FLEXIBLE DISPLAYS USING LEP

By: Shaik Mohammed Muzakkir
1DA07EC091
Contents

- Introduction
- What is LEP?
- Chemistry Behind LEP
- Structure And Working
- Types of LEP’s
- Manufacturing
- Advantages
- Limitations
- Applications
- Conclusion
Introduction

- It’s a rapidly emerging technology for next generation flat panel displays
- It promises thin, light weight emissive displays with low drive voltage, low power consumption, high contrast, wide viewing angle, and fast switching times
- LEPs are inexpensive and consume much less power than any other flat panel display
- One interesting application of these displays is electronic paper that can be rolled up like newspaper.
Introduction

- Light emitting polymers are superior than other displays like, liquid crystal displays (LCDs) vacuum fluorescence displays and electro luminescence displays.
- The technology uses a light-emitting polymer (LEP) that costs much less to manufacture and run than CRTs because the active material used is plastic.
What is LEP?

- LEP is a polymer that emits light when a voltage is applied to it.
- The structure comprises a thin film semi conducting polymer sandwiched between two electrodes namely anode and cathode.
- When electrons and holes are injected from the electrodes, the recombination of these charge carriers takes place, which leads to emission of light that escape through glass substrate.
What is LEP?

- The ban gap, that is energy difference between valence band and conduction band of the semi conducting polymer determines the wave length, that is colour of the emitted light.
- The first polymer LEPs used poly phินylene vinylene (PPV) as the emitting layer.
- PPV and its derivatives, including poly thiophenes, poly pyridines, poly phenylenes and copolymers are still the most commonly used materials.
- The charge transport mechanism in conjugated polymers is different from traditional inorganic semiconductors.
CHEMISTRY BEHIND LEP

- LEPs are constructed from a special class of polymers called conjugated polymers.
- Plastic materials with metallic and semiconductor characteristics are called conjugated polymers.
- These polymers possess delocalised pi electrons along the backbone, whose mobility shows properties of semiconductors.
- The charge transport mechanism in conjugated polymers is different from traditional inorganic semiconductors.
Figure: basic structure of LEP
Fig. 1: The structure of a light-emitting polymer device
STUCTURE AND WORKING

- The basic LEP consists of a stack of thin organic polymer layers sandwiched between a transport anode and a metallic cathode.
- The indium-tin-oxide (ITO) coated glass is coated with a polymer.
- On the top of it, there is a metal electrode of Al, Li, Mg or Ag.
- These moving holes and electrons combine together to form hole-electron pairs known as “excitons’.”
STUCTURE AND WORKING

- When this energy drop occurs light comes out from the device. This phenomenon is called electroluminescence.
- The greater the difference in energy/between the hole and the electron, the higher the frequency of the emitted light.
Fig. 2: The structure of (a) single-layer device and (b) symmetrically configured alternating current light emitting (SCALE) device.
Types of *displays*

Passive matrix

Active matrix.
Passive matrix

• To drive a passive matrix display, the current is passed through select pixels by applying a voltage to the drivers attached to the corresponding rows and columns.
• These schemes pattern the anode and cathode into perpendicular rows and columns and apply a data signal to the columns while addressing the sequentially
Active matrix

- a thin film polysilicon transistor on the substrate address each pixel individually. Active matrix displays are not limited by current consideration
- One exciting possibility is that polymer transistors, which can be manufactured by techniques similar to those used for LEP patterning, could be used to drive an LEP display.
MANUFACTURING

Spin coating process
- This technique involves spinning a disk, that is glass substrate at a fixed angular velocity and letting a small amount of polymer solution to drop on the top of the disk.
- The robot pours the plastic over the rotating plate, which in turn, evenly spreads the polymer on the plate. This results in an extremely fine layer of the polymer having a thickness of 100 nanometers.
Spin coating process

Figure: spin coating process.
LEPs can be patterned using a wide variety of printing techniques. The most advanced is ink-jet printing (figure). Resolution as high as 360 dpi have been demonstrated, and the approach are scalable to large-screen displays. Printing promises much lower manufacturing cost.
Printer based technique
ADVANTAGES

- Require only 3.3 volts and have lifetime of more than 30,000 hours
- Greater power efficiency than all other flat panel displays
- No directional or blurring effects
- Can be viewed at any angle
- Fast switching speed, that is 1000 times faster than LCDs.
- Higher luminescence efficiency.
LIMITATIONS

- Vulnerable to shorts due to contamination of substrate surface by dust.

- Mechanically fragile.

- Space charge effect
  
  The effect of space charge on the voltage-current characteristics and current-voltage characteristics becomes more pronounced when the difference in the electron hole mobilities is increased. This will decrease the luminescence and hence decreases the efficiency.
APPLICATIONS

- Multi or full colour cell phone displays
- Full colour high-resolution personal digital assistants (PDAs)
- Lightweight wrist watches
- High definition televisions.
- Roll-up daily refreshable electronic newspapers
- Automobile light systems without bulbs
- Windows/wall/partitions that double as computer screens
- Military uniforms
- Aircraft cockpit instrumentation panel a lot of others
Conclusion

- LEPs are promising, low cost solutions for today’s flat panel displays. Although not commercialised yet, these replace bulky and heavy CRT displays in the near future. However research is underway to improve the efficiency and lifetime of the polymer displays.
THANK YOU