OLED

Department: Computer Science

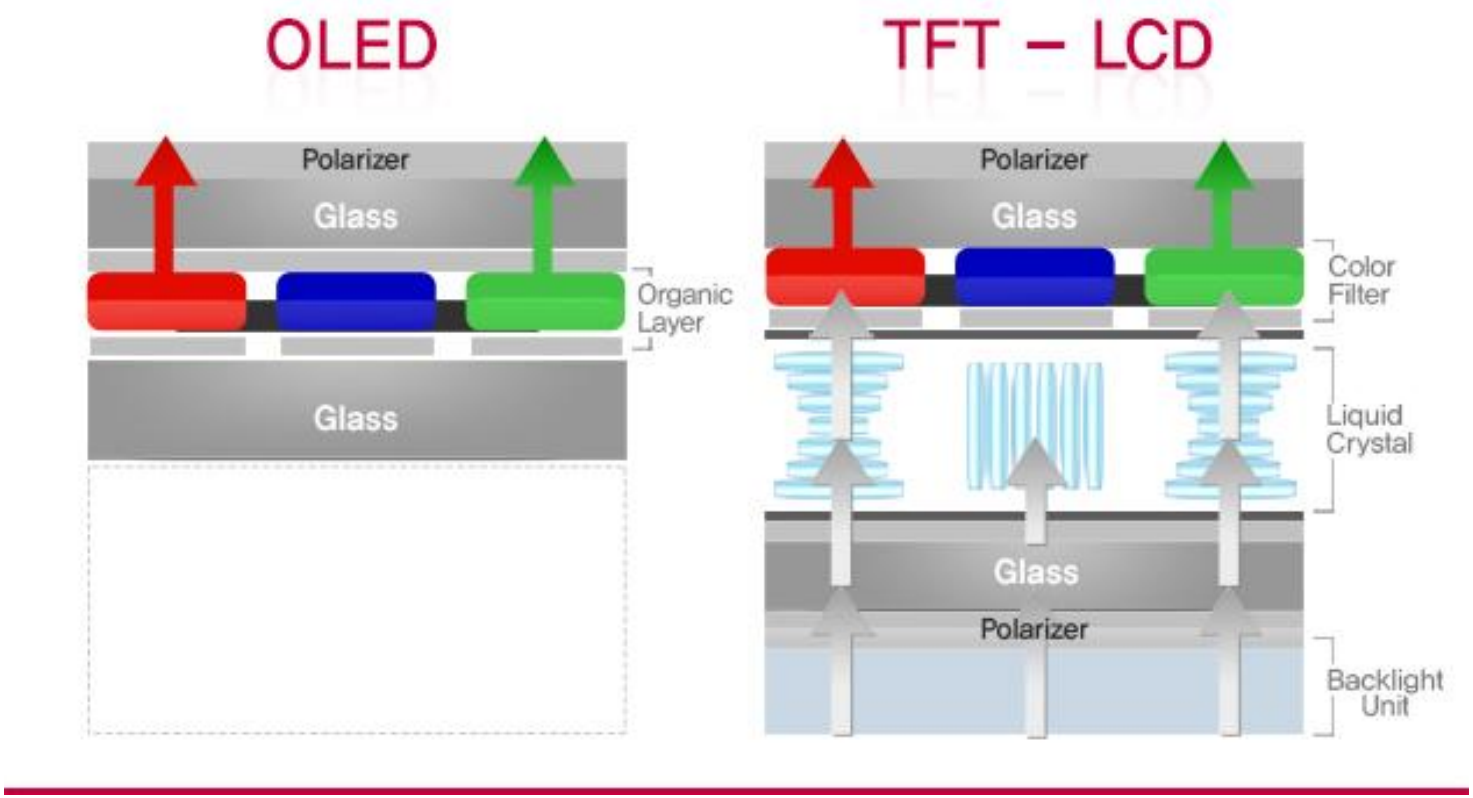
Student ID: 111062644

Name: 黃廉傑

Outline

- **Introduction**
- Technology
- Industry Analysis
- Applications
- Conclusion
- References

LCD vs OLED


OLED
Polarizer
Glass
Organic
Layer
Glass
TFT – LCD
Polarizer
Glass
Color
Filter
Liquid
Crystal
Glass
Polarizer
Backlight
Unit

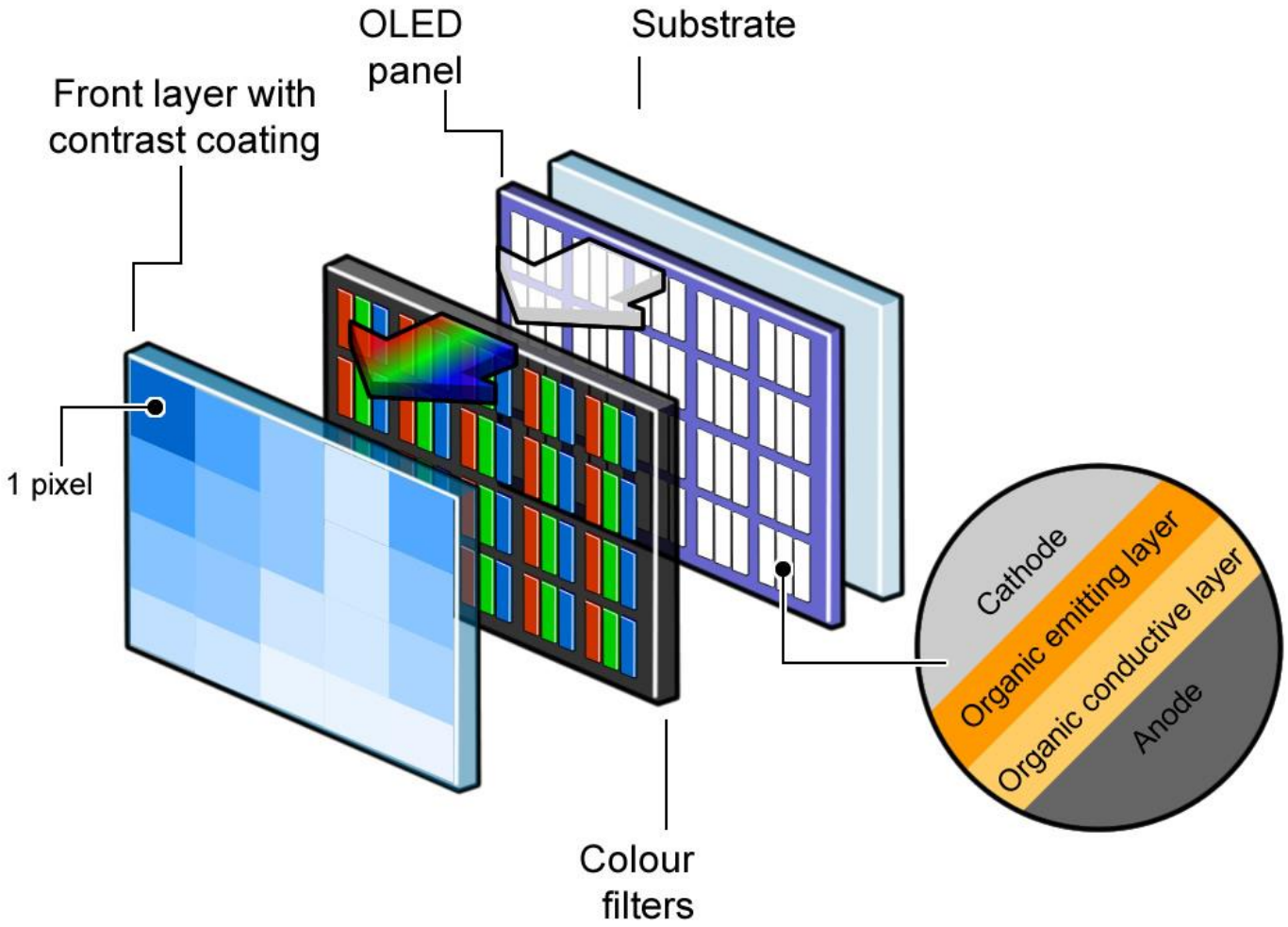
Why OLEDs

- Large fields of view
- High contrast and vivid color
- Faster Response
- Energy Efficiency
- Thin

Outline

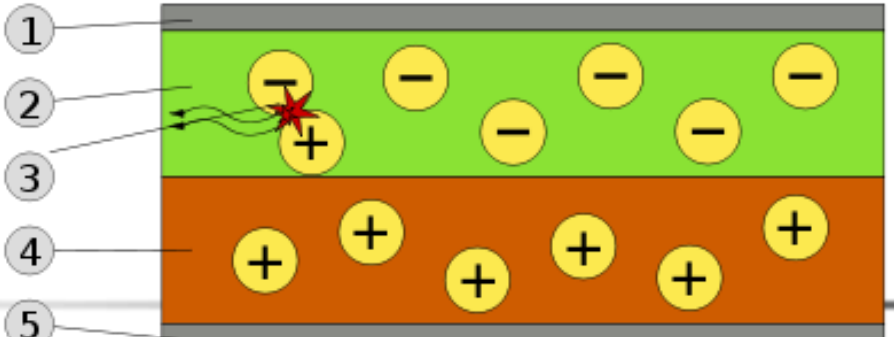
- Introduction
- **Technology**
- Industry Analysis
- Applications
- Conclusion
- References

OLED Screen

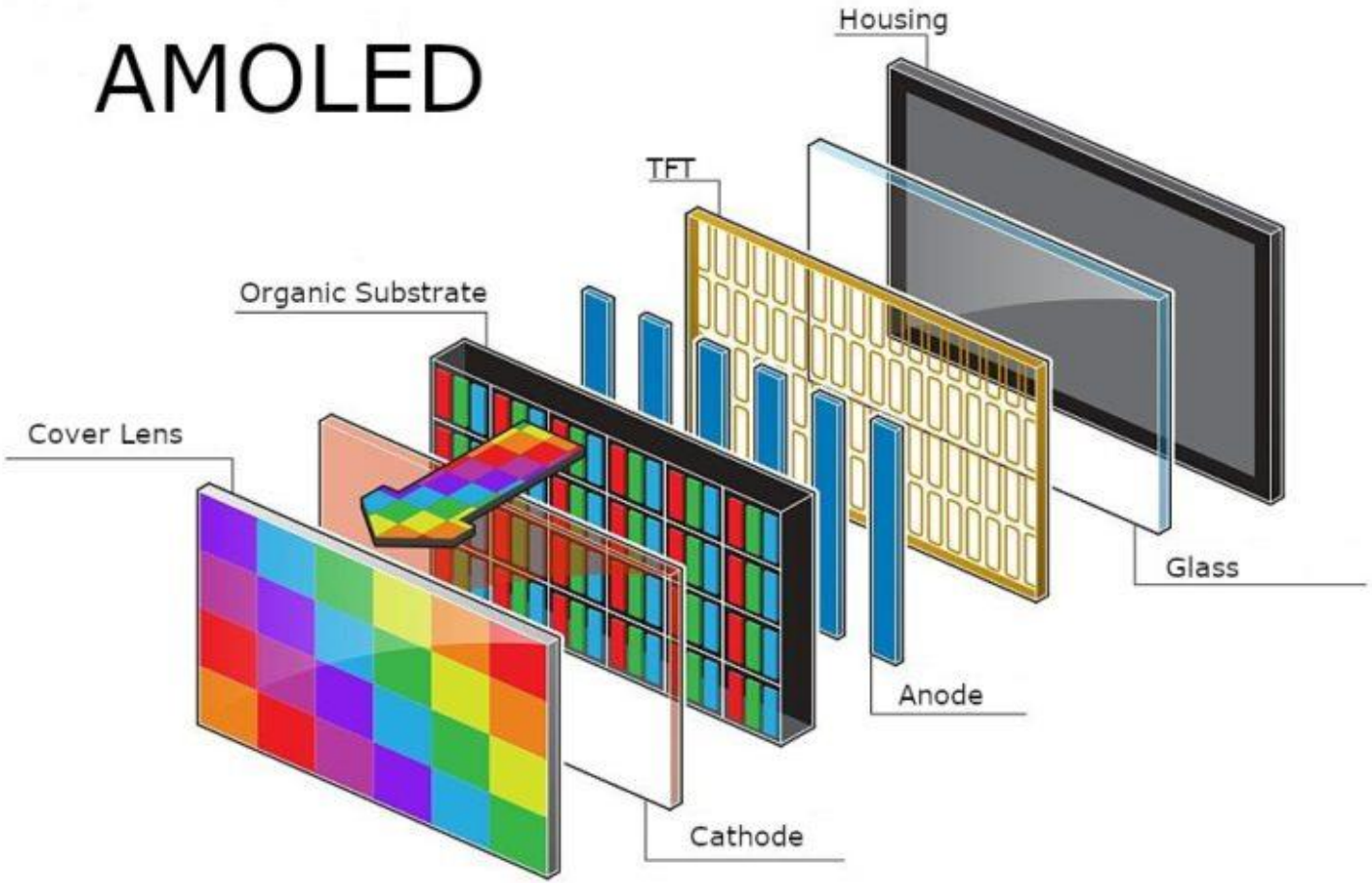

OLED
panel
Substrate
Front layer with
contrast coating
1 pixel
Cathode
Organic emitting layer
Organic conductive layer
Anode
Colour
filters

OLED Working Operation

- Due to battery or power supply, voltage is being applied to the OLED.
- As a result current flows from cathode to the anode through the organic layers.
- This process gives electrons to the emissive layer and removes electrons from conductive layer.
- Removal of electrons from conductive layer leave out holes which need to be filled with electrons in emissive layer.
- The holes jump to emissive layer and will recombine with electrons. As electrons drop into holes, they release their extra energy as light. This way light emission takes place in the OLED device.

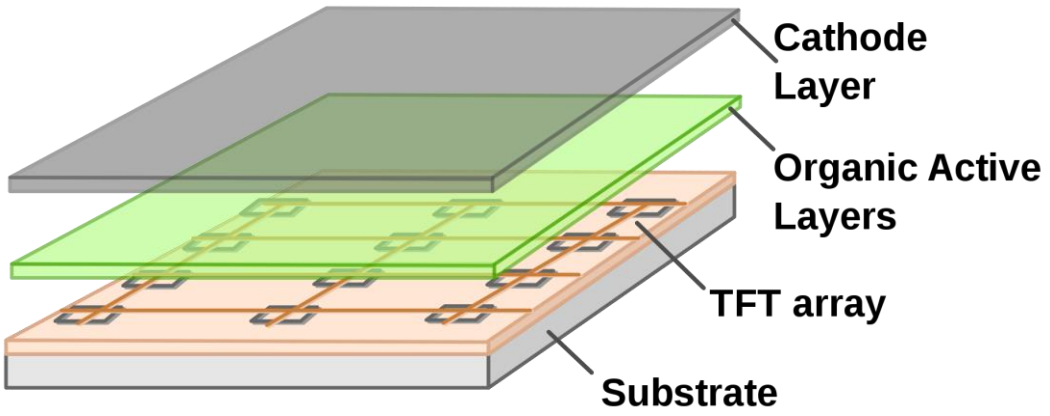


AMOLED Screen

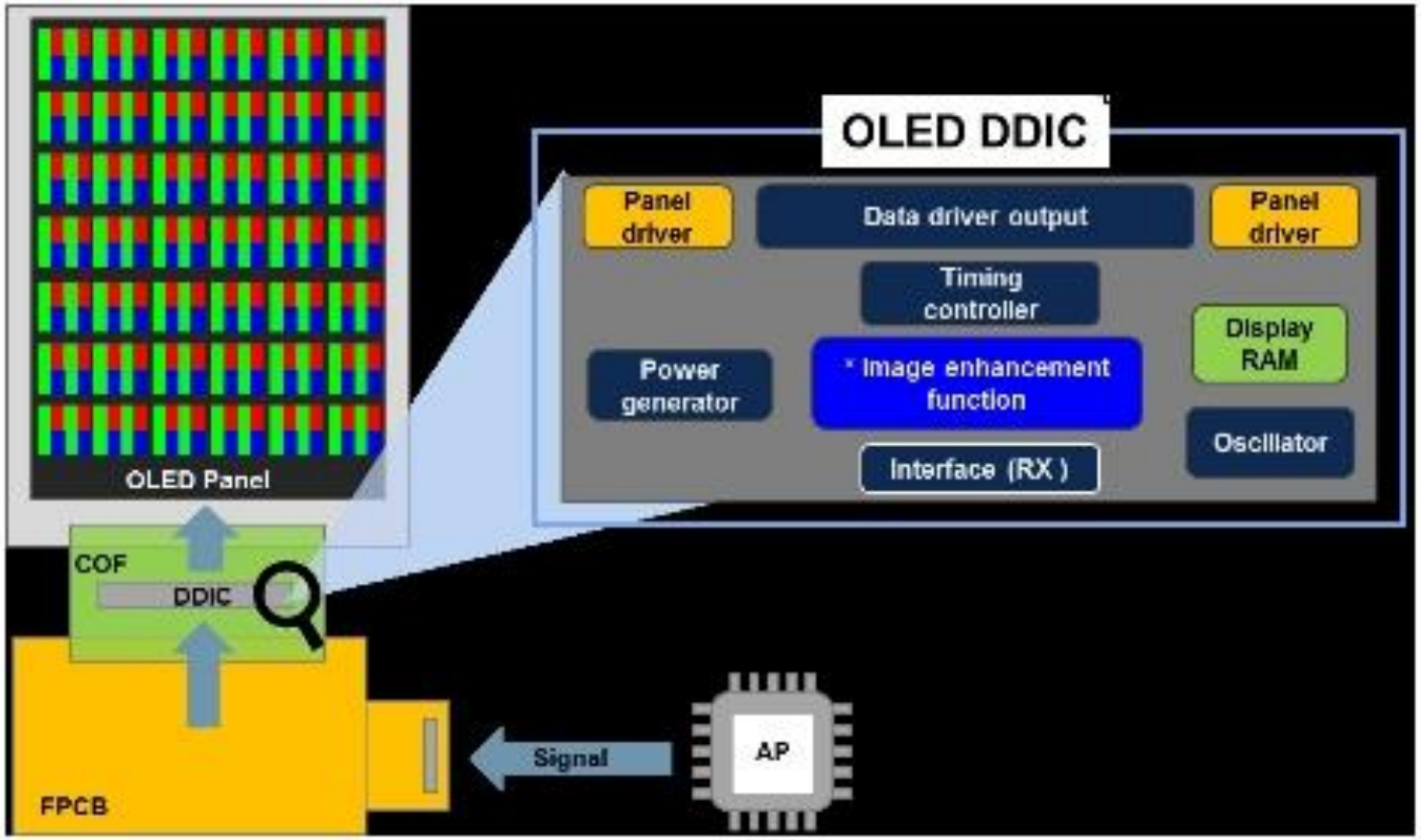


AMOLED

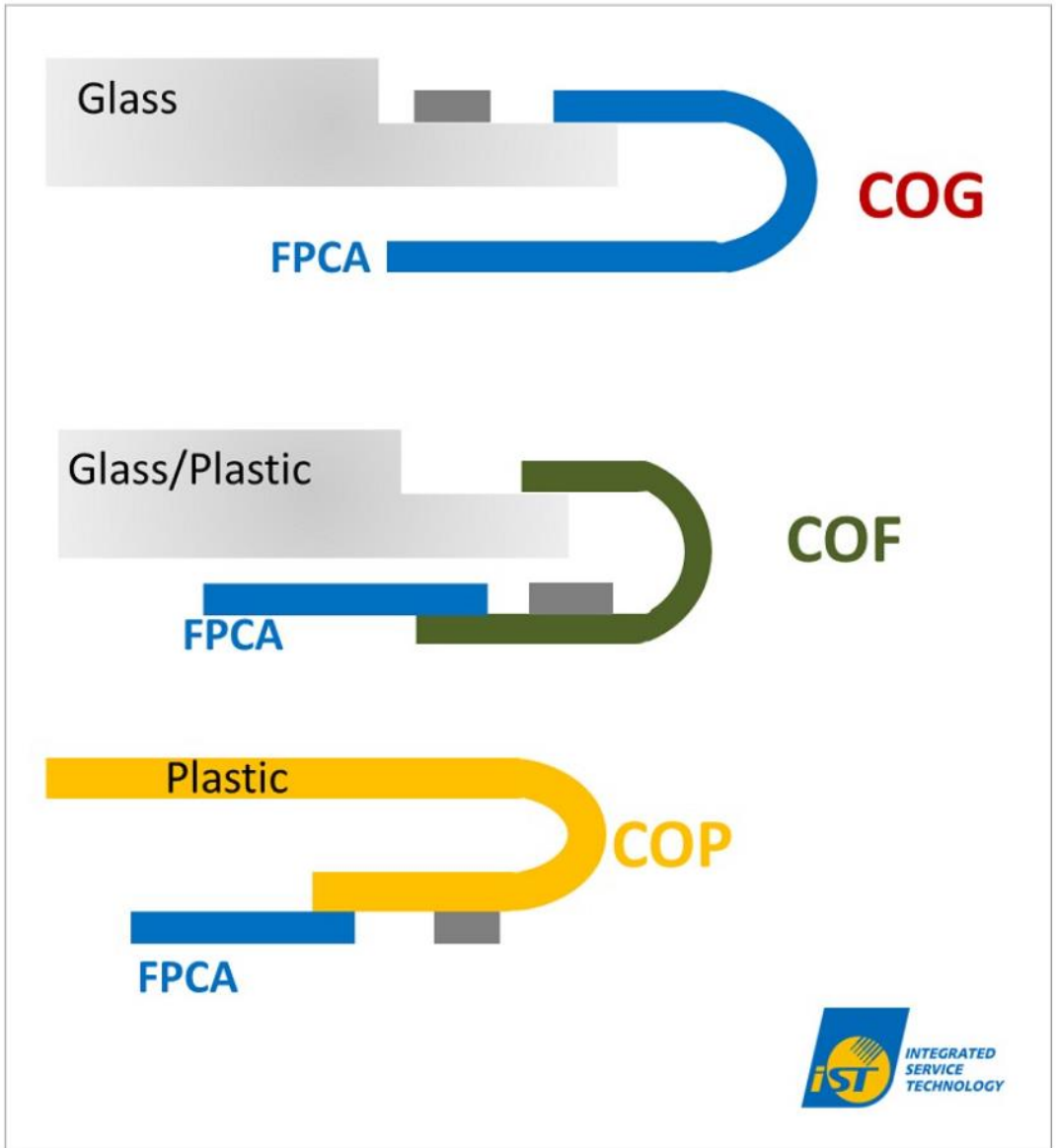
- The most important component of these displays is the TFT element that controls the flow in each pixel.
- With two TFTs per pixel, one to start and one to stop charging the storage capacitors this allows each LED to operate individually and generate light for itself.



OLED DDIC


OLED DDIC
Panel driver
Data driver output
Panel driver
Timing controller
Power generator
* Image enhancement function
Display RAM
Oscillator
Interface (RX)
OLED Panel
COF
DDIC
FPCB
Signal
AP

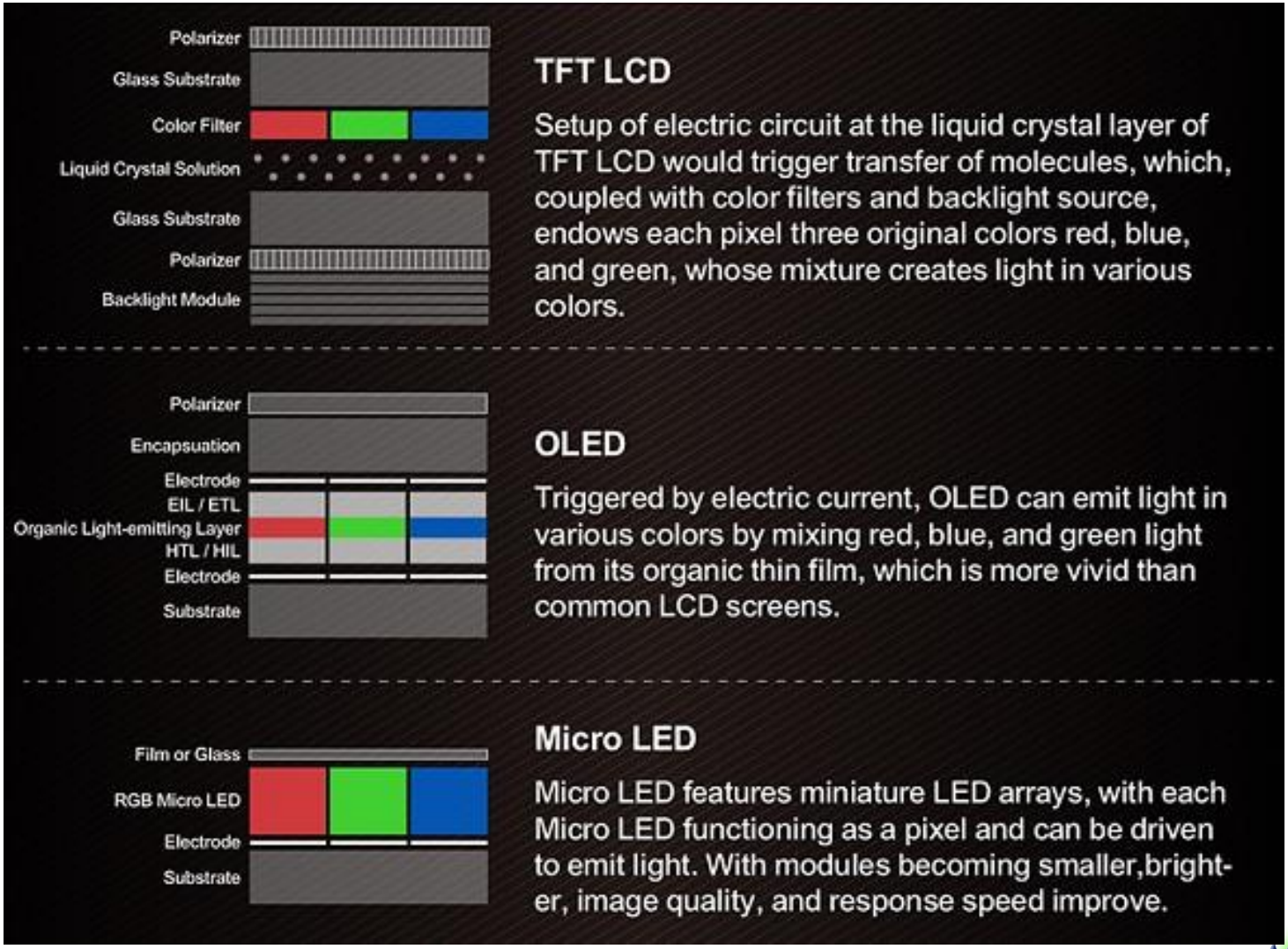
COG, COF, COP


Glass
FPCA
COG
Glass/Plastic
FPCA
COF
Plastic
COP
FPCA
iST
INTEGRATED
SERVICE
TECHNOLOGY

Outline

- Introduction
- Technology
- **Industry Analysis**
- Applications
- Conclusion
- References

LCD vs OLED vs Micro LED



TFT LCD

- **Pros**
  - Low cost & long lifespan: LCD is mature technology. Comparing with OLED, it has longer life time.
  - No stroboscopic effect: LCD uses DC power white LED backlight. Which won't produce stroboscopic effect.
  - High pixel density：Under the same resolution, TFT LCD produces sharper image than OLED.
- **Cons**
  - High power consumption：TFT LCD needs backlight. So it is thicker and consumes more power.
  - Relatively lower contrast：Light needs to pass through LCD glasses, liquid crystal layer, polarizers and color filters. Over 90% is lost. Also, LCD can not display pure black.

OLED

- **Pros**
  - OLED is thinner and lighter than LCD.
  - Low power consumption and flexible: OLED doesn't rely on backlight and consumes less power.
  - High contrast and vivid color: OLED emits light itself, can produce very bright image with beautiful color. And because OLED can be turned off, it can produce true black.
  - Turning LED on and off is faster than liquid crystal twisting, OLED's response time is shorter than LCD.
- **Cons**
  - OLED could have image retention (burn-in) problem. It is gradual degradation of pixels, after showing static image for a long period of time.
  - Stroboscopic effect: most OLED screen uses PWM dimming technology. Some people who are easy perceive stroboscopic frequency may have sore eyes and tears.
  - Organic material that produces blue light has shorter life time. This leads to OLED color shifting and shorter lifespan.

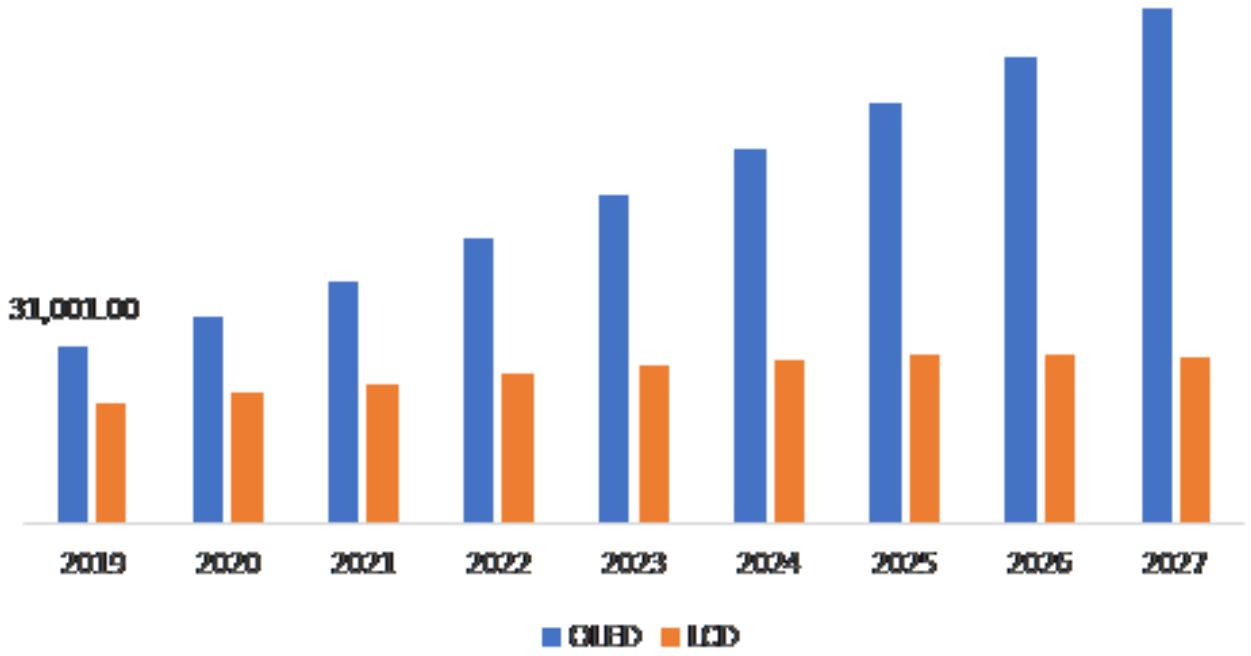
Micro LED

- **Pros**
  - Comparing with TFT LCD and OLED, Micro LED has very fast response time, high brightness, wide viewing angle and long lifespan.
  - Replacing organic material with inorganic GaN material eliminates the need of polarizing and encapsulation layer, found in OLED. Micro LED is smaller and thinner, consumes less power.
- **Cons**
  - Expensive: Micro LED is a new technology, expensive to make.
  - Difficult to produce: As all new technologies, manufacturing Micro LED is facing many difficulties at the moment.

LCD vs OLED vs Micro LED

Technology	TFT LCD	OLED	Micro LED
Light Source	LCD backlight	Self emmit	Self emmit
Cost	Low	Medium	High
Power Consumption	High	60%–80% of LCD	30%-40% of LCD
Brightness	Low	High	High
Efficiency	Low	Medium	High
Lifespan	Long	Medium	Long
Contrast	Low	High	High
Response Time	ms	μs	ns

Display Panel Market



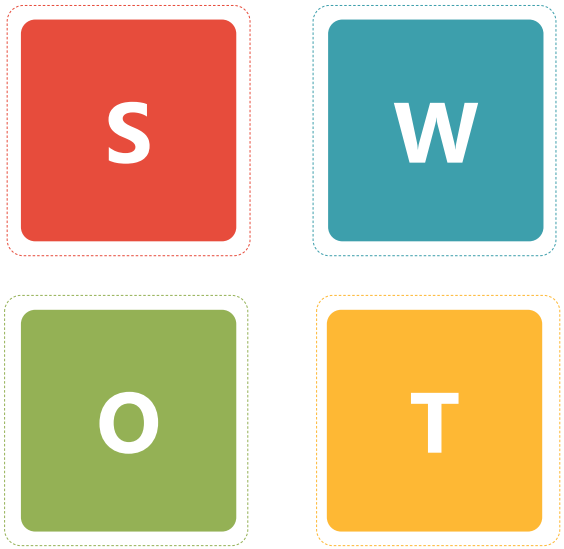
OLED SWOT

STRENGHTS

Brightness
High contrast
Response time
Thinner

WEAKNESSES

Lifespan
Image retention (burn-in)
Stroboscopic effect



OPORTUNITIES

Micro OLED

THREATS

Mini LED
Micro LED

Outline

- Introduction
- Technology
- Industry Analysis
- **Applications**
- Conclusion
- References

Foldable

Always on display

The AOD image is slightly repositioned on the screen over time to prevent screen burn-in.

Outline

- Introduction
- Technology
- Industry Analysis
- Applications
- **Conclusion**
- References

Conclusion

- Although OLED has few drawbacks, it still takes over the display market and are adopted in smartphones, TVs and in other devices.
- Micro LED is believed to be the next-generation display technology. Once the Micro LEDs are mature, they will be a great threat to OLEDs.

Outline

- Introduction
- Technology
- Industry Analysis
- Applications
- Conclusion
- **References**

References

- https://www.makerfabs.com/display-oled-vs-lcd.html
- https://www.topwaydisplay.com/en/blog/lcd-oled-microled-comparison
- https://en.wikipedia.org/wiki/OLED
- https://zh.wikipedia.or
- https://tech-society.com/what-is-the-difference-between-lcd-oled-and-amoled-screens-and-what-is-the-best/g/zh-tw/AMOLED
- https://www.ctimes.com.tw/DispArt/tw/COG/IC%E5%B0%81%E8%A3%9D/COF/COP/2004211425ZL.shtml
- https://www.trustedreviews.com/explainer/what-is-an-always-on-display-4264890
- https://www.researchdive.com/390/display-panel-market