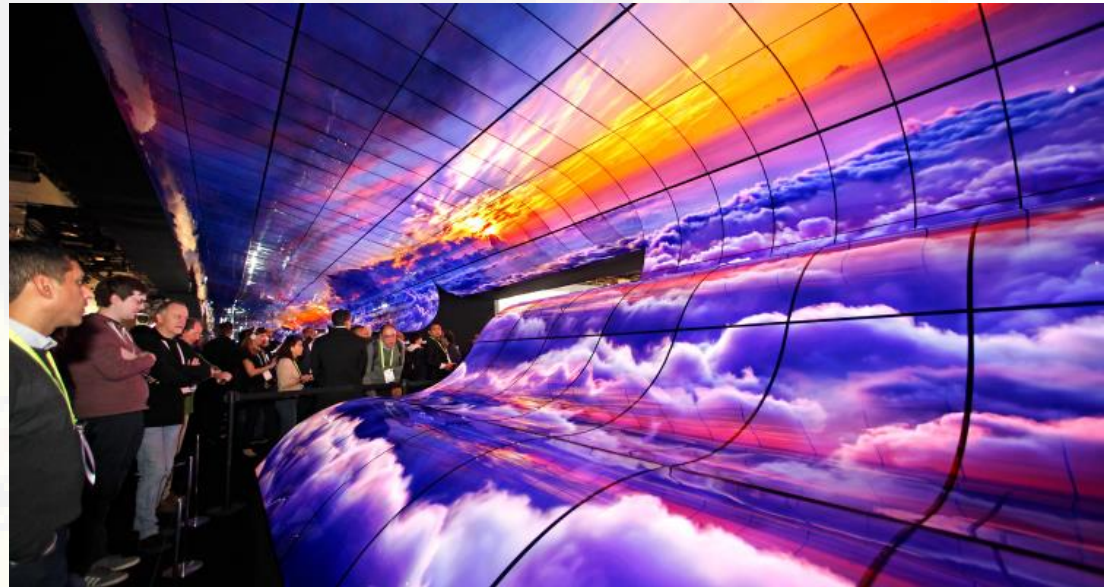




UNIT IV



Organic Light Emitting Diodes



CONTENTS

- INTRODUCTION
- WHAT IS OLED?
- HISTORY
- FEATURES
- WORKING PRINCIPLE
- MANUFACTURING OF OLED
- TYPES OF OLED
- ADVANTAGES AND DISADVANTAGES
- APPLICATIONS
- CONCLUSION



INTRODUCTION

- Organic light emitting diode(OLED).
- Emerging Technology for displays in devices.
- Main principle behind OLED technology is electroluminescence.
- Offers brighter, thinner, high contrast, flexible displays.



WHAT IS AN OLED?

- OLEDs are solid state devices composed of thin films of organic molecules that is 100 to 500 nanometres thick.
- They emits light with the application of electricity.
- They doesn't require any backlight. i.e., they are self emitting.
- They are made from carbon and hydrogen.



HISTORY

- The first OLED device was developed by Eastman Kodak in 1987.
- In 1996, pioneer produces the world's first commercial PMOLED.
- In 2000, many companies like Motorola, LG etc developed various displays.
- In 2001, Sony developed world's largest fullcolor OLED



HISTORY (CONTD.)

- In 2002, approximately 3.5 million passive matrix OLED sub-displays were sold, and over 10 million were sold in 2003.
- In 2010 and 2011, many companies announced AMOLED displays.
- Many developments had take place in the year 2012.

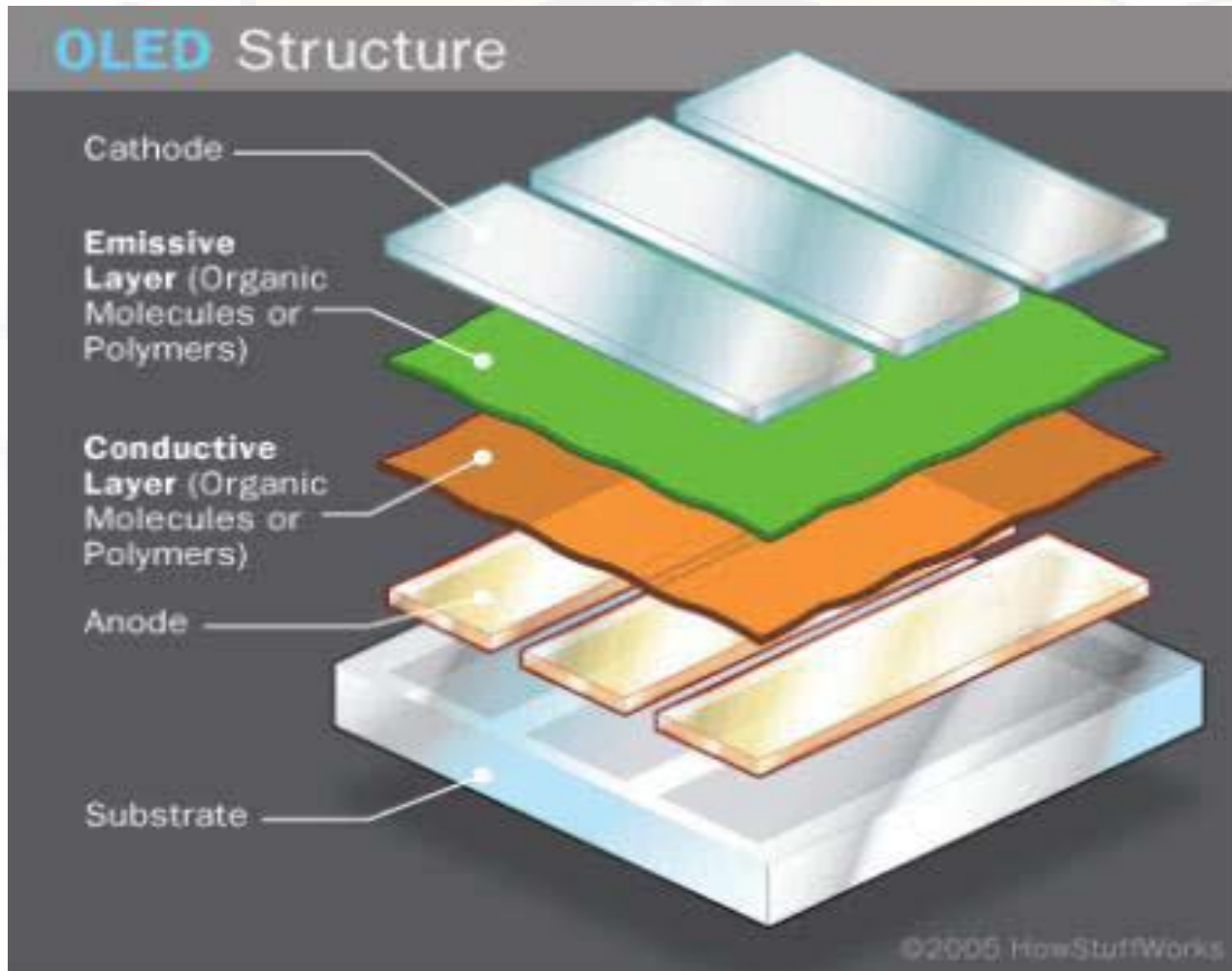


FEATURES

- Flexibility.
- Emissive Technology.
- Light weight and thin.
- Low power consumption.
- High contrast, brighter and perfect display from all angles.

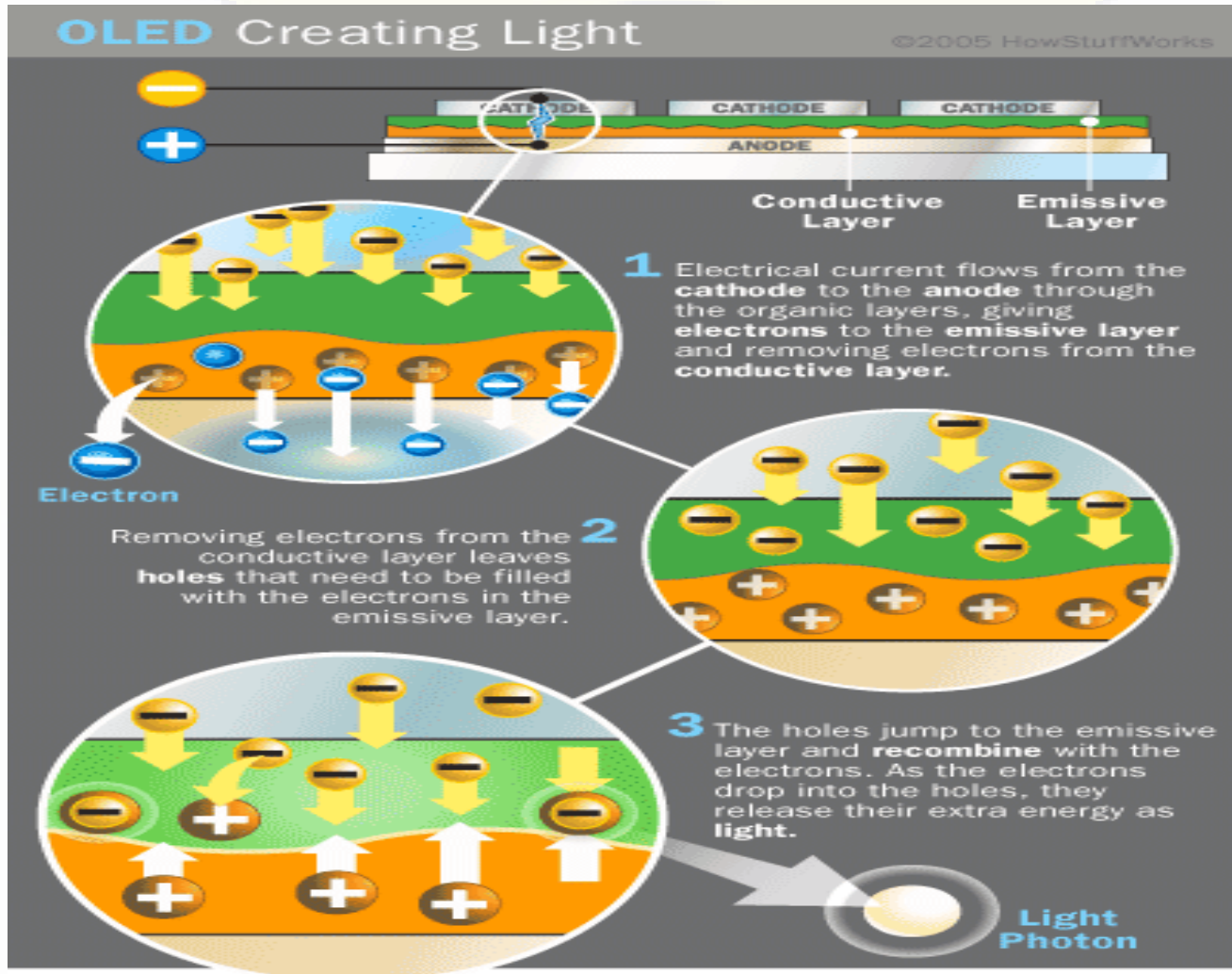


STRUCTURE OF OLED(FIGURE)





How OLED Works





WORKING PRINCIPLE

- A voltage is applied across the anode and cathode.
- Current flows from cathode to anode through the organic layers.
- Electrons flow to emissive layer from the cathode.
- Electrons are removed from conductive layer leaving holes.
- Holes jump into emissive layer .
- Electron and hole combine and light emitted.



MANUFACTURING OF OLED

- Vacuum deposition or Vacuum Thermal evaporation (VTE)
- Organic vapor phase deposition (OVPD)
- Inkjet Printing

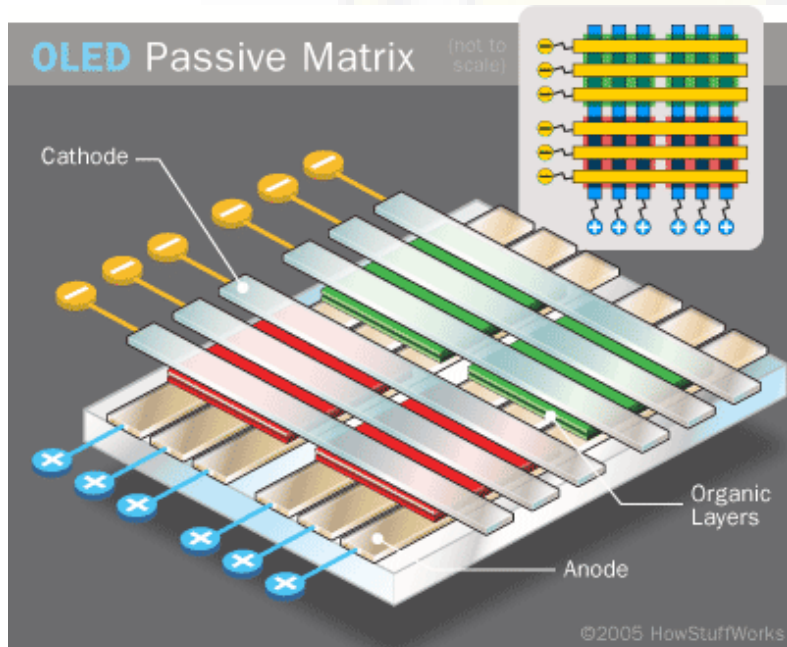


Types of OLEDs

- Passive-matrix OLED
- Active-matrix OLED
- Transparent OLED
- Top-emitting OLED
- Foldable OLED
- White OLED



1. Passive-Matrix OLED (PMOLED)

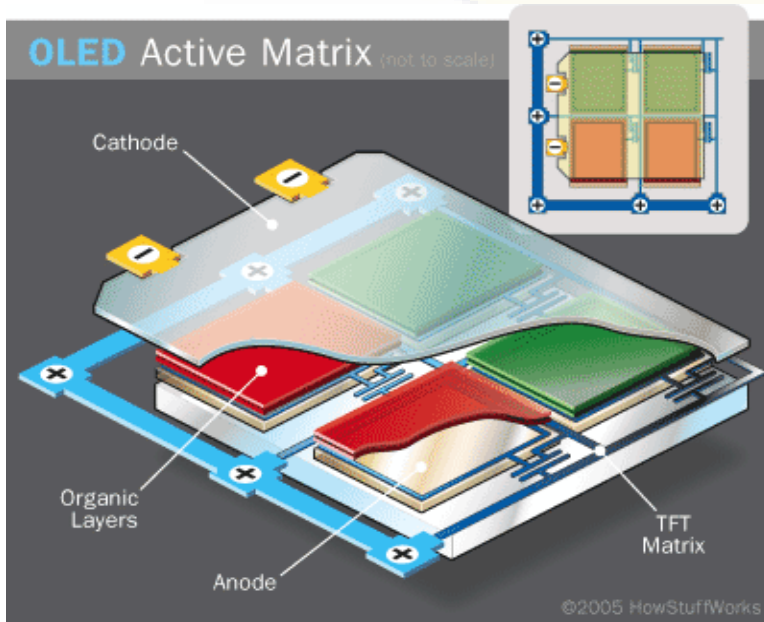


- Perpendicular cathode/anode strip orientation
- Light emitted at intersection (pixels)
- External circuitry
 - Turns on/off pixels
- Large power consumption
 - Used on 1-3 inch screens
 - Alphanumeric displays





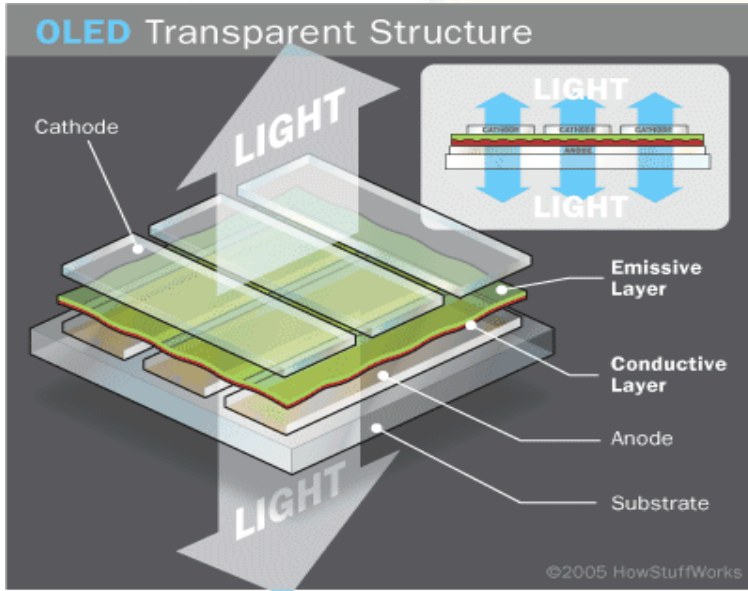
2. Active-Matrix OLED (AMOLED)



- Full layers of cathode, anode, organic molecules
- Thin Film Transistor matrix (TFT) on top of anode
 - Internal circuitry to determine which pixels to turn on/off
- Less power consumed than PMOLED
 - Used for larger displays



3. Transparent OLED(TOLED)

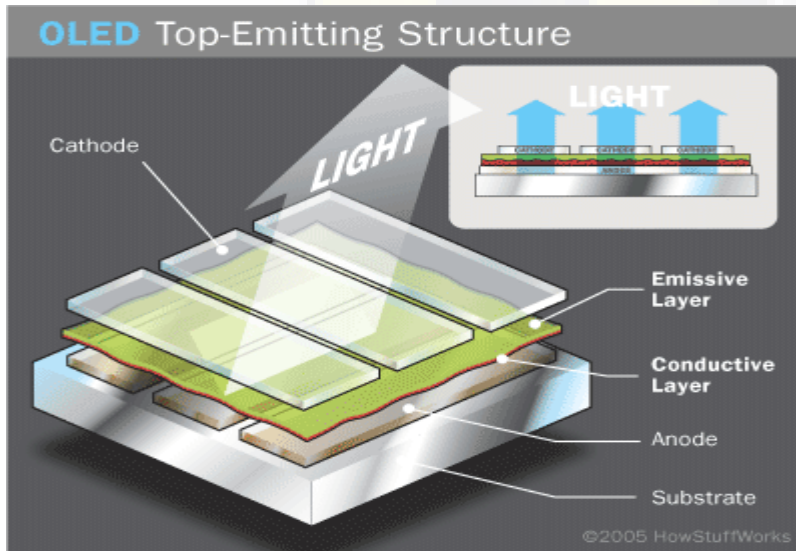


- Transparent substrate, cathode and anode
- Bi-direction light emission
- Passive or Active Matrix OLED
- Useful for heads-up display
 - Transparent projector screen
 - Glasses





4. Top-emitting OLED(TEOLED)



- Non-transparent or reflective substrate
- Transparent Cathode
- Used with Active Matrix Device
- Smart card displays



5. Foldable OLED

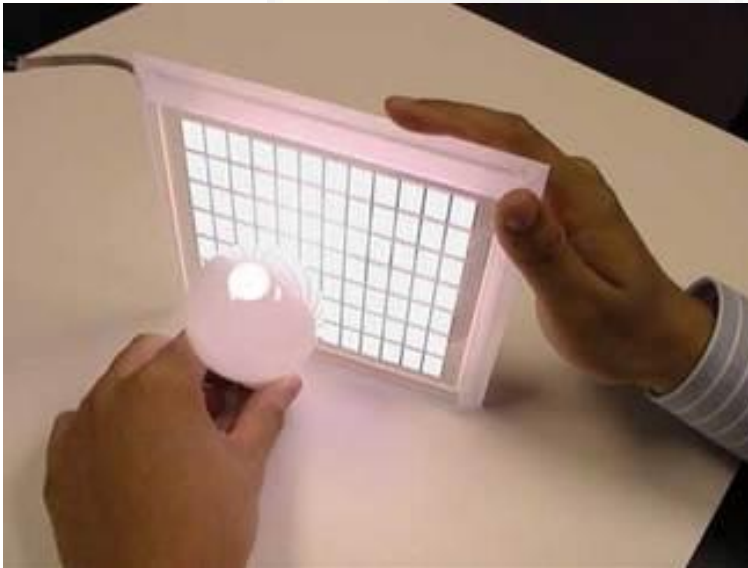


- Flexible metallic foil or plastic substrate
- Lightweight and durable
- Reduce display breaking
- Clothing OLED





6. White OLED



- Emits bright white light
- Replace fluorescent lights
- Reduce energy cost for lighting
- True Color Qualities



vantages of OLED

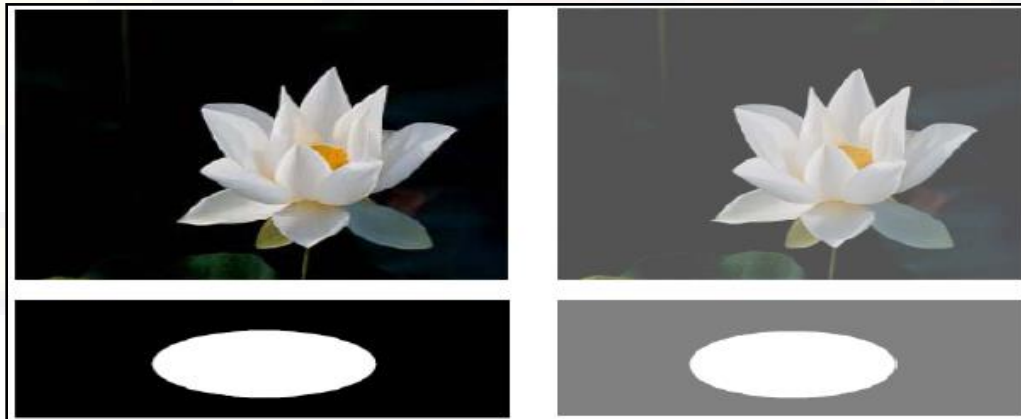
1. Very thin panel of approximately 1mm
2. Low power consumption
3. High brightness
4. High contrast ratio of 10,000 : 1
5. Wide viewing angle of 170°
6. Foldable display panel



Advantages of OLED display over TFT-LCD display

1. Contrast Ratio

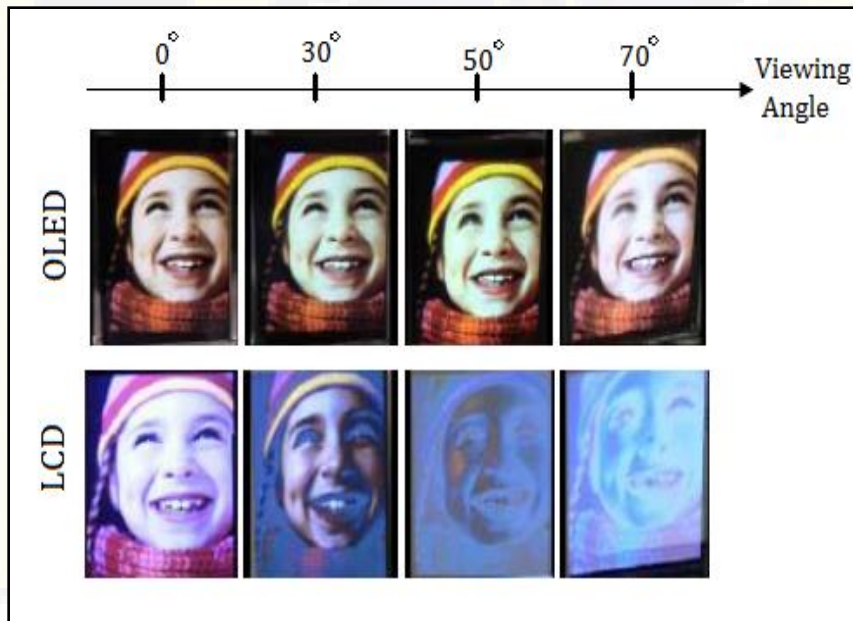
- Higher contrast ratio than TFT-LCD display
- Better impression for higher brightness





2.Viewing Angle

- Higher viewing angle up to 170° for constant contrast ratio





3. Response Time

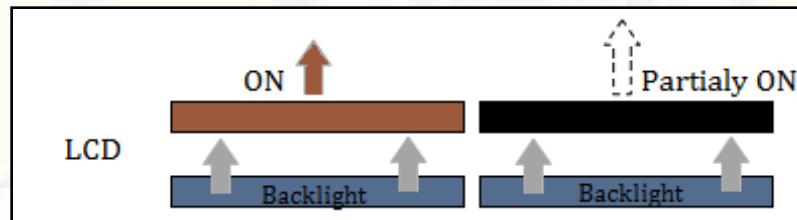
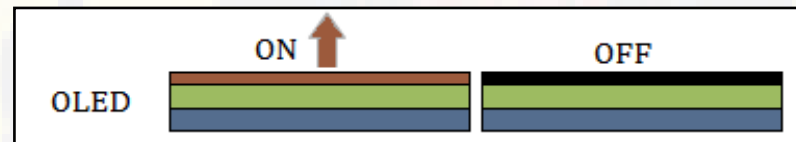
- Fast time response in order of $<50 \mu\text{s}$
- Comparison by graphical point of view





4. Backlight Function

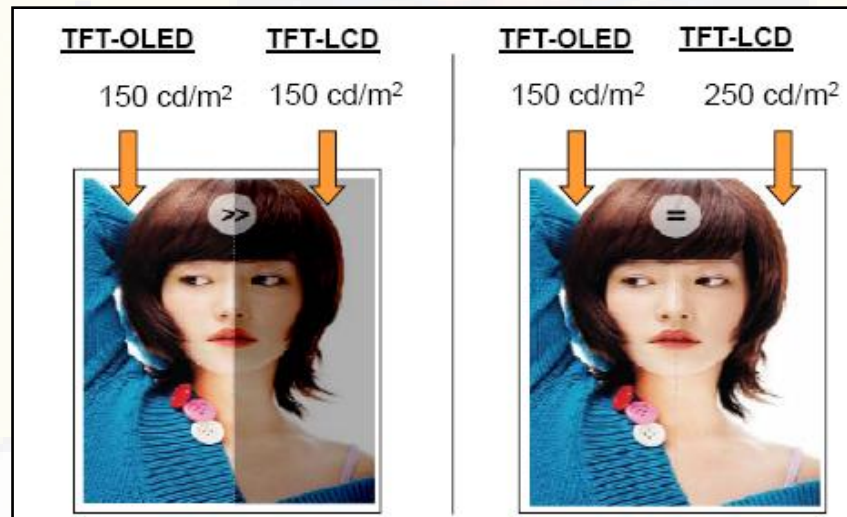
- No backlight required in OLED display
- During black background OLED is turned OFF
- In LCD backlight is still required





5. Power Efficiency

- OLED display is more power efficient than TFT-LCD display
- For the same power OLED display is more brighter





OLED Disadvantages

- Lifetime
 - White, Red, Green → 46,000-230,000 hours
 - About 5-25 years
 - Blue → 14,000 hours
 - About 1.6 years
- Expensive
- Susceptible to water
- Overcome multi-billion dollar LCD market



APPLICATIONS

Major applications of OLED technology are

- OLED TV.
- Mobile phones with OLED screens.
- Smart watch with OLED screens.



OLED TV





MOBILE PHONES WITH OLED SCREEN





ART WATCH WITH OLED DISPLAY





CONCLUSION

- Limited use caused by degradation of materials.
- OLED will replace current LED and LCD technologies
- Expensive
- Flexibility and thinness will enable many applications