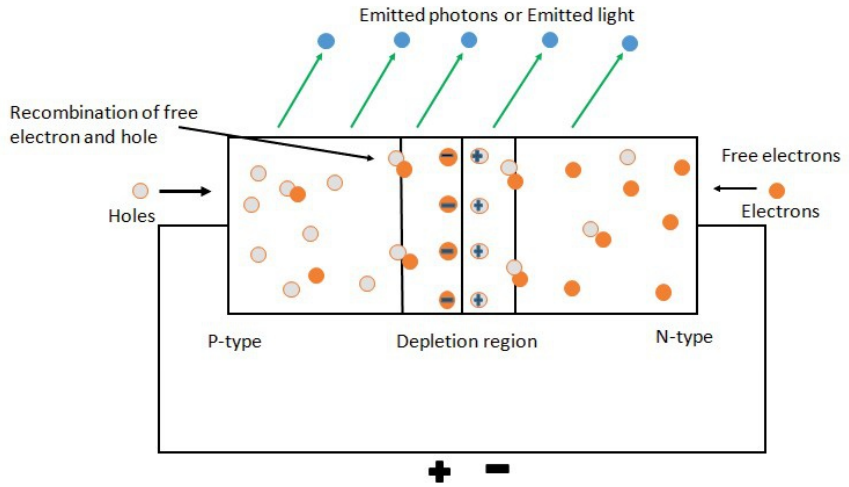

Fig. 1 Light Emitting Diode

When anode is connected to positive side of battery then electrons & holes are combined. Immediately after electrons move from n-type to p-type, it associates with holes, then it emits light in the form of photons. OLEDs work in a similar way but unlike LEDs they use organic molecules to produce electrons and holes. OLEDs is made up of six different layers. We can call top layer as seal and we can call the bottom layer as substrate and the other layers which is placed in between these two that is cathode and anode. In between anode and cathode there are two layers which are made up of organic molecules called emissive and conductive layer as shown in figure.

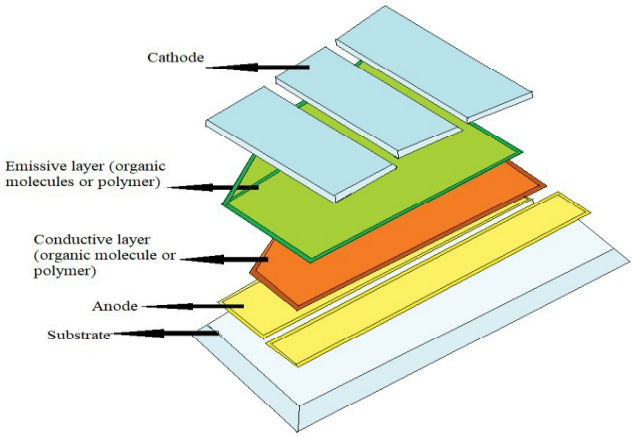

Fig. 2 OLED Structure

Let's talk about layers, we use substrate to endorsement OLED. We use anode to inject more holes when electrical current is applied. Conducting layer helps in haulage the holes from the anode. When negative charge flows through the cathode it generates electrons. Emissive layer helps in haulage the electrons form cathode. Make the anode positive. Hereby electron will flow from cathode to anode. When electron flux from cathode to anode during that time electron is seize by the emissive layer, hereby causing the anode to takes back electrons from the conductive layer. That means flux of holes into the conductive layer. After this we can see that the conductive layer has full of positive charge and the emissive layer has full of negative charge.

Holes and electrons are combined due to electrostatic force. This combination occurs near the emissive layer. This process emits light in the emissive realm. Light colours can vary if we change the type of organic molecule which is used for this process. Intensity also the main factor of the light. When maximum current is applied to the OLED, the light will appear brighter. Materials which are used to bring the charges in the recombination sites usually poor photon emitters. That's why, suitable dopants are added, which first transfer the

energy from the original exaction, and release the energy as photons.

IV TYPES OF OLEDS

It is classified into the type of design and their uses; OLED is mainly classified into 8 types;

(a) **Passive Matrix OLEDs:** It is composed of stripes of cathode and anode and organic layers. These stripes are perpendicular to each other when cathode and anode intersect, they emit light and then pixels are generated in that area. A current is applied to some strips of cathode and anode to determine pixels whether on or off. This OLEDs not having any storage capacitor for these reasons each row has pixels in fact they are closed most of time. To compensate this, you have to use more voltage to make them brighter. Power consummation is less. It is easy to make. It is not proficient. This OLED display are usually small they are used in cell phones etc.

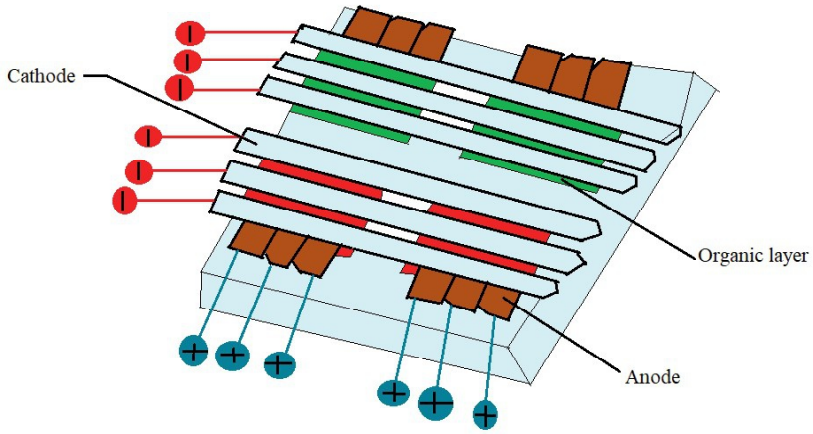

Fig. 3 OLED Passive Matrix

(b) **Active-Matrix OLEDs (AMOLEDs):** They are composed of cathode layer, organic layer, thin-film transistor array and anode layer. The TFT controls the brightness and which pixel gets turned on to form an image AMOLEDs consumes less power. they are efficient for large displays like smart watches, large screen tv etc.

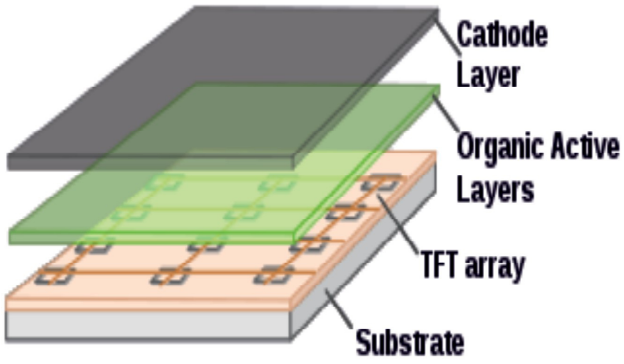

Fig. 4 Active Matrix OLED (Image From - https://www.wikiwand.com/en/AMOLED)

(c) **Foldable OLED:** You can fold these foldable OLED displays. Since this material is sturdy, it prohibits wear and tear and is therefore used in GPS devices etc. They are flexible, durable and also lightweight. It can be attached to clothing. Substrates are made up of plastic etc.

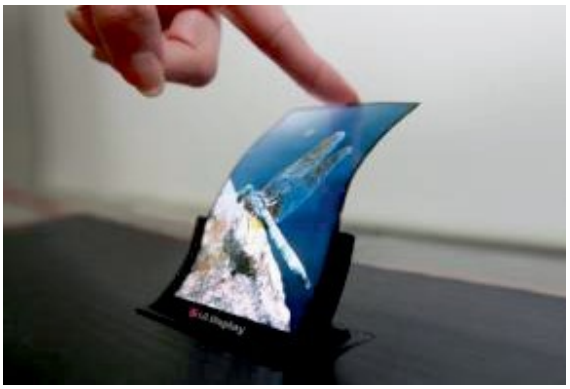

Fig. 5 Foldable OLED (Image From - https://www.oled-info.com/flexible-oled)

(d) Top Emitting OLED: These devices are used in smart cards. In this, substrate is made up of opaque or reflective type. It may be half transparent or whole transparent electrode. Or else, from pellucid substrate light will not pass through it.

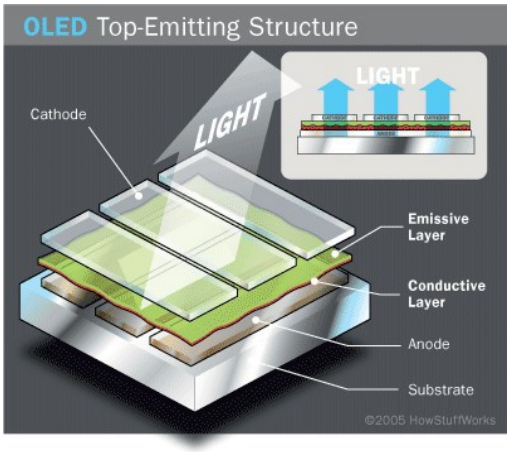

Fig. 6 Top Emitting OLED (Image From -https://4sense.medium.com/display-types-of-oled-1710861bd246)

(e) Transparent OLED: In this device substrate, cathode and anode are made up of transparent, when they are in the switch off position, it becomes fully transparent. It is applied in smart windows etc.

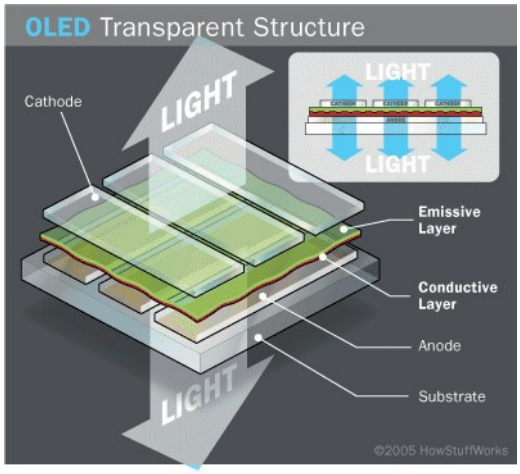

Fig.7 Transparent OLED (Image From - https://4sense.medium.com/display-types-of-oled-1710861bd246)

(f) White OLED: This tool makes the Brightest

(g) Light of All. They are fabricating in large sheets. It is uniform. It is also energy proficient. They can use in homes. It can reduce the power consumption.

(h) Stacked OLED: This tool also uses assorted colours and blended on top of each other. This reduces pixel gap and increases colour profundity. Thus, they are being offered as television displays.

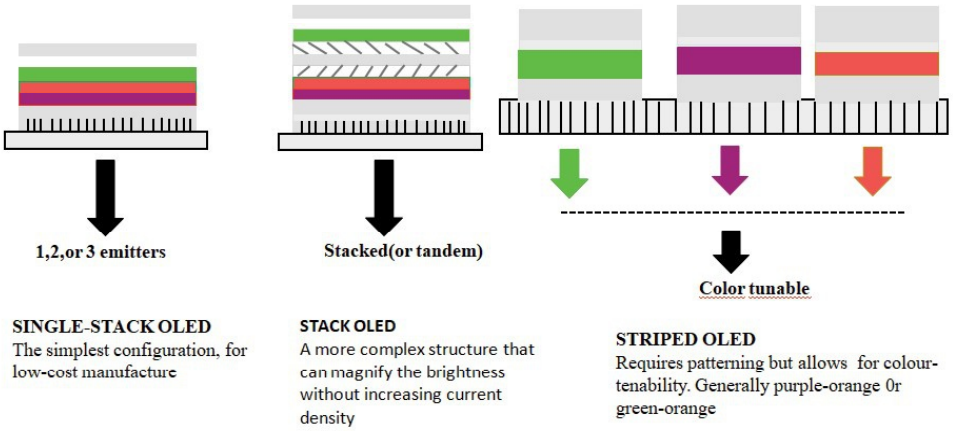

Fig. 8 Stacked OLED

(i) Inverted OLED: IOLED attracted heed on large scale due to the demand for the procurement of springy OLEDs that do not desire rigid compact. It produces OLEDs of low cost with small number of applications.

V ADVANTAGES OF OLEDs

- One of the strengths of organic light-emitting diode is that it consumes less power, compared to other technologies such as LEDs and LCDs. Each
- OLEDs are biodegradable because eco-friendly polymer used to build OLED.

VI DISADVANTAGES OF OLEDs

- Power consummation is less if black image is displayed as compared to LCD. But when bright image is displayed it jumps to 3 times. Thus, this tool is harmful for mobile applications.
- Over time, OLED pixels brightness will droop.
- The device is not at all water obstructive.
- This device has a very short life span.
- In this device artificial light is used to display the images. That's why, full power has to be used to perform this kind of operation.
- Manufacturing processes are expensive right now.

diode in an OLED panel emits light. Unlike LCDs, the entire panel doesn't even require backlighting.

- The procedure of making OLED is simple and can be made into large thin sheets.
- OLEDs enable wider viewing angle because pixel in OLEDs emit light directly. Colors appear correct.
- OLED has very fast response time (>> 0.01 ms) compare to other technologies.

VII CURRENT APPLICATIONS

- The most efficient and light weight display architecture currently available on the market is due to the self-emissive nature of OLED devises. They also have the nature of multilateral and have been implemented in a range of end-use application.
- Televisions and Monitors- In the year 2013 television and computer monitors OLED devices are liberated. Currently, in the commercial display market a broad range of OLED device is available, from flat and curved panel TV called OLED wallpaper.
- In the resent year OLED technology has come up as the head most Smartphone demonstration technology and the world's most currently used vendors are all shipping AMOLED Smartphone.

Following are some examples of OLED display-

- Apple iPhone 13 Pro / 13 Pro Max

- Samsung Galaxy S21 / S21 Ultra
- OnePlus 10 Pro
- Real me GT2 / GT2 Pro
- Vivo V23 / V23 Pro etc.
- Wearable devices with OLED display- In the resent year OLED technology has come up as the head most Smartphone demonstration technology for wearable device like fitness bands, smart watches and VR headset, because of the low power consumption, its great image quality and to the design possibilities enable by flexible OLEDs.

Following are some example of wearable device with OLED display-

- Apple Watch series 7
- Samsung Galaxy Watch 4
- Sony PlayStation VR2
- Honor Watch GS3
- Shiftall Megane X, etc.
- Panel light- For both residential and commercial application panel lighting is construction.
- For example; Hospital, Hotels, Apartment, Office block, Super market, Banks etc.

VIII CONCLUSION

Organic light emitting diode makes electronic viewing much easier as it uses more power. OLED has changed so much that in the field of its specification it is hailed as "the first discovery from Edison". Today OLED technology is widely regarded as part of the next generation of flat panel displays and is expected to be an important technology in the development of flexible displays. They are smaller and more flexible than crystal layers on LED or LCD. They have large viewing fields as they have created their own light.

IX ROLE OF OLED IN AATM NIRBHAR BHARAT

India was exposed during the recent covid disaster of being dependent on the global electronics supply chain. India should have a strong eco-system for the production of electronic components. Currently no one in India is manufactures electronic displays even though domestic R&D is growing slowly. With the introduction of covid-19, we realized that smartphones and laptops were an important part of our lives. We spent most of our day looking at our screens, which is why we need to make sure the display technology we use is the best. If India starts making OLED displays then the cost of middle-class people becomes smoother and India's future in display technology is cheaper, stronger and more efficient.

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