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Unlocking New Markets for OLEDs with Novel Cathode Materials

OTI Lumionics

Novel Cathode Materials Enables New Market

Enabling IT, Auto and New TV market

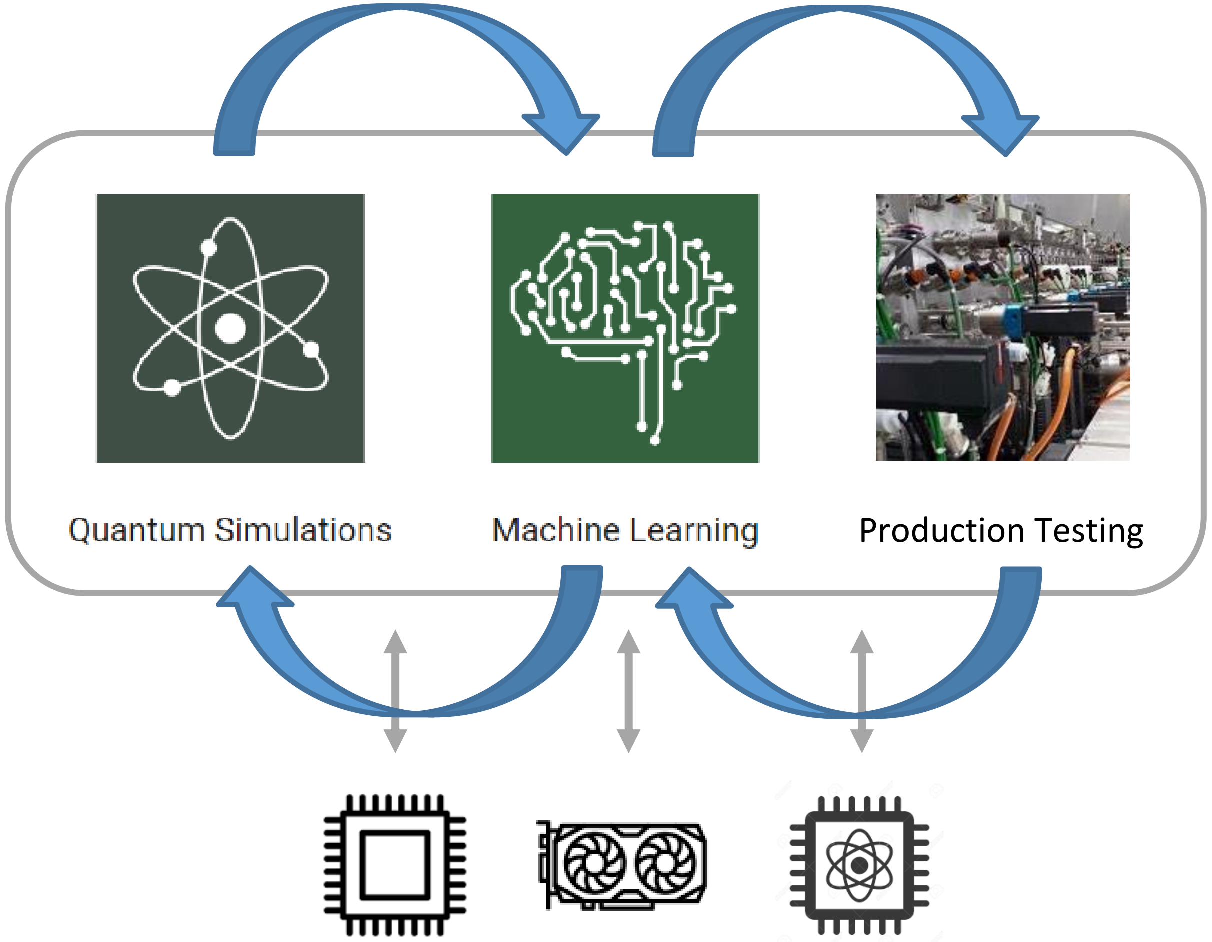
Our materials enable high resolution top emission OLED displays for the large panel market segment

Integrated Materials Discovery Platform

Quantum simulation + AI/ML + production validation

Properties

- Vapor pressure
- Optical constants
- Electronic structure
- Film forming
- Crystallinity
- Etc.



CPU GPU QPU (Quantum Computer)

Structure

New Market Opportunities for OLEDs

Industry wide solutions to incumbent materials limitations

1. Mid-size display panels for IT + auto
2. High resolution display panels for TV
3. Transparent AMOLED for PID and mobile

1. Enable Mid-Size OLED display

(ConducTorr™ Electrode)

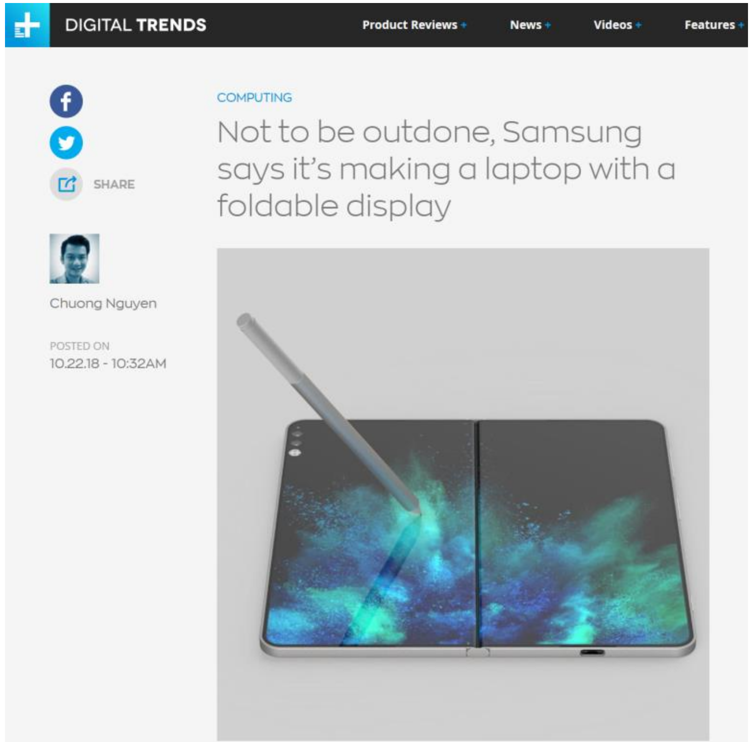
Any Hope for Mid-size OLED Panels?

Few mid-sized OLED displays to be found at CES 2018

Strong OEM and consumer demand for mid-size OLED panels

Any Hope for Mid-size OLED Panels?

New form factor mid-size OLED panel brings new excitement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Chuong Nguyen

POSTED ON
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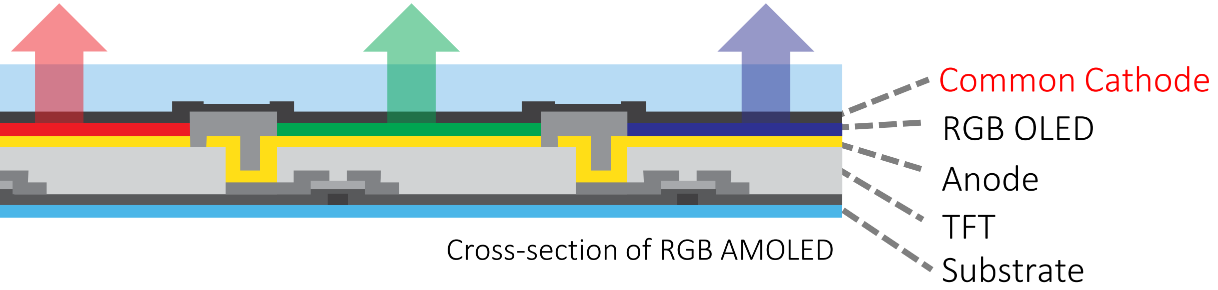
COMPUTING

Not to be outdone, Samsung says it's making a laptop with a foldable display

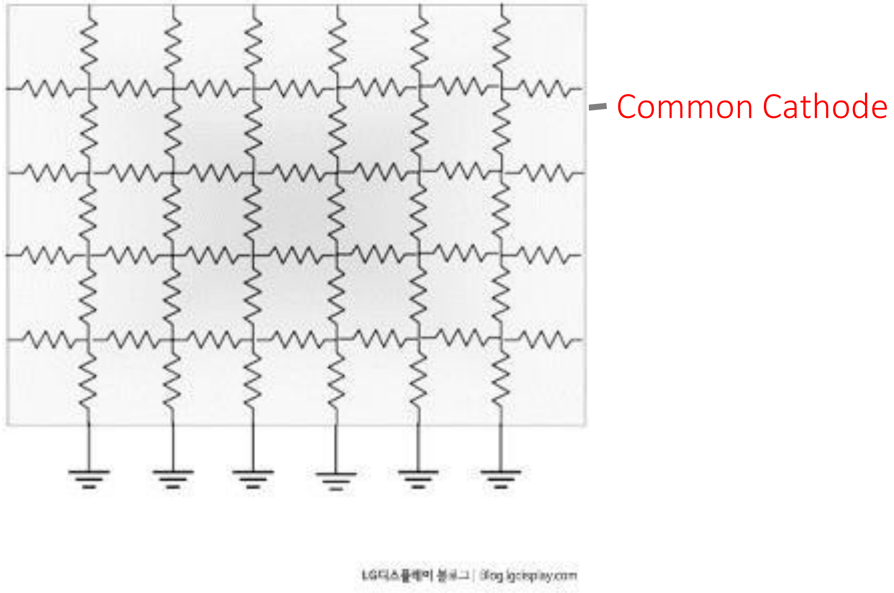
Foldable, Curved, Ultra-Light enables new application in IT + auto

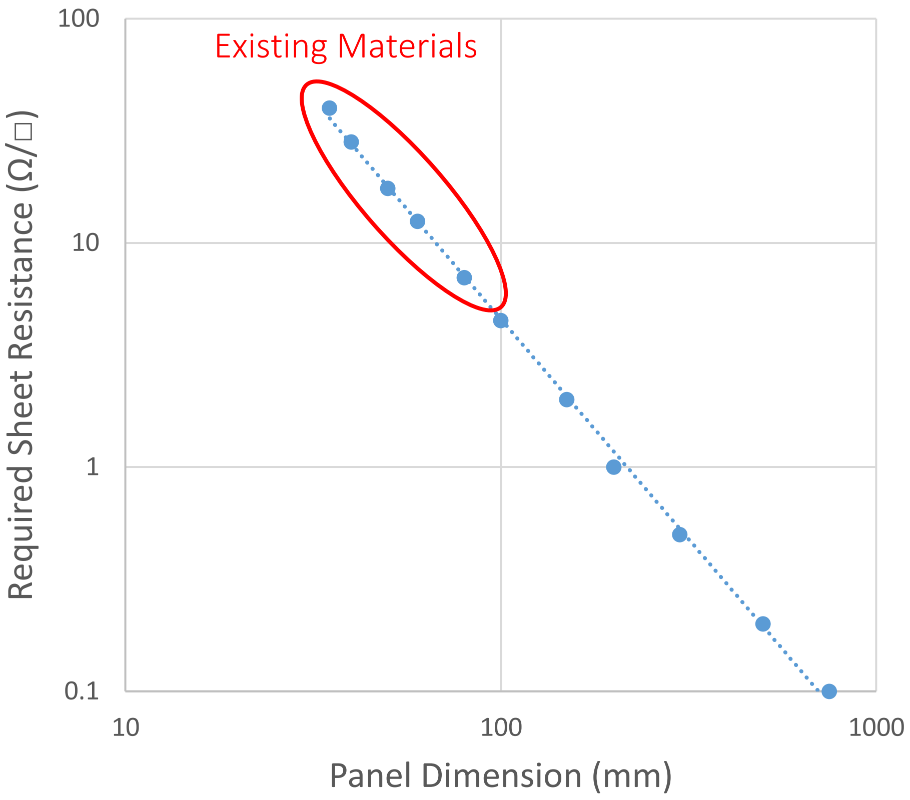
Existing Cathode Materials are Limited to Mobile

Common Cathode far too resistive for mid-size top emission AMOLED



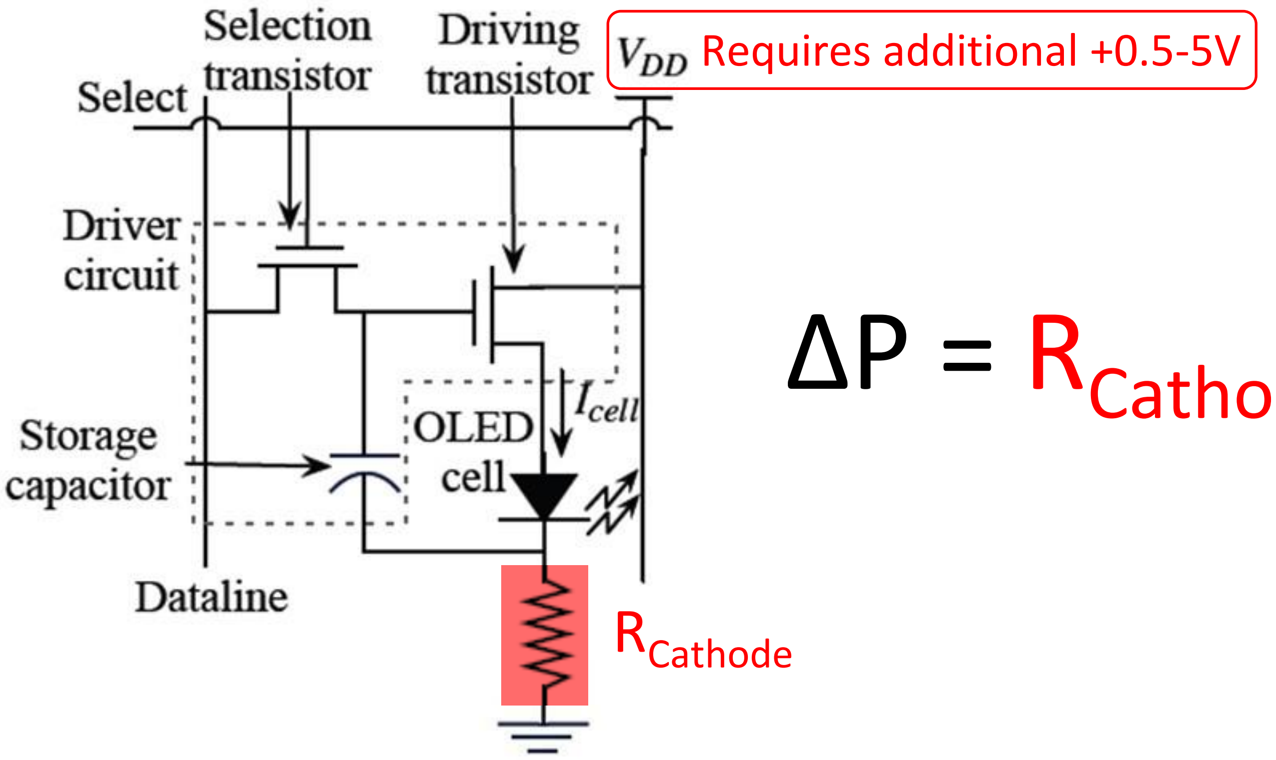
Cross-section of RGB AMOLED





Power Loss from Cathode IR Drop Compensation

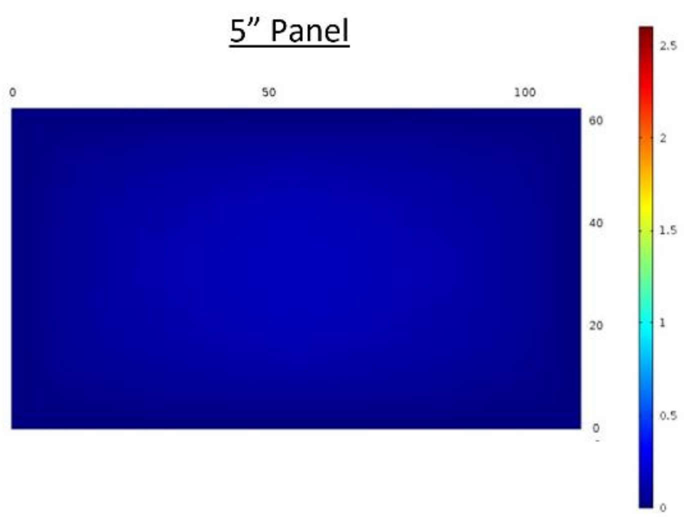
Current Solution: Compensation, but at expense of power consumption

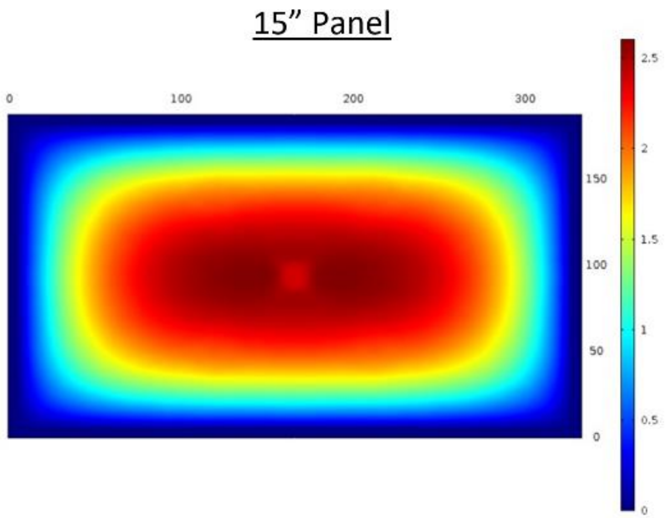


$$\Delta P = R_{Cathode} \times I_{cell}^2$$

Compensating for IR drop requires higher power consumption!

Power Loss from Cathode IR in AMOLED Panels



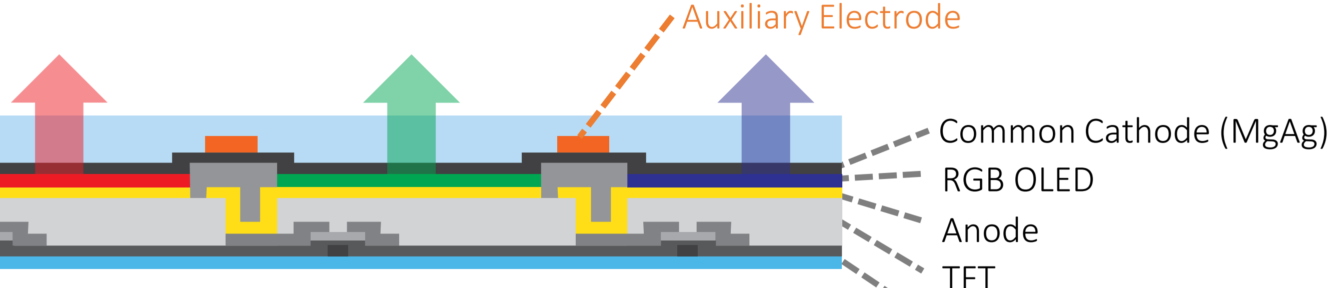


0.5V

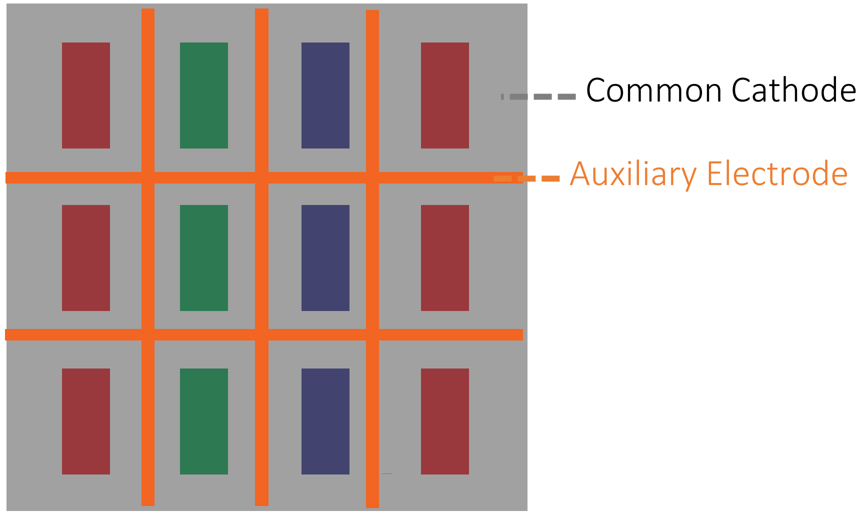
2.6V

40% more power consumption due to cathode IR loss

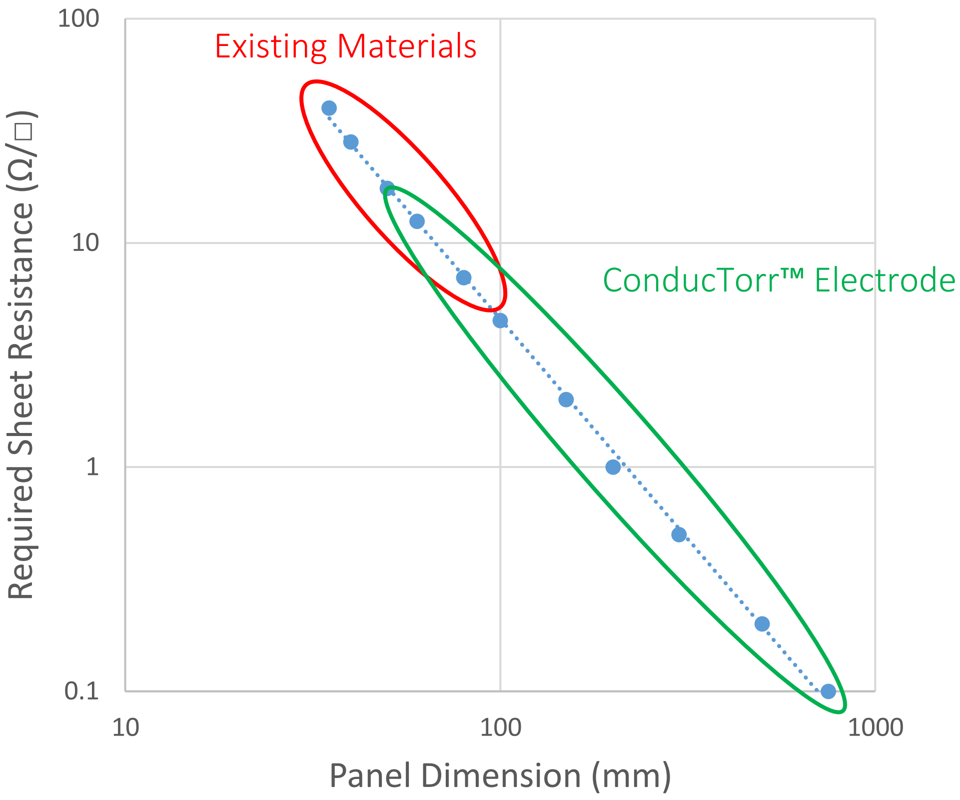
Our Solution: ConducTorr™ Electrode



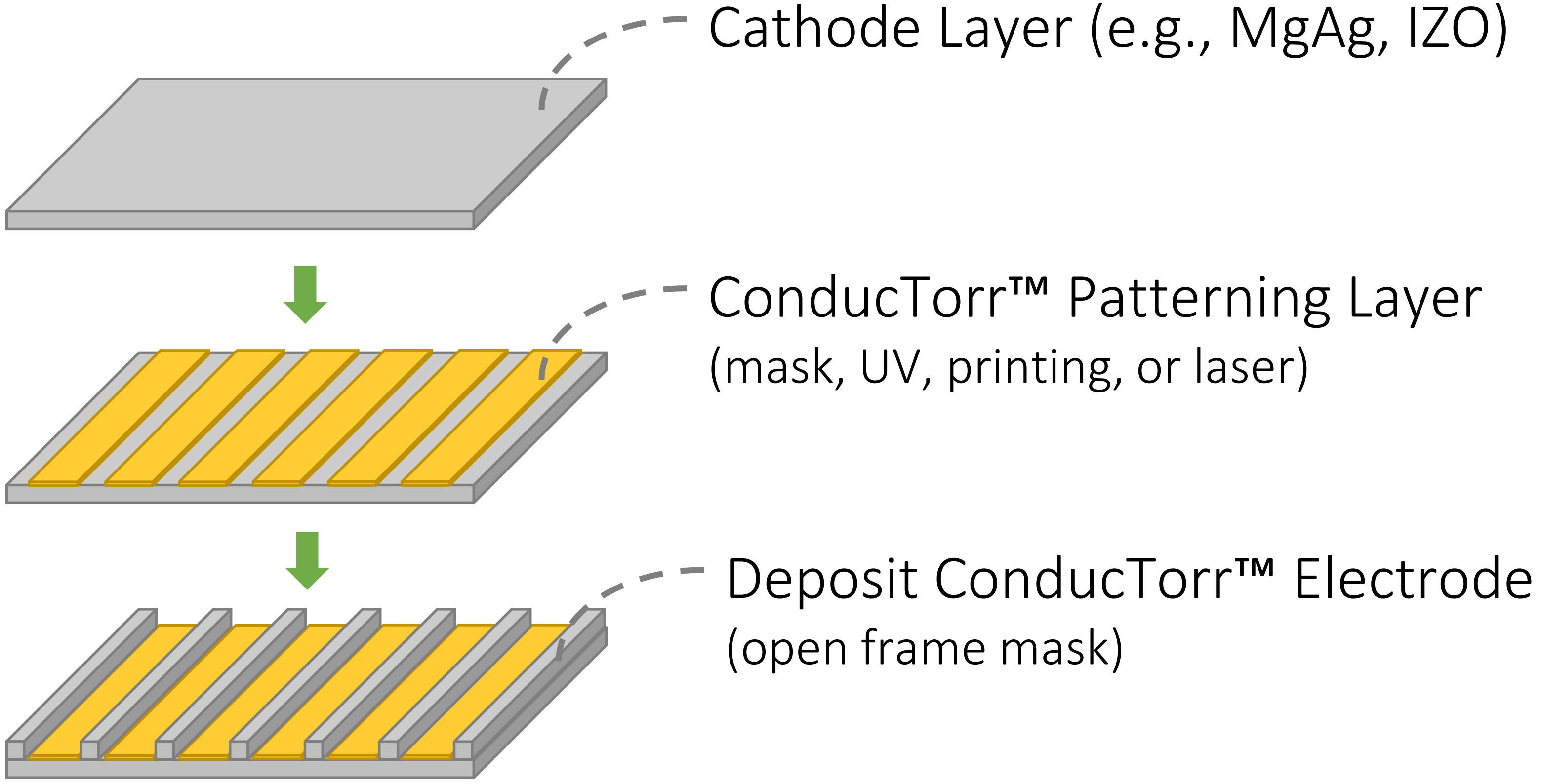
Cross-section of RGB AMOLED



Top-view of RGB AMOLED

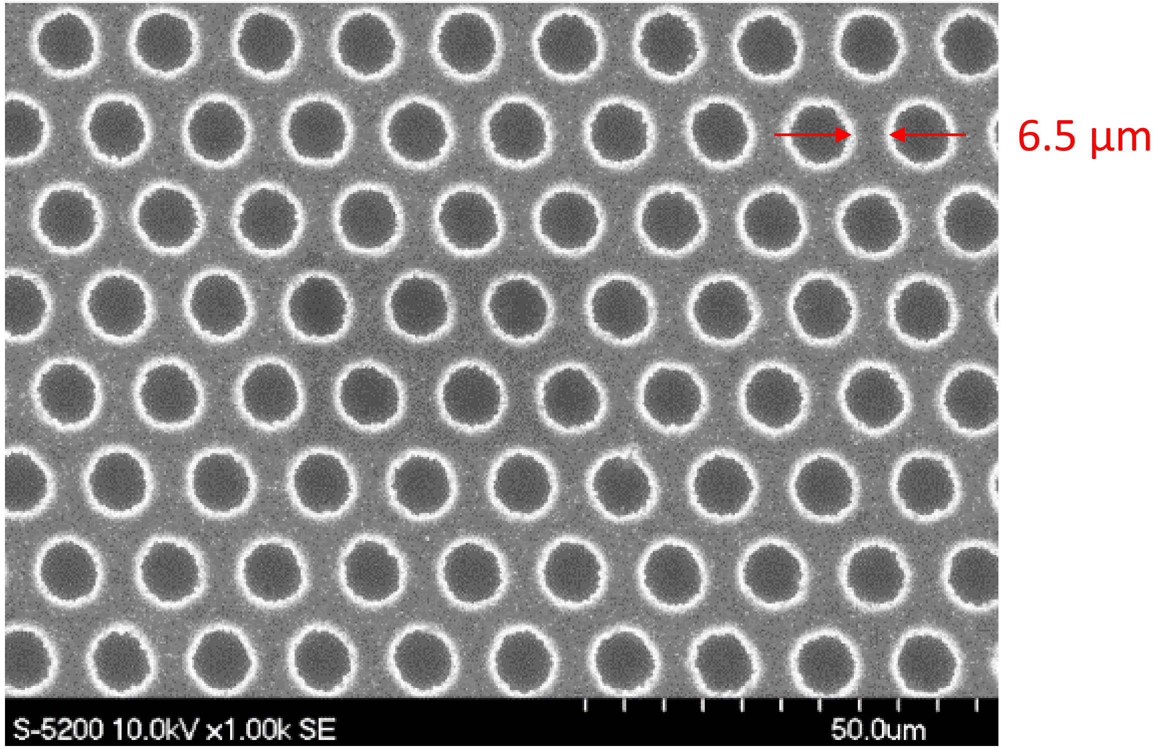


ConducTorr™ Electrode Patterning Process

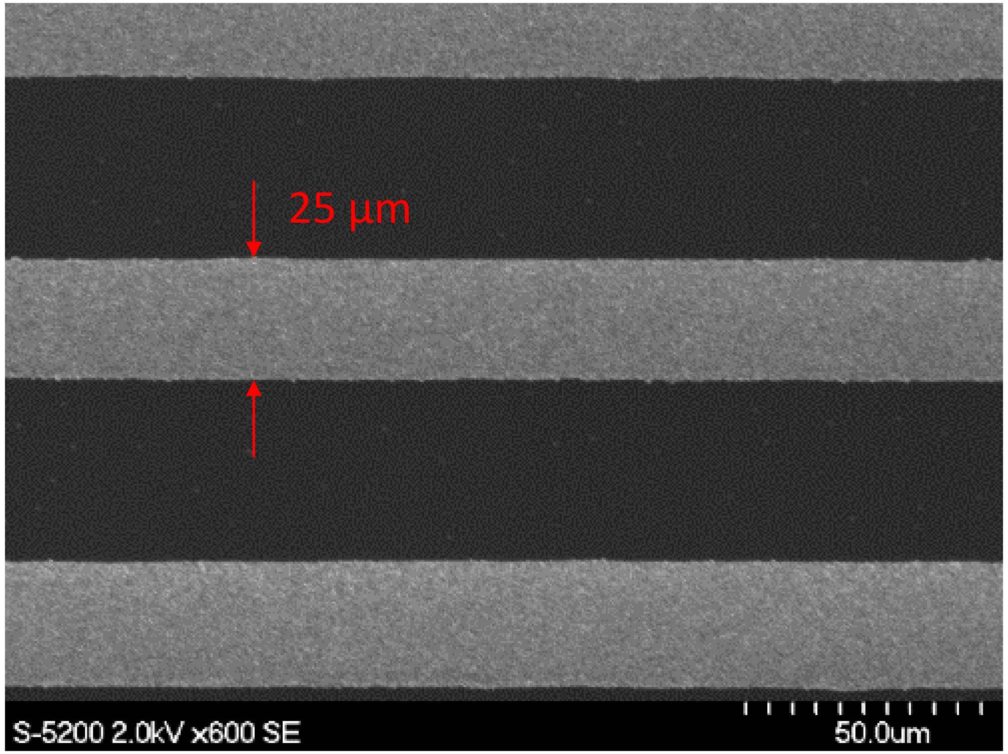


Self assembly yields low resistance electrode with micron resolution

ConducTorr™ is Compatible with High Resolution Displays



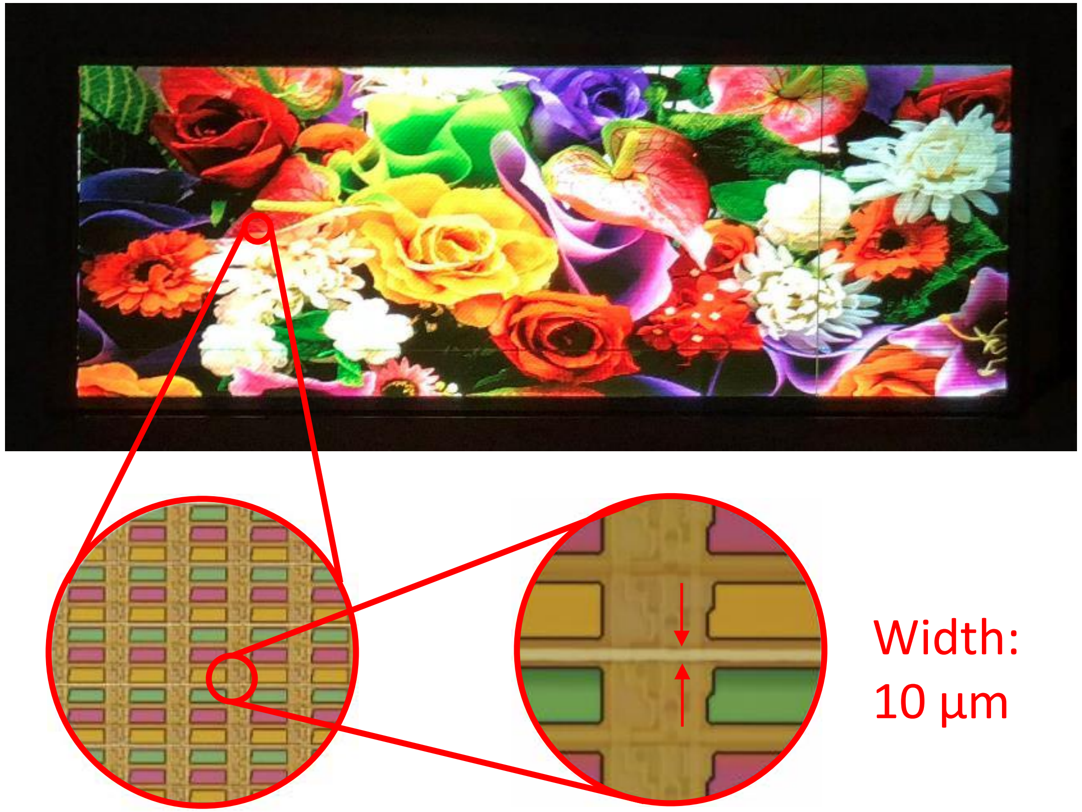
ConducTorr™ film with 6.5 µm circular mesh (mask patterning)



ConducTorr™ film with 25 µm lines (UV patterning)

High Resolution patterning demonstrated down to 6.5 µm features

ConducTorr™ AMOLED Demonstration



- 15 nm cathode + 600 nm ConducTorr™ Electrode

- 5.2” diagonal AMOLED panel
- Vacuum process using existing AMOLED tools and mask set
- No ConducTorr™ related defects
- 120 ppi (37” @ 4K equivalent)
- 10 µm auxiliary electrode width

2. Enable high-res OLED TV

(ConducTorr™ Electrode)

8K is the Next TV Battleground

8K is the Centerpiece for TV at IFA 2018

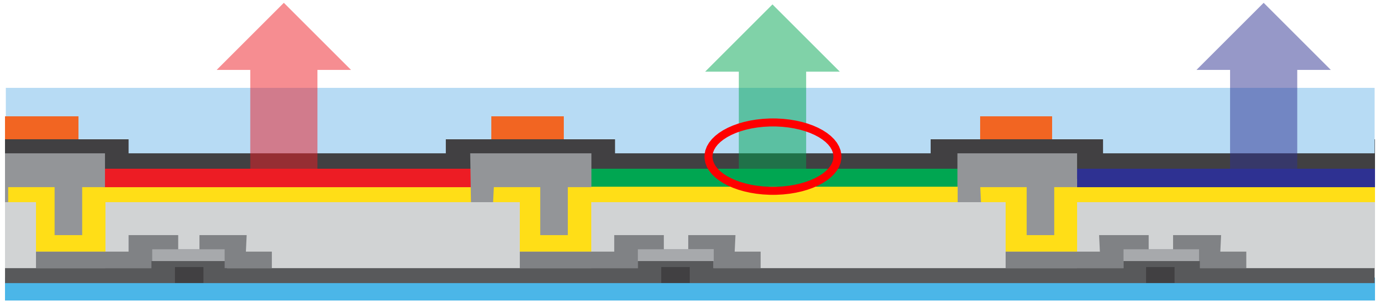
8K TV to become the dominant format in **5 years**,
if similar to the evolution of 4K TV

Top Emission vs Bottom Emission

8K OLED TV needs to move towards top emission architecture

Top Emission

Larger aperture ratio



Requires semi-transparent / transparent cathode with low resistance

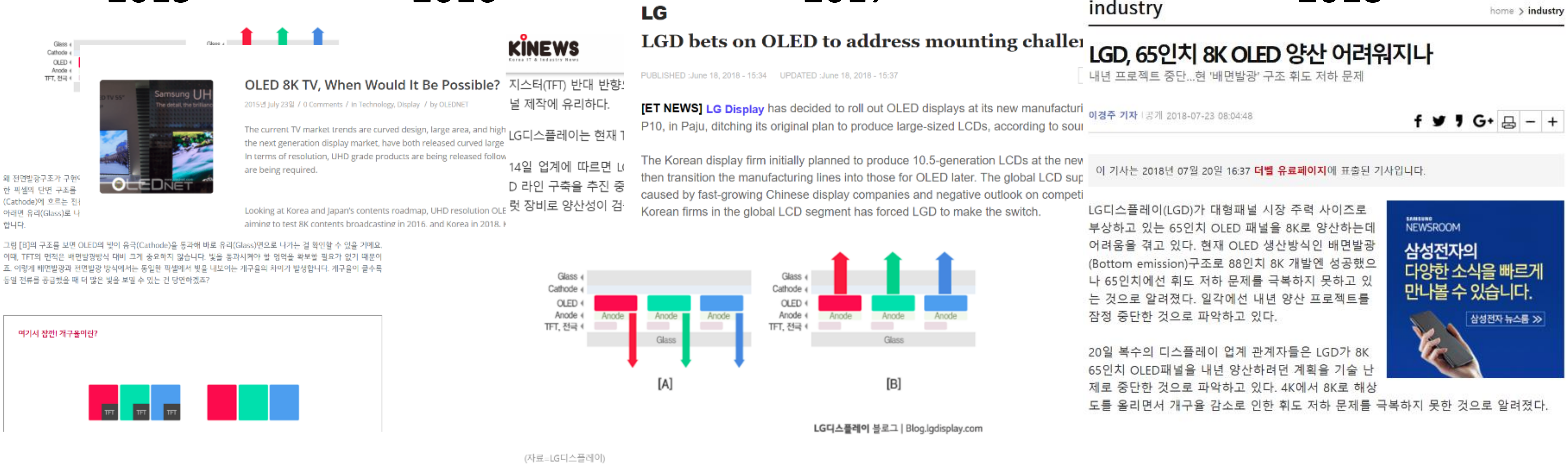
Bottom Emission

Limited to low ppi

Panel Makers Looking for Solution Since 2015

Cathode IR drop cited as barrier to 8K TV since 2015

2015 2016 2017 2018


OLED 8K TV, When Would It Be Possible?

The current TV market trends are curved design, large area, and high

the next generation display market, have both released curved large

In terms of resolution, UHD grade products are being released follow

are being required.

Looking at Korea and Japan's contents roadmap, UHD resolution OLE

KINEWS

지스터(TFT) 반대 방향

널 제작에 유리하다.

LG디스플레이는 현재 1

14일 업계에 따르면 L

D 라인 구축을 추진 중

럭 장비로 양산성이 검

(자료=LG디스플레이)

LG

LGD bets on OLED to address mounting challe

PUBLISHED :June 18, 2018 - 15:34 UPDATED :June 18, 2018 - 15:37

[ET NEWS] LG Display has decided to roll out OLED displays at its new manufactur P10, in Paju, ditching its original plan to produce large-sized LCDs, according to sou

The Korean display firm initially planned to produce 10.5-generation LCDs at the new then transition the manufacturing lines into those for OLED later. The global LCD sup caused by fast-growing Chinese display companies and negative outlook on competi Korean firms in the global LCD segment has forced LGD to make the switch.

LG디스플레이 블로그 | Blog.lgdisplay.com

industry

home > industry

LGD, 65인치 8K OLED 양산 어려워지나

내년 프로젝트 중단...현 '배면발광' 구조 휘도 저하 문제

이경주 기자 | 공개 2018-07-23 08:04:48

이 기사는 2018년 07월 20일 16:37 더벨 유료페이지에 표출된 기사입니다.

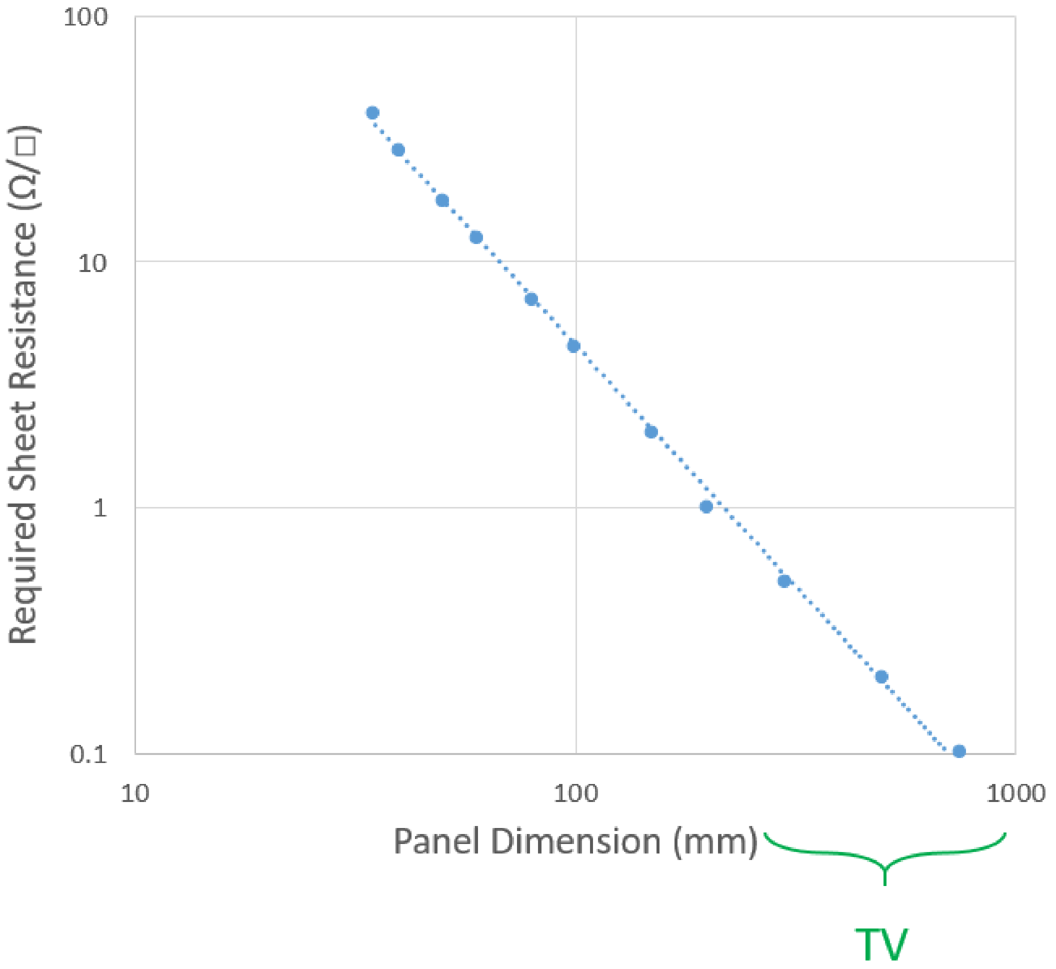
LG디스플레이(LGD)가 대형패널 시장 주력 사이즈로 부상하고 있는 65인치 OLED 패널을 8K로 양산하는데 어려움을 겪고 있다. 현재 OLED 생산방식인 배면발광(Bottom emission)구조로 88인치 8K 개발엔 성공했으나 65인치에선 휘도 저하 문제를 극복하지 못하고 있는 것으로 알려졌다. 일각에선 내년 양산 프로젝트를 잠정 중단한 것으로 파악하고 있다.

20일 복수의 디스플레이 업계 관계자들은 LGD가 8K 65인치 OLED패널을 내년 양산하려던 계획을 기술 난제로 중단한 것으로 파악하고 있다. 4K에서 8K로 해상도를 올리면서 개구율 감소로 인한 휘도 저하 문제를 극복하지 못한 것으로 알려졌다.

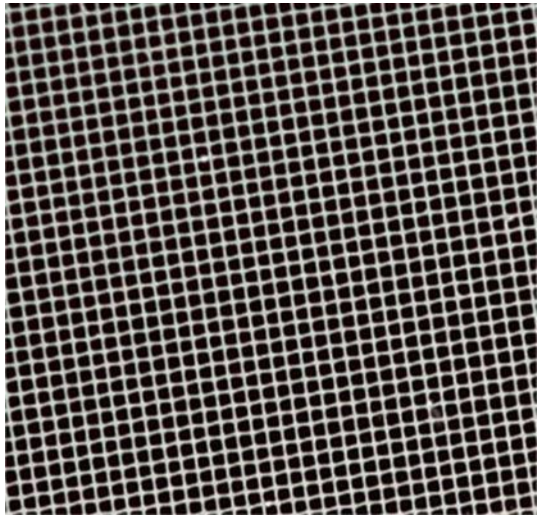
Cathode IR drop cited as barrier to top emission TV for past 3 years

ConducTorr^{TM} Auxiliary Electrode – Enabling High Res OLED TV

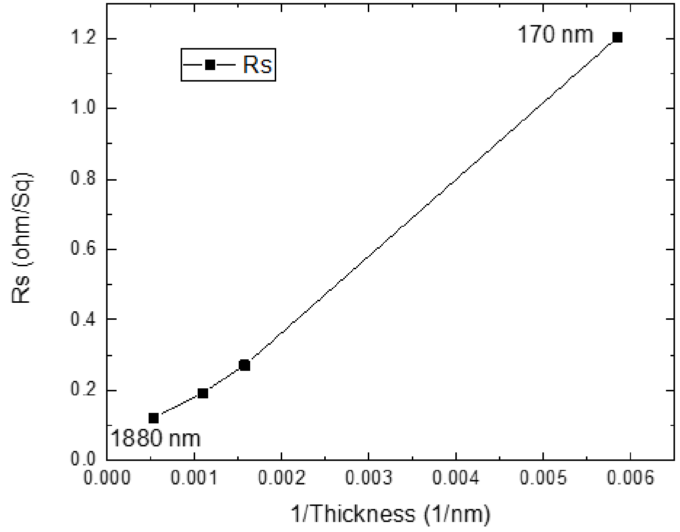
ConducTorr^{TM} can achieve the required electrical properties



Microscope Image of the formed grid

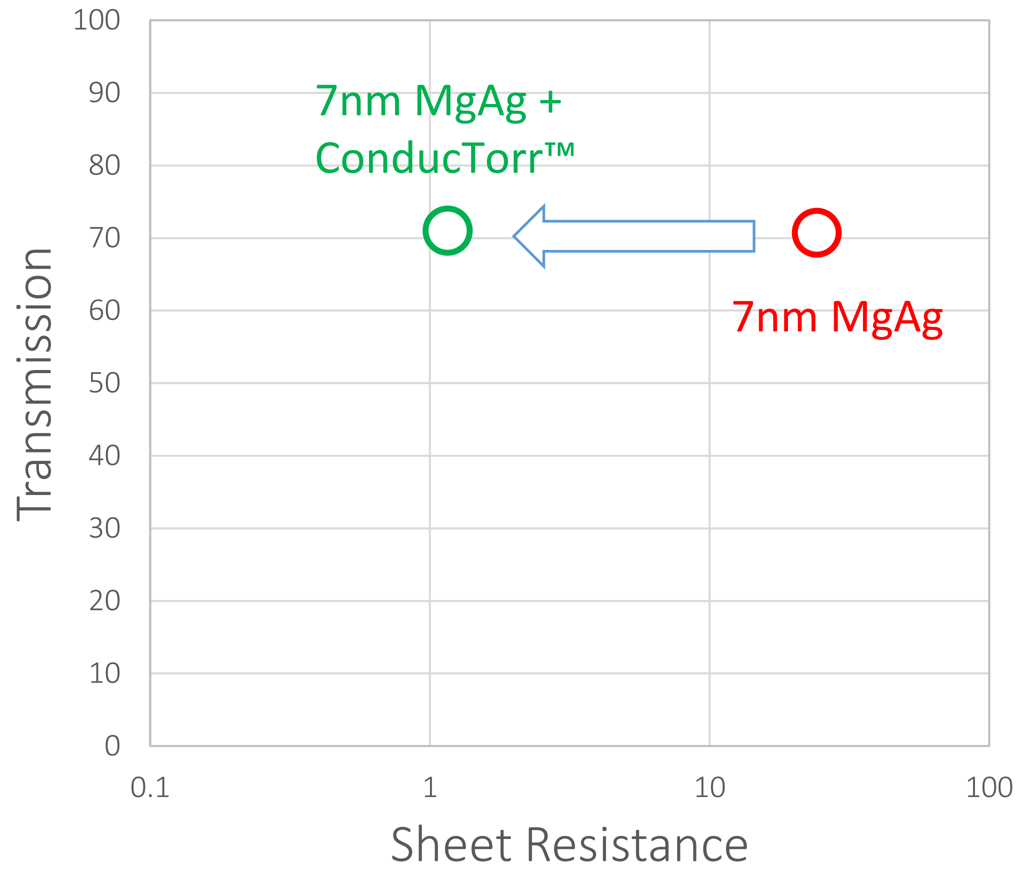


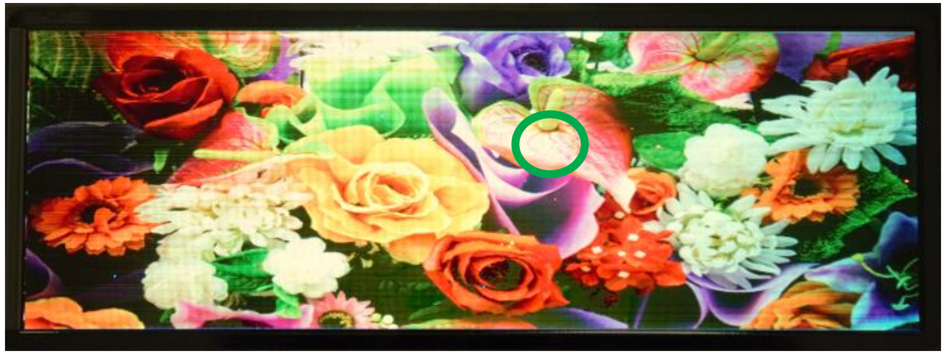
- ~ 67% aperture ratio
- 300 lines/inch



ConducTorr™ AMOLED Demo With 7nm MgAg Cathode

Tuning cathode optical and electrical performance independently





547 nits

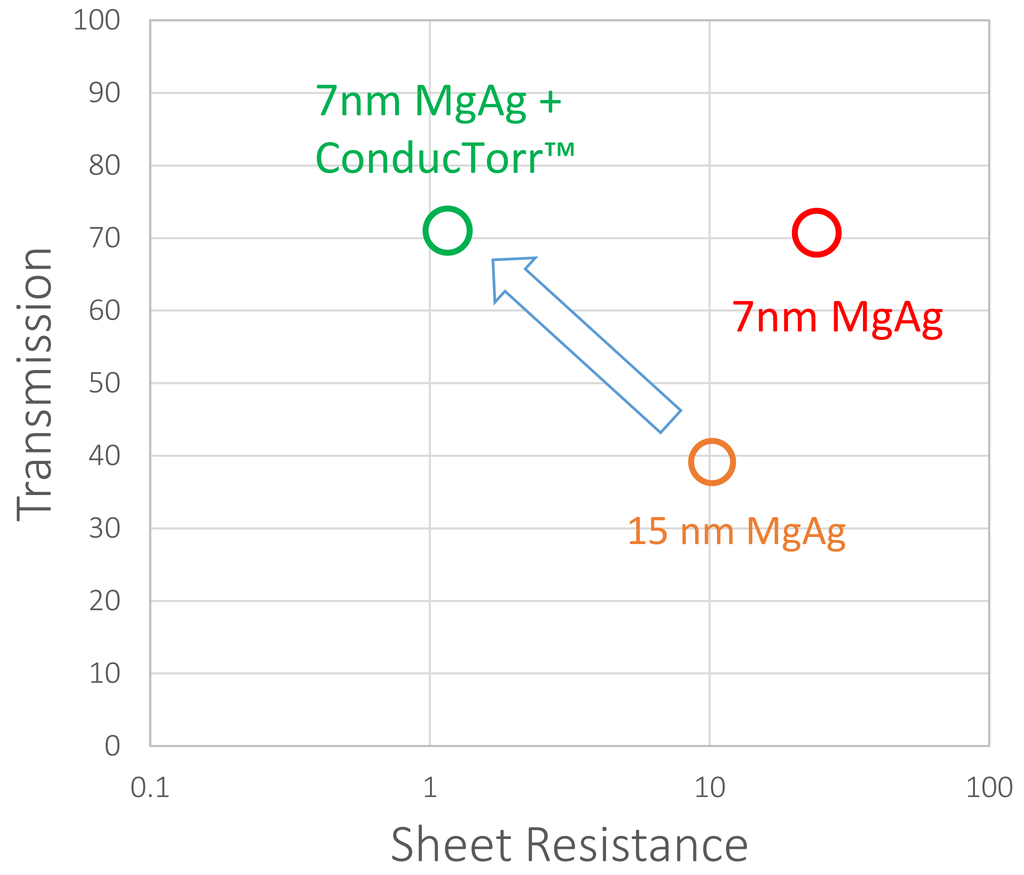
- 7 nm MgAg + 600 nm ConducTorr™ Electrode

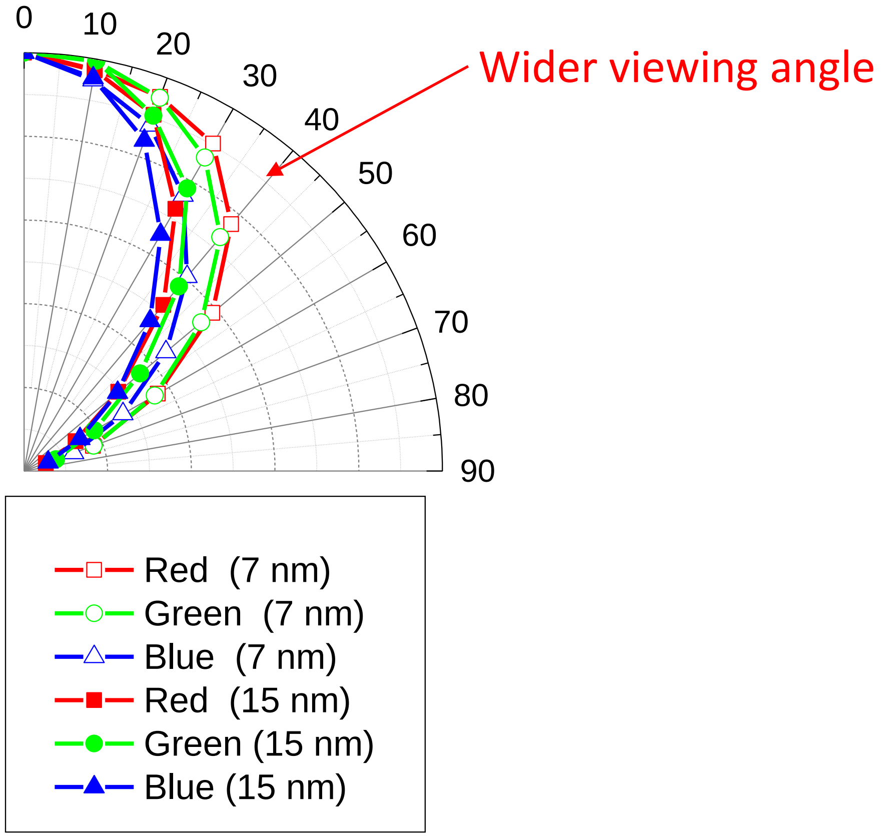
< 1 nit

- 7 nm MgAg (too resistive to turn on at typical Vss)

Improved Viewing Angle with 7 nm Cathode + ConducTorr™

Reduce angular color-shift through reduced micro-cavity





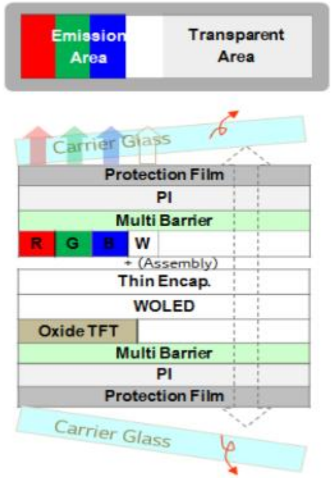
3. Enable Transparent OLED

(ConducTorr™ Electrode)

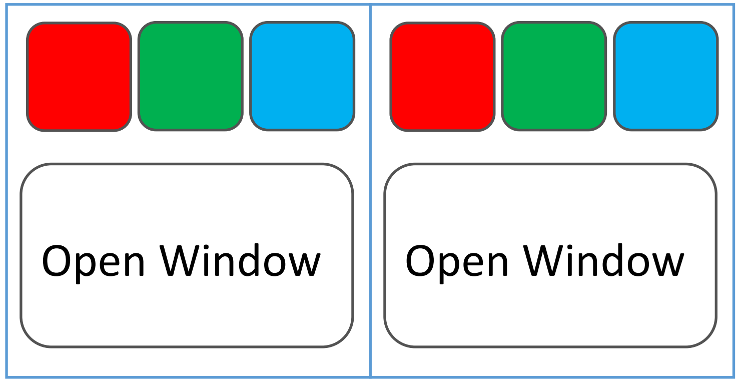
Transparent AMOLED Display

Transparent AMOLED must be top emission

OLED TV utilizes the “Transparent Window” Structure



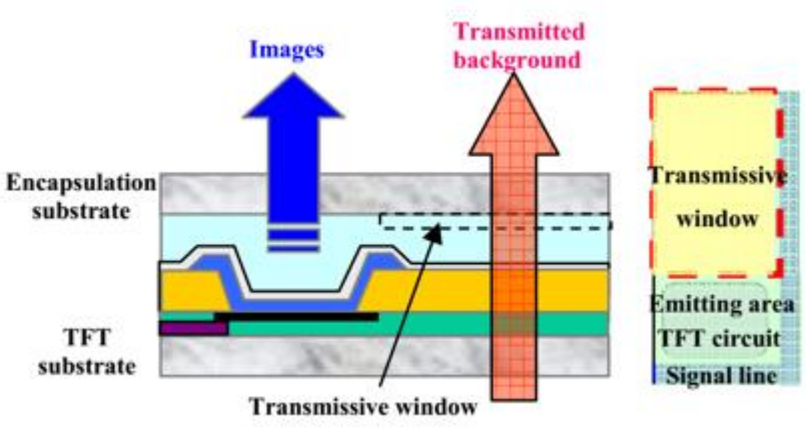
Structure with “Transparent Window”



Transparent AMOLED must be top emission, mainstream architecture uses Transparent Window architecture to achieve transparency.

Transparent AMOLED Display

Cathode transmittance is the limiting factor



(a) Top emission structure

Source: SID 2010, 11-4

Optical Layers	Transmission
Glass	~90%
OCA	~100%
Organic	~100%
Cathode	20 – 80%
TFE	95-100%

Transmission = Window Size × Window Transmission

Cathode layer transmittance is limiting factor

Transparent Display

Current Examples

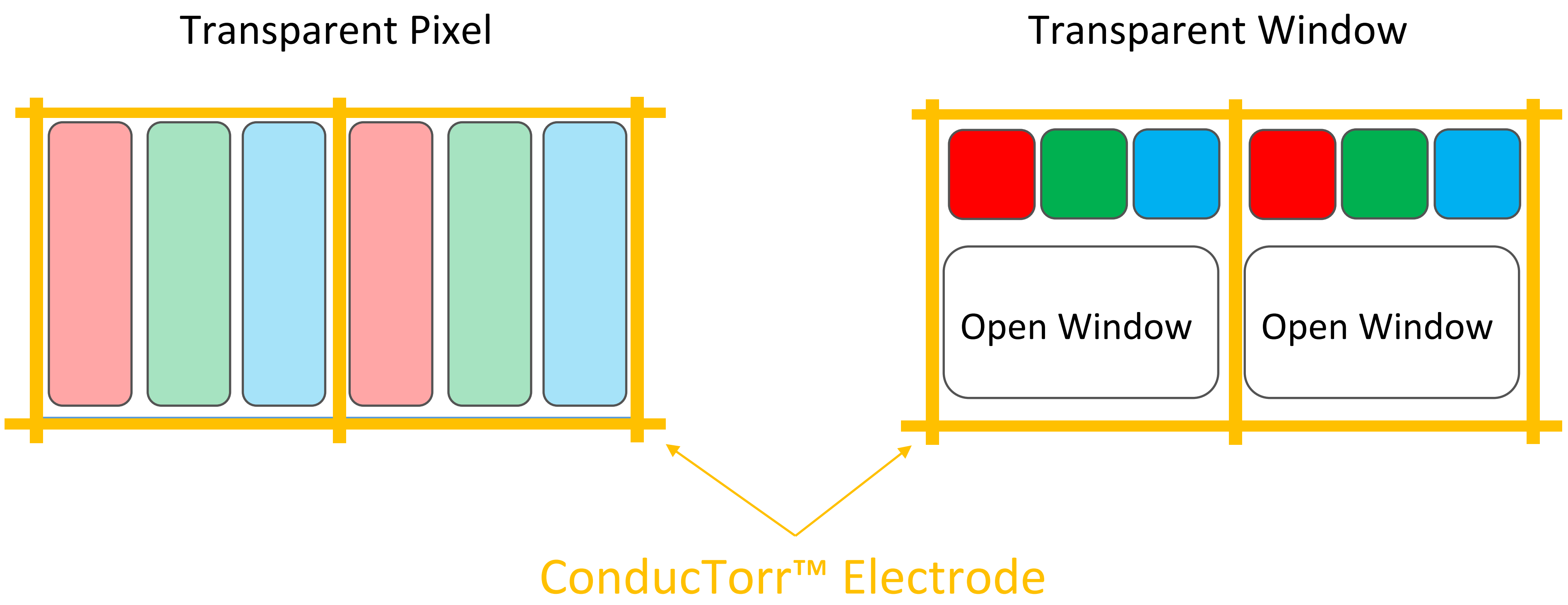
70.6% Transparent OLED from ITRI shown in Touch Taiwan 2018

Current concern:

- Significant cathode IR drop
- Panel yellowing from cathode
- Not transparent enough

Transparent AMOLED with ConducTorr™

ConducTorr™ AMOLED Implementation Examples



ConducTorr™ Transparent Demonstration

Transparent OLED panels demonstrated using ConducTorr™ Electrode

Next Level Transparent AMOLED with ConducTorr™

ConducTorr™ Enables Transparent Mobile Panel with Under-display Sensors

Transparent AMOLED panel with under-display sensors adds new functionality:

- Under-display finger print sensors
- Under-display light sensors
- Under-display IR sensors
- Under-display camera

ConducTorr™ technology ensures highest transparency transparent AMOLED panel

Conclusion

ConducTorr™ Ready for Mass Production

OTI

- Compatible with existing MP tools
  Demonstrated compatibility with standard tools + mask set
- Materials available in kg scale (end of Q4)
  Scale-up underway with experienced materials supplier
- Enables OLED display for new markets
  All application - Tablet, Notebook, Monitor, small/medium sized TV, etc…
- Ability to fine-tune material properties
  Refractive index, transmission, thermal stability, etc…

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OTI

Thank you

OTI **Lumionics**