ORGANIC LIGHT EMITTING DIODES
(OLED)

Dr. DHANYA S. R.
Assistant Professor
Department of Chemistry
CET, Trivandrum

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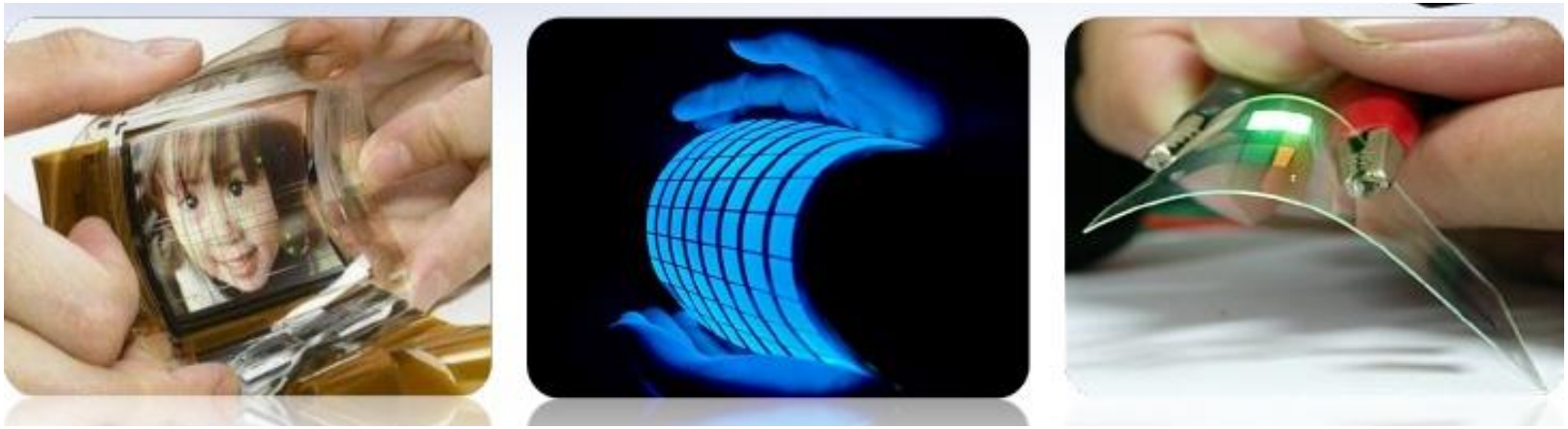
INTRODUCTION

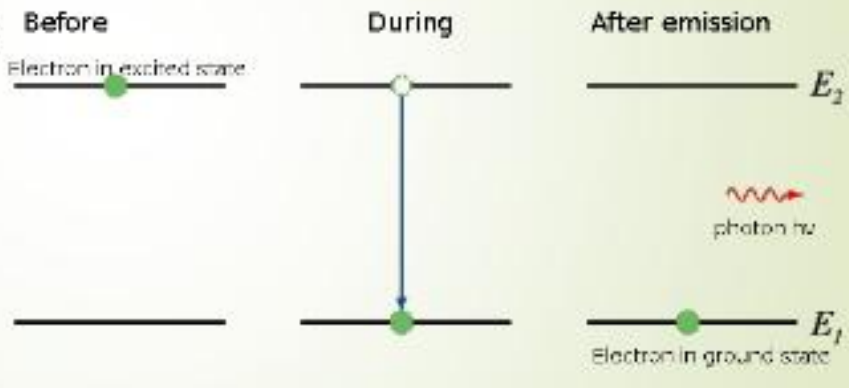
Light emitting diode in which the emissive electroluminescent layer is a film of organic compound which emits light in response to an electric current.

(i) those employing conducting polymers

(ii) those based on small molecules



Electroluminescence is a process in which a material emits light in response to electrical field applied across it.



OLED EMPLOYING CONDUCTING POLYMERS

Principle: HOMO – LUMO transitions

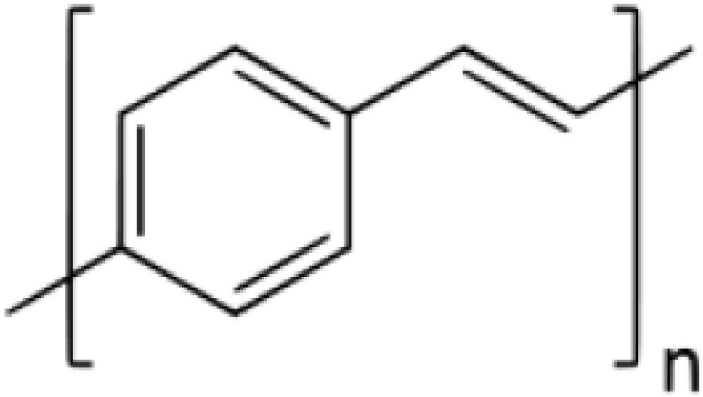
✔**Organic layer between anode & cathode**

✔**Conductive due to the delocalization of Π electrons**

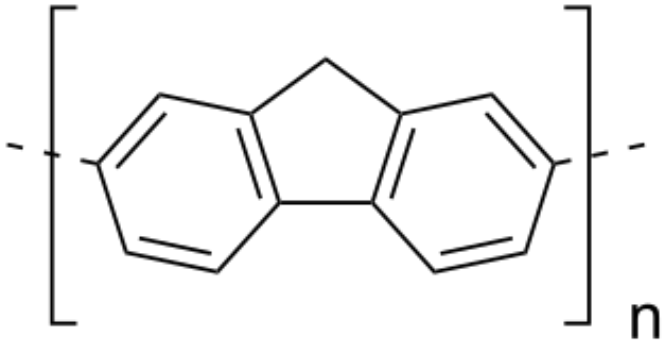
caused by conjugation

The organic compounds used in OLEDs include derivatives of **Poly(p-phenylene vinylene)** and **polyfluorene**.

Substitution of side chains onto the polymer backbone may determine the colour of emitted light.



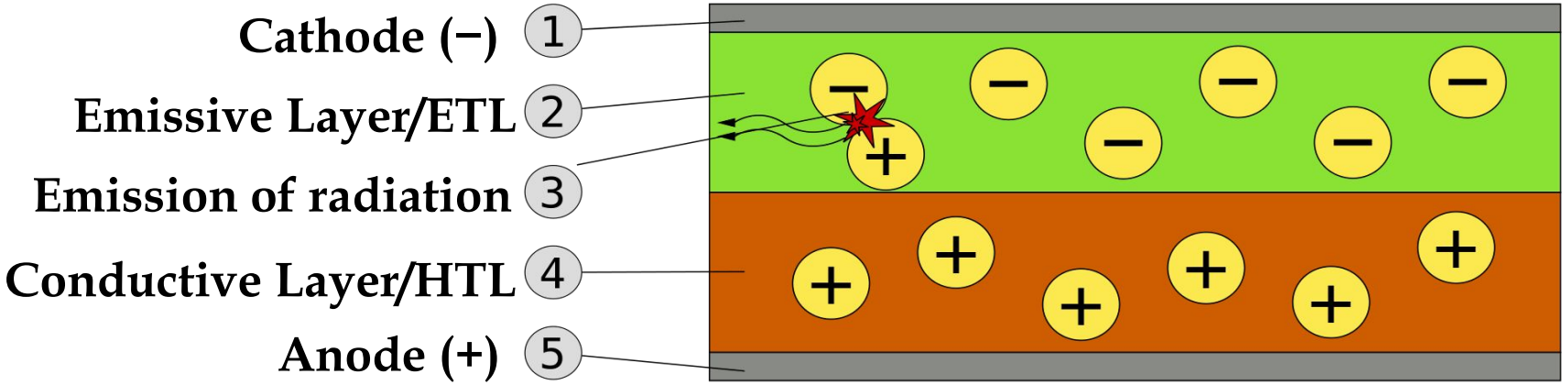
Poly(p-phenylene vinylene) PPV

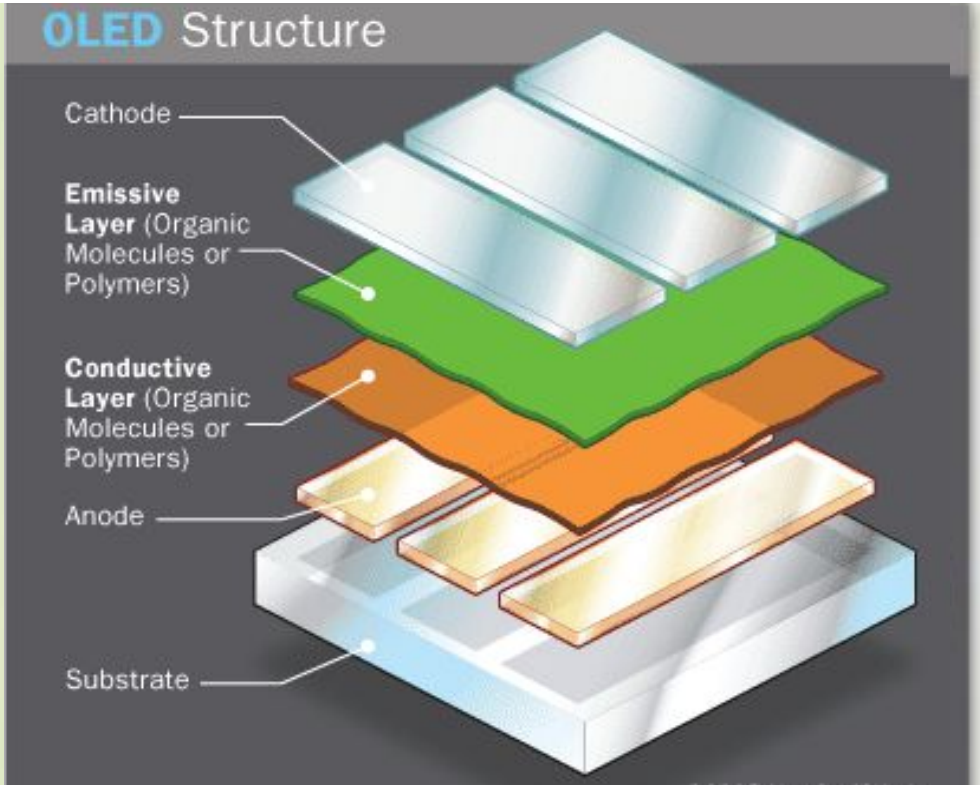


polyfluorene

CONSTRUCTION

Schematic diagram of a bilayer OLED





Cathode - The cathode injects electrons into emissive layer.

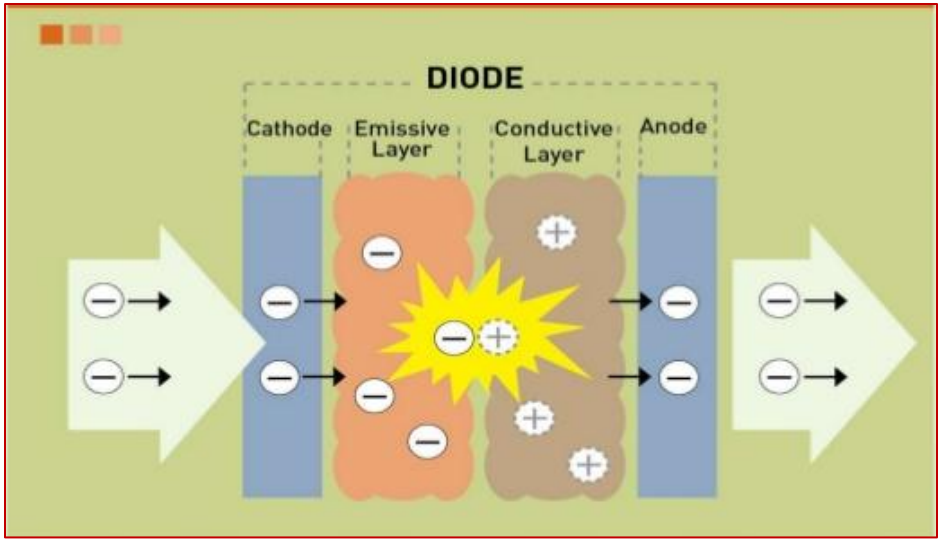
Emissive layer - This layer is made of polyfluorene that transport electrons from the cathode. This is where light is made.

Conducting layer - This layer is made of polyaniline that transport "holes" from the anode.

Anode – It is kept transparent. Usually made up of Indium tin oxide (ITO) that removes electrons.

Substrate - The substrate supports the OLED.

WORKING

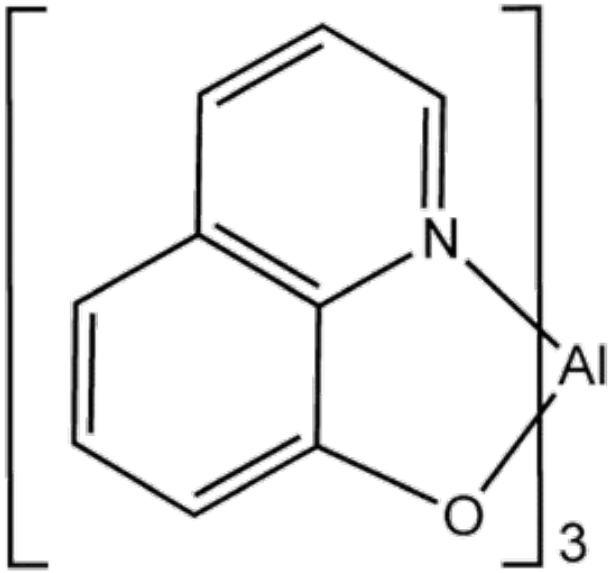


- ✔Apply a voltage across the anode and cathode.
- ✔As the electricity starts to flow, the cathode receives electrons from the power source and the anode loses them.
- ✔The added electrons are making the n-type emissive layer negatively charged, while the p-type conductive layer is becoming positively charged.
- ✔Positive **holes are much more mobile than electrons** so they jump across the boundary from the conductive layer to the emissive layer.
- ✔When a hole meets an electron, the y cancel out and release a brief burst of energy in the form of a quantum of light or a photon. This process is called **recombination**. Since it's happening many times in a second the OLED produces continuous light for as long as the current keeps flowing.

Note: In conventional LED electrons are more mobile than holes so p-region is the emissive layer.

SMALL MOLECULE OLED

- ✔Creation of light emitting electrochemical cell on adding mobile ions to an OLED
- ✔3 organic layers sandwiched between electrodes
- ✔EML consists of light emitting dyes or dopant dispersed in suitable host material



Aluminium Quinacridone ALlq3

ADVANTAGES

1. The manufacture of OLED is highly economical and is more efficient than LCD and flat panel screens.

2. OLED display can be printed cloths and fabrics by ink jet printing. This technology will help in carrying huge displays in our hands.

3. There is much difference in watching a high-definition TV to a OLED display. As the contrast ratio of OLED is very high (even in dark conditions), it can be watched from an angle nearly 90 degrees without any difficulty.

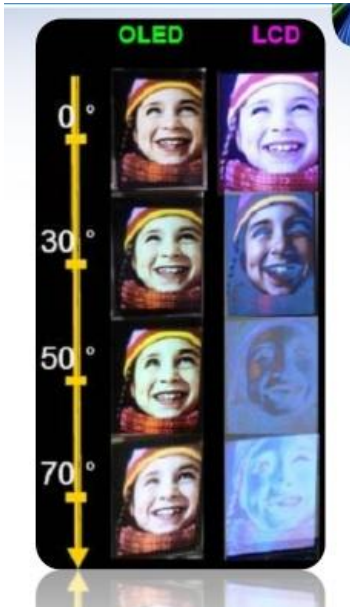
4. No backlight is produced by this device and the power consumption is also very less.

5. OLED has a refresh rate of 100,000 Hz which is almost 9900 Hz greater than an LCD display.

6. The response time is less than 0.01 ms. LCD needs a response time of 1 ms.

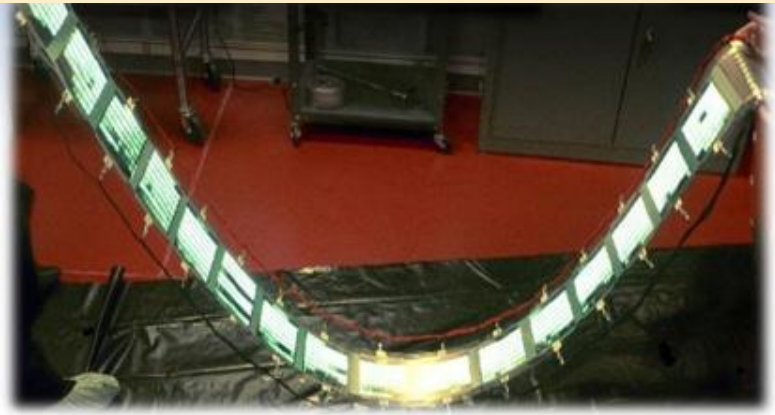
ADVANTAGES

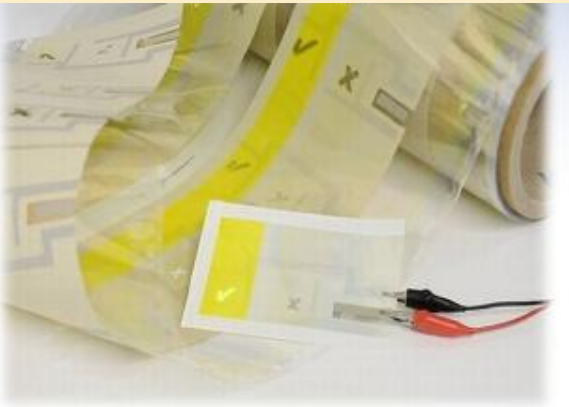
Better contrast ratio



Wider Viewing Angle

ADVANTAGES





- The flexible OLED element capable of being produced using roll-to-roll printing technology.

Fast response time means full motion graphics can be displayed

APPLICATIONS

- Televisions
  - SONY
  - LG transparent TV

- Cell Phone screens

- Wrist Watch
- Computer Screens
  - Laptops
  - Desktops
- Bendable Devices
- Portable Device displays
  - Philips Go Gear MP3 Player

TRY TO ANSWER

1. What are OLEDs ? What are different types of OLEDs? Discuss their basic principles

2. Write a note on the construction and working of an OLED.

3. Why n-region acts as emissive layer in contrast conventional inorganic LEDs?

4. What are the advantages of OLEDs?


THANK
YOU