OLED

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DIFFERENT TECHNOLOGIES USED FOR DISPLAY

• CRT
• PLASMA
• LCD
• LED
• OLED
Organic Light-Emitting Diode

- Emissive organic material, that when supplied with an electrical current, produces a superior full-color flat panel display.
- OLED’s can provide brighter, crisper displays on electronic devices and it uses less power than conventional light-emitting diodes or liquid crystal displays.

http://www.crunchgear.com/wp-content/photos/oled_01.jpg
History

- First developed in the early 1950’s in France by applying a high-voltage alternating current field to crystalline thin films of acridine orange and quinacrine
- The first diode device was invented at Eastman Kodak in the 1980’s by Dr. Ching Tang and Steven Van Slyke
- Today OLED is used in television screens, computer displays, portable system screens, advertising, information and indication
- Also used in light sources for general space illumination, and large-area light-emitting elements
STRUCTURE OF OLED

- ITO Anode
- Glass Substrate
- Metal Cathod
- Electron Transport Layer (ETL)
- Organic Emitters
- Hole Injection Layer
- Light Output
- 2 to 10 VDC
Architecture of OLEDs

- **Substrate** (clear plastic, glass, foil) - The substrate supports the OLED.
- **Anode** (transparent) - The anode removes electrons (adds electron "holes") when a current flows through the device.
  - **Conducting layer** - This layer is made of organic plastic molecules that transport "holes" from the anode. One conducting polymer used in OLEDs is polyaniline.
  - **Emissive layer** - This layer is made of organic plastic molecules (different ones from the conducting layer) that transport electrons from the cathode; this is where light is made. One polymer used in the emissive layer is polyfluorene.

- **Cathode** (may or may not be transparent depending on the type of OLED) - The cathode injects electrons when a current flows
How OLED Works

1. Voltage applied across Cathode and Anode
   1. Typically 2V-10V
2. Current flows from cathode to anode
   1. Electrons flow to emissive layer
   2. Electrons removed from conductive layer leaving holes
   3. Holes jump into emissive layer
3. Electron and hole combine and light is emitted
MANUFACTURING OF OLED

- The biggest part of manufacturing OLEDs is applying the organic layers to the substrate. This can be done in three ways:
  - **Vacuum deposition** or **vacuum thermal evaporation** (VTE) - In a vacuum chamber, the organic molecules are gently heated (evaporated) and allowed to condense as thin films onto cooled substrates. This process is expensive and inefficient.
  - **Organic vapor phase deposition** (OVPD) - In a low-pressure, hot-walled reactor chamber, a carrier gas transports evaporated organic molecules onto cooled substrates, where they condense into thin films. Using a carrier gas increases the efficiency and reduces the cost of making OLEDs.
  - **Inkjet printing** - With inkjet technology, OLEDs are sprayed onto substrates just like inks are sprayed onto paper during printing. Inkjet technology greatly reduces the cost of OLED manufacturing and allows OLEDs to be printed onto very large films for large displays like 80-inch TV screens or electronic billboards.
Types of OLEDs

- Passive-matrix OLED
- Active-matrix OLED
- Transparent OLED
- Top-emitting OLED
- Foldable OLED
- White OLEDs
1. Passive-Matrix OLED (PMOLED)

- Perpendicular cathode/anode strip orientation
- Light emitted at intersection (pixels)
- External circuitry
  - Turns on/off pixels
- External circuitry
- 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 then PMOLED
  - Used for larger displays
Advantages of OLEDs

- Much faster response time
- Consume significantly less energy
- Able to display "True Black" picture
- Wider viewing angles
- Thinner display
- Better contrast ratio
- Safer for the environment
- Has potential to be mass produced inexpensively
- OLEDs refresh almost 1,000 times faster then LCDs
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

- Small electronic screens
- Motorola, Samsung, Sony Ericsson Mobile phones
- Cameras
- Keyboards
- TVs and Monitors
Future Uses for OLED

Scroll Laptop
- a concept OLED Laptop

Lighting
- Flexible / bendable lighting
- Wallpaper lighting defining new ways to light a space
- Transparent lighting doubles as a window
CONCLUSION

- Organic materials are poised as never before to transform the world of display technology. Major electronic firms such as Philips and pioneer and smaller companies such as Cambridge Display Technology are betting that the future holds tremendous opportunity for low cost and surprisingly high performance offered by organic electronic and opt electronic devices. Using organic light emitting diodes, organic full color displays may eventually replace LCDs in laptop and even desktop computers. Such displays can be deposited on flexible plastic coils, eliminating fragile and heavy glass substrate used in LCDs and can emit light without the directionality inherent in LCD viewing with efficiencies higher than that can be obtained with incandescent light bulbs.

- Organic electronics are already entering commercial world. Multicolor automobile stereo displays are now available from Pioneer Corp., of Tokyo And Royal Philips Electronics, Amsterdam is gearing up to produce PLED backlights to be used in LCDs and organic ICs.

- The first products using organic displays are already in the market. And while it is always difficult to predict when and what future products will be introduced, many manufactures are working to introduce cell phoned and personal digital assistants with organic displays within the next few years. The ultimate goal of using high efficiency, phosphorescent

- flexible organic displays in laptop computers and even for home video applications may be no more than a few years in to the future. The portable and light weight organic displays will soon cover our walls replacing the bulky and power hungry cathode ray tubes.