Opportunities and Challenges of Micro-LED Display on Automotive Application

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Advanced Technology Research Institute
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2021.3.25

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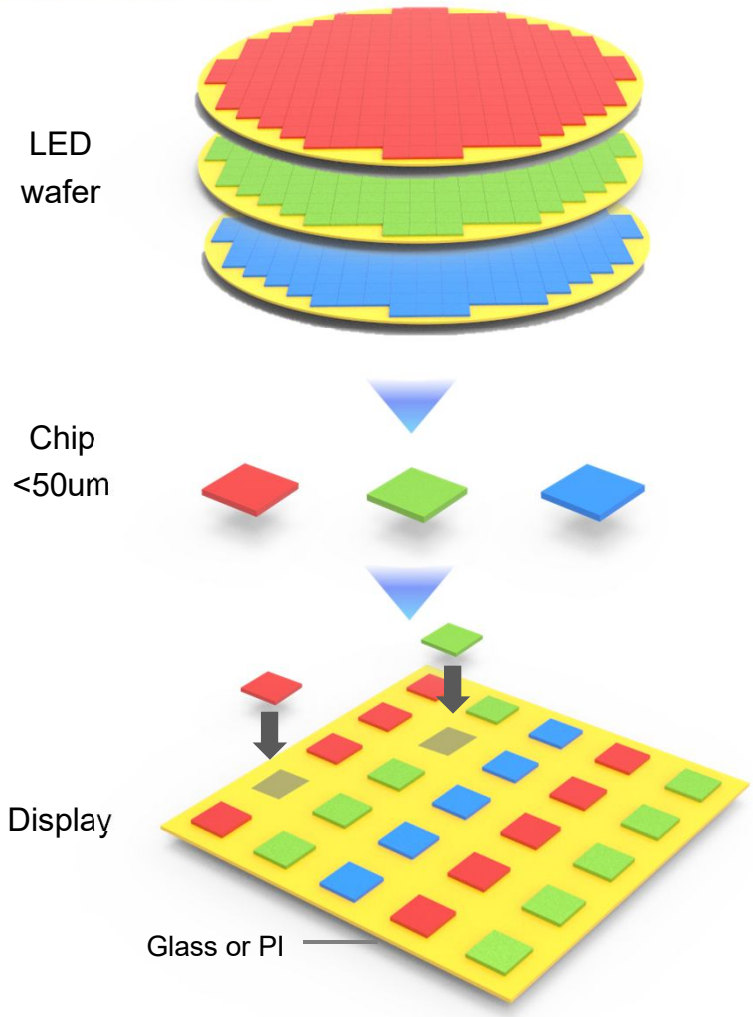
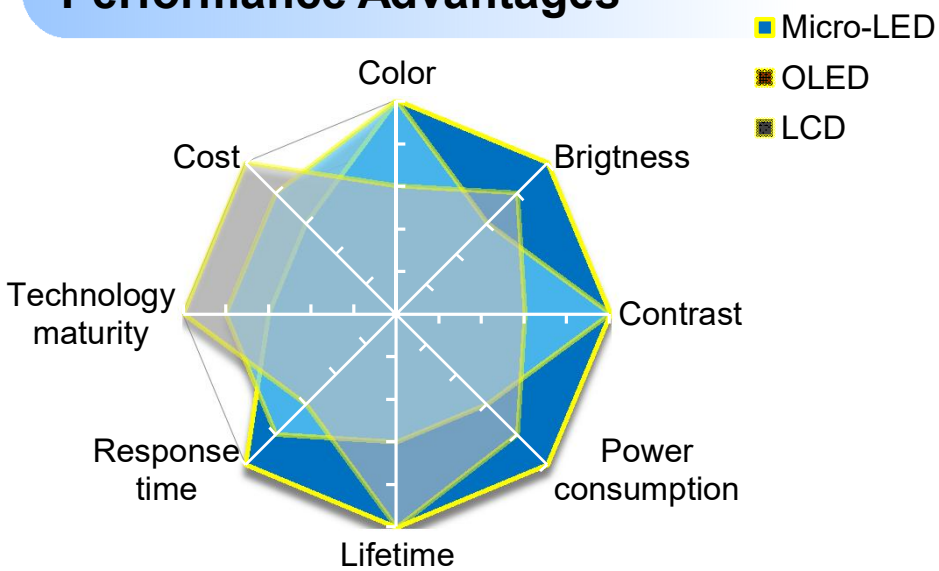
Advantages of Micro-LED Display

Micro-LED Display



Performance Advantages



Brightness
> 10,000 nits

Lifetime
> 80,000 Hr

Reliability
- 100° ~ 120°

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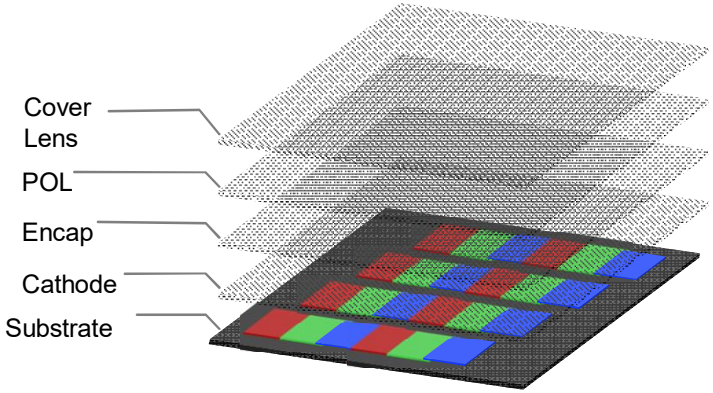
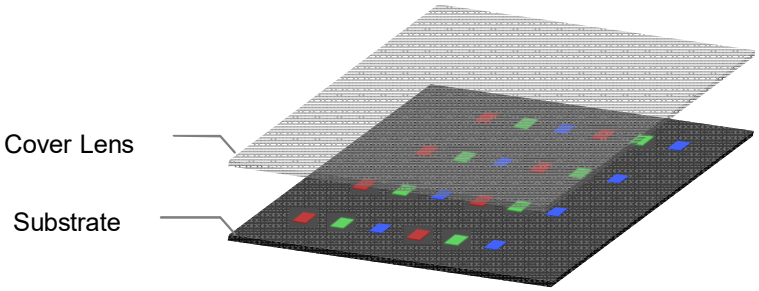
Advantages of Micro-LED Display

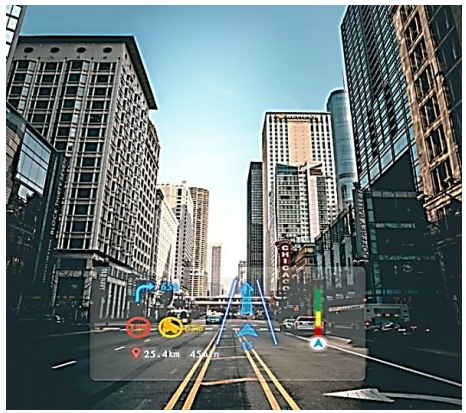
High Transparency

OLED Display
Transparency：20%~40%



Micro-LED Display
Transparency：>60%





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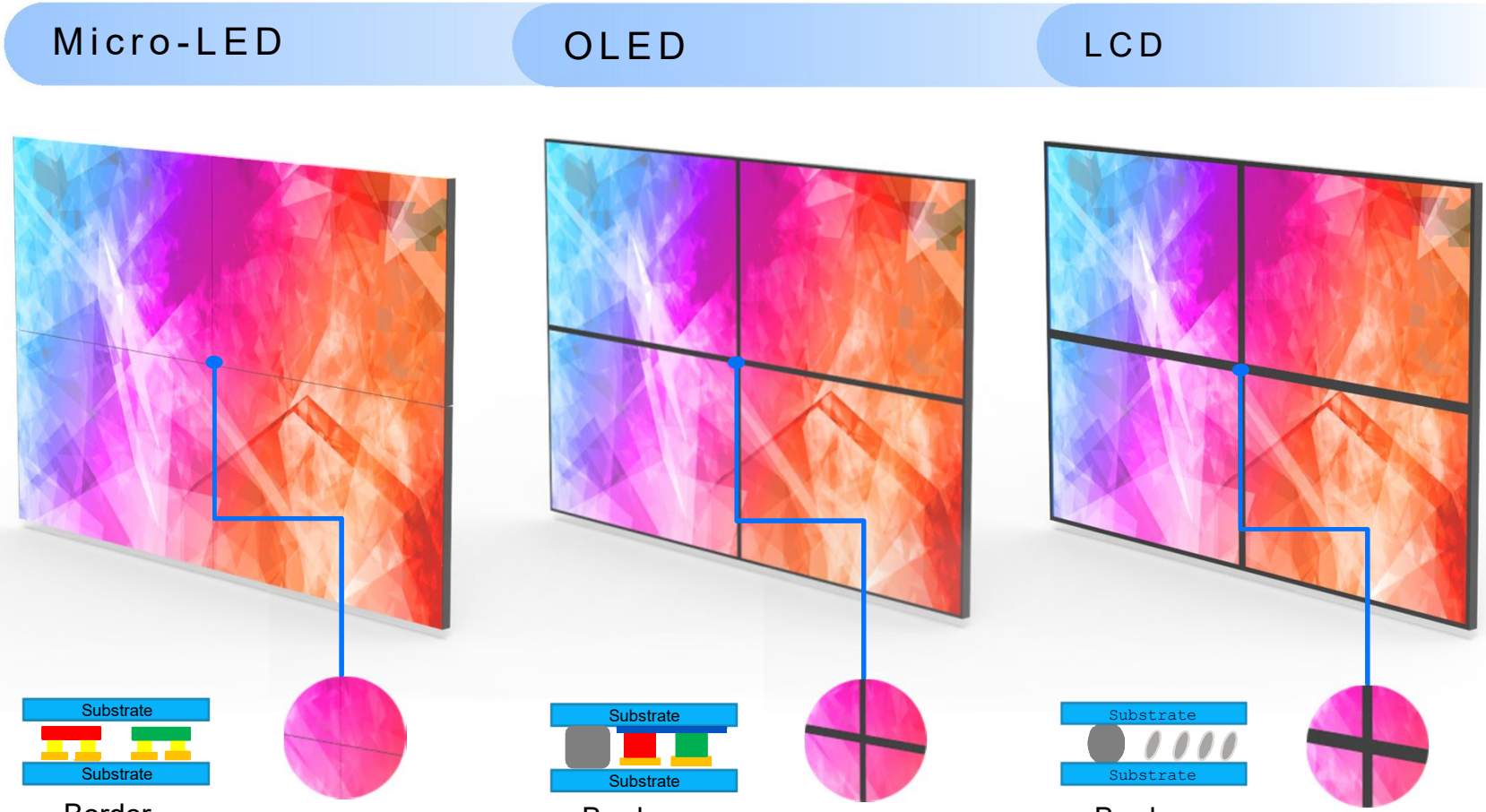
Advantages of Micro-LED Display

Borderless



Border
≈ 0

Border
~mm

Border
~mm

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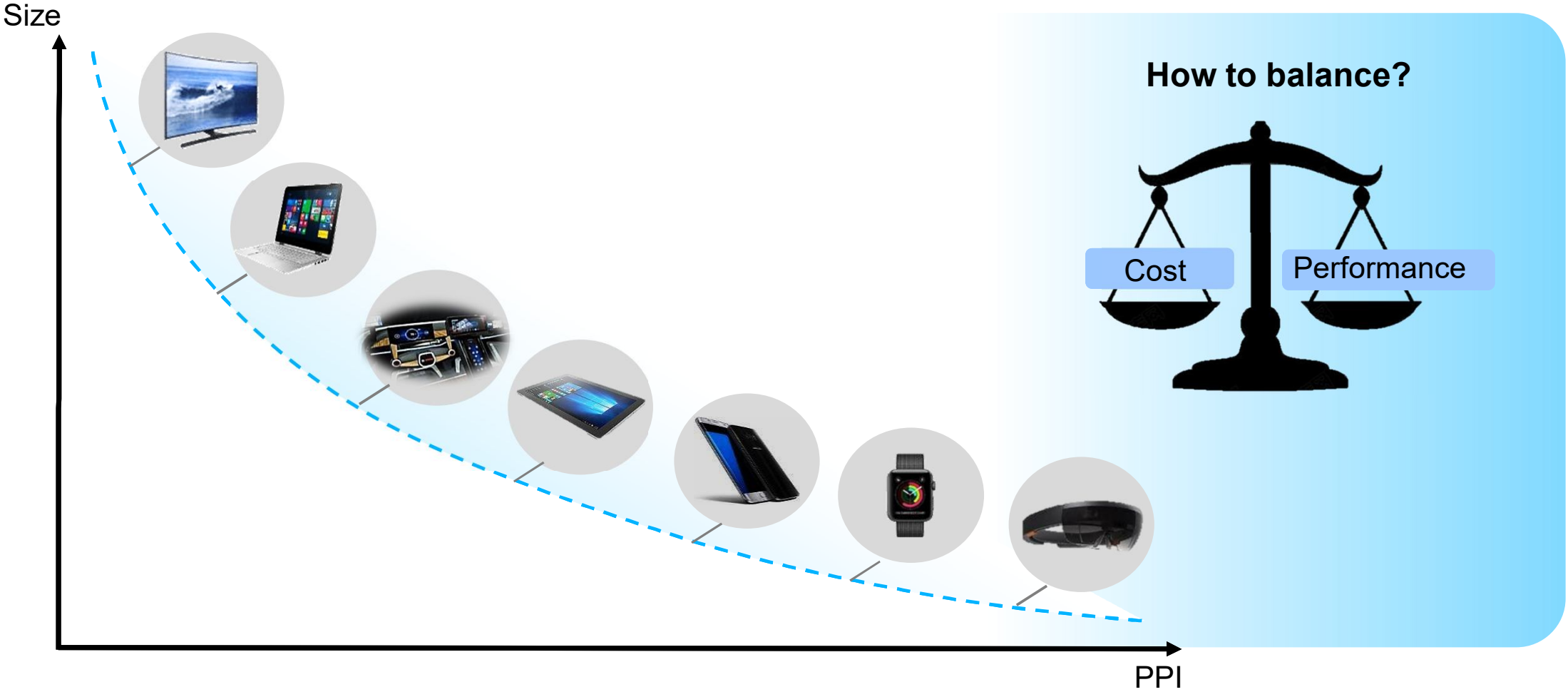
Analysis of Application Field



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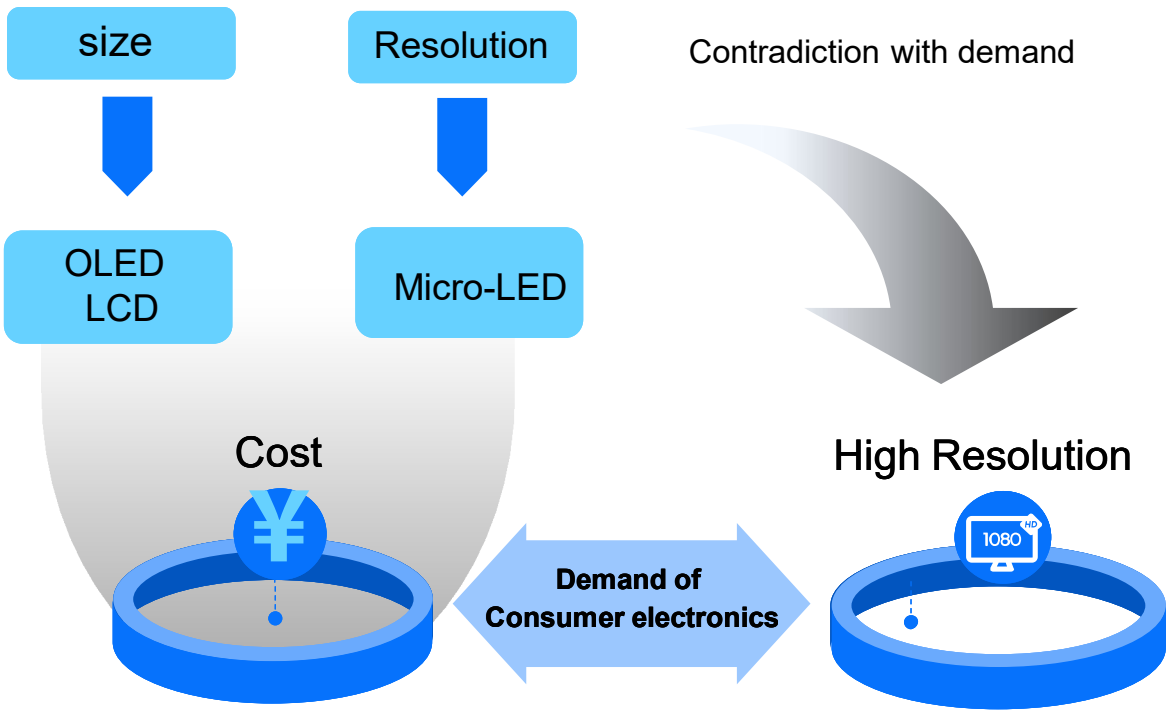
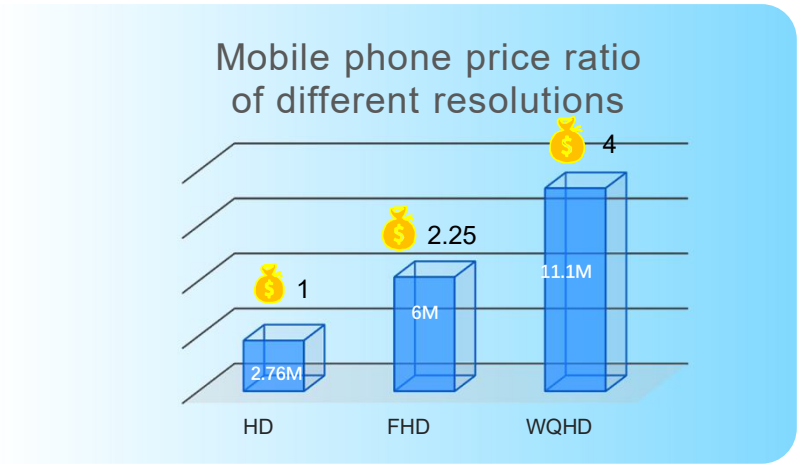
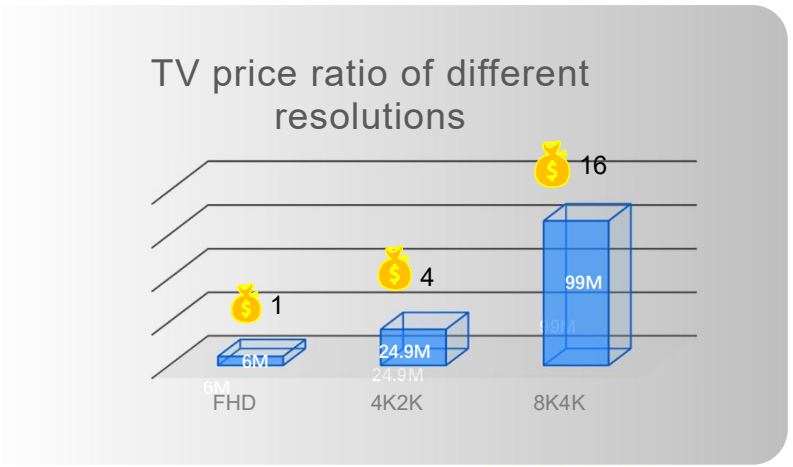
Analysis of Application Field

Consumer electronics are not the best breakthroughs for Micro-LED Display







Consumer electronics :TV、 NB、 PC、 Phone, etc.

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Analysis of Application Field

- **High performance requirements**
- **Low price sensitivity**

Application	TV	PC/Tablet	Mobile phone	Watch	Automotive	Transparent Display	Splicing display
							
Special Advantage	• None (<100 inch)	• Power saving*	• Power saving*	• High brightness • Power saving*	• Long lifetime • High brightness • Flexibility	• High transparency • High brightness	• No border • High brightness • Customization
Resolution	High	High	High	Low	Middle	Low	Middle
Price sensitivity	High	High	High	High	Low	Low	Low
Recommendation	😕	😕	😕	😀	😄	😄	😄

Automotive, transparent and splicing display are better breakthroughs for Micro-LED display.

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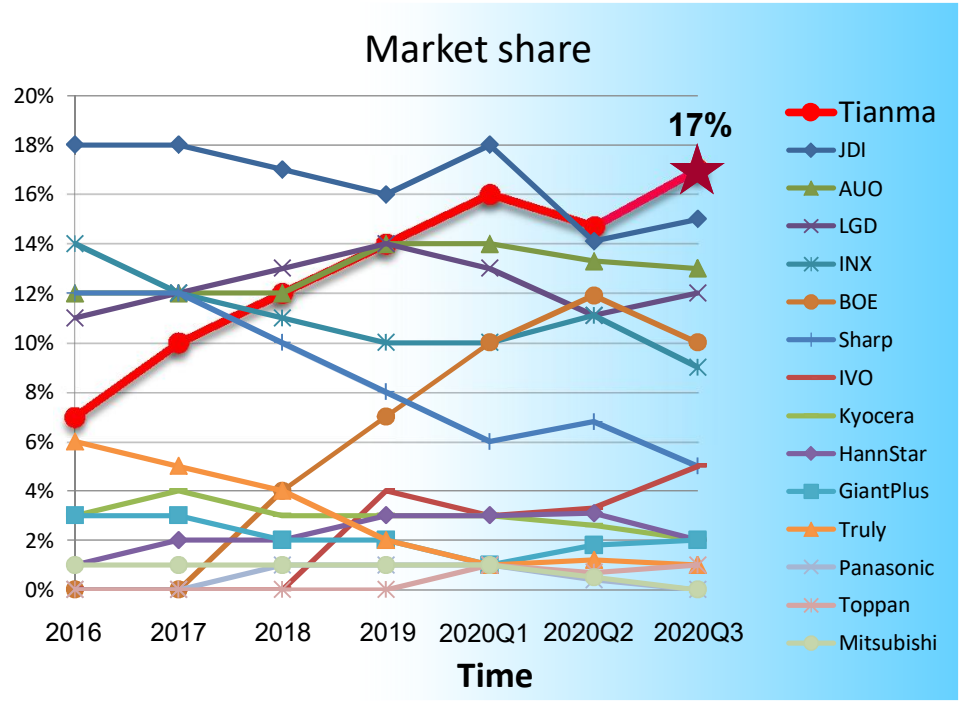
* Theoretically

Analysis of Application Field

Strategic Direction: automotive display

1 out of 5 vehicles in the world is equipped with Tianma product.



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Analysis of Application Field

Transparent Display

- High transparency
- High brightness
- Long lifetime

Splicing Display

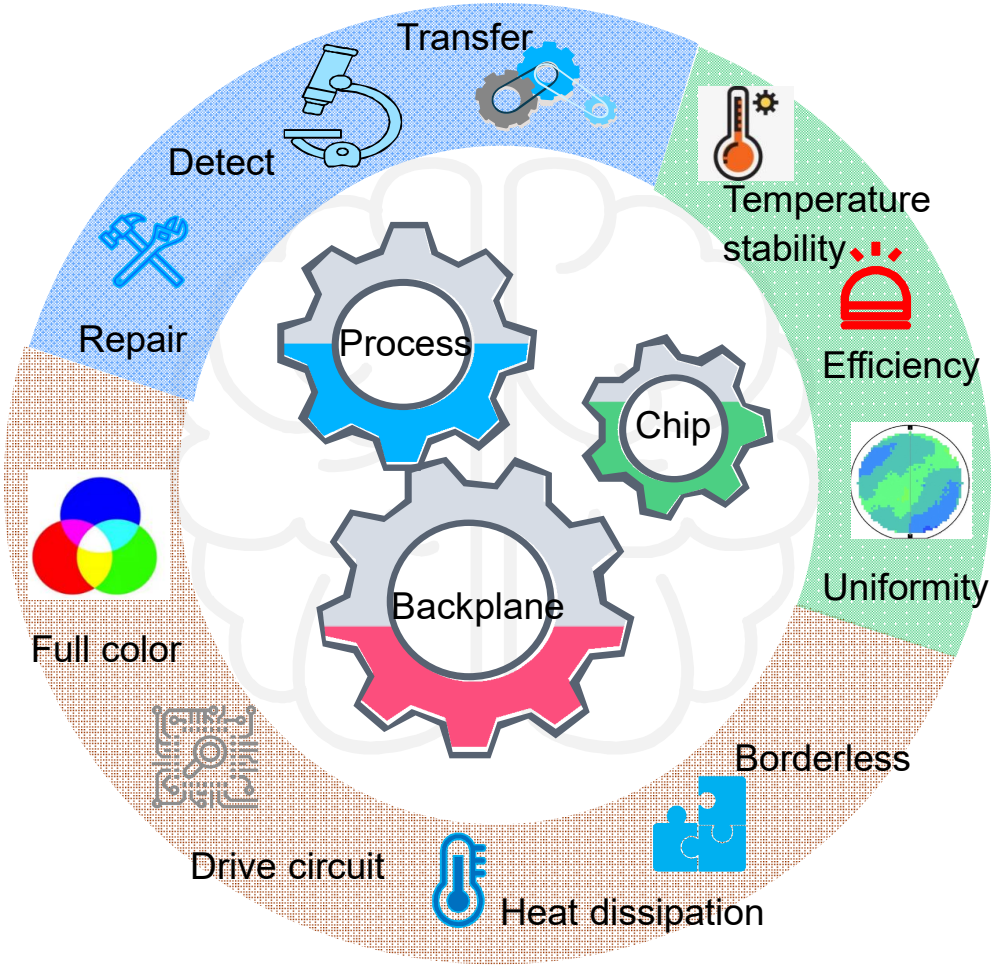
- Borderless
- High brightness
- Long lifetime

Flexible Display

- Flexibility
- High brightness
- Long lifetime

Automotive Display

Challenges



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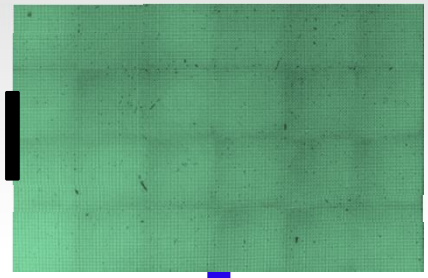
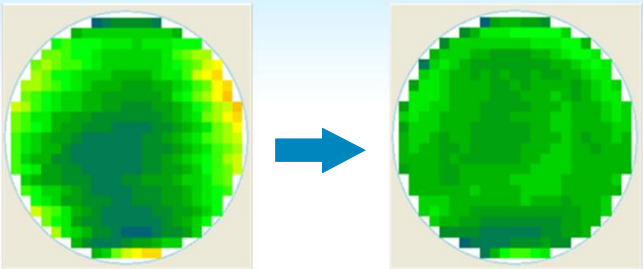
Challenges

Uniformity

lighter darker

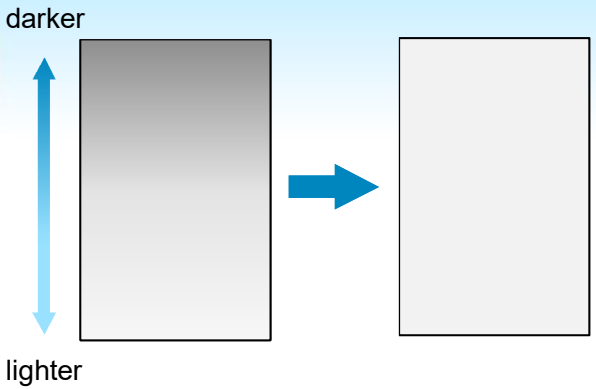


Micro-LED chip



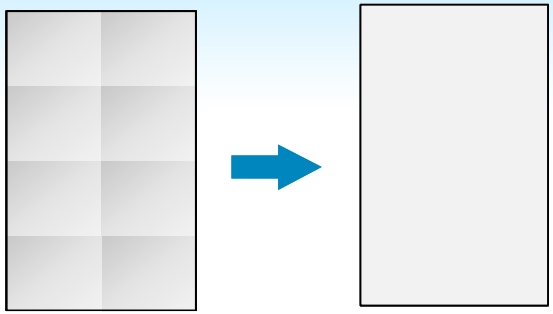
Improve wavelength uniformity

TFT backplane



Reduce IR drop

Mass transfer



Reduce imprint difference

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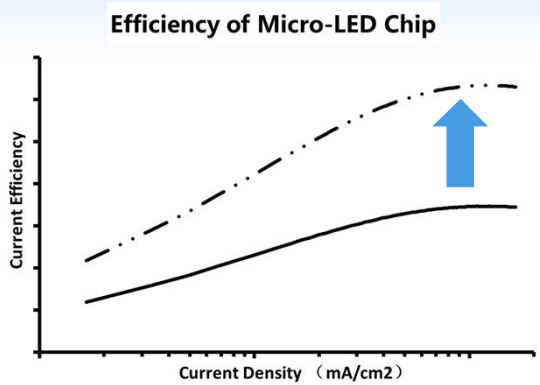
Challenges

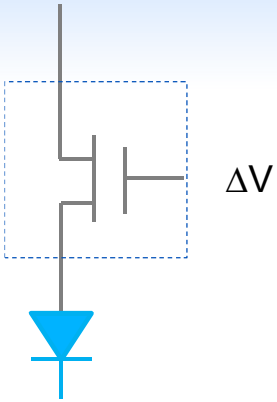
Power consumption

LED efficiency



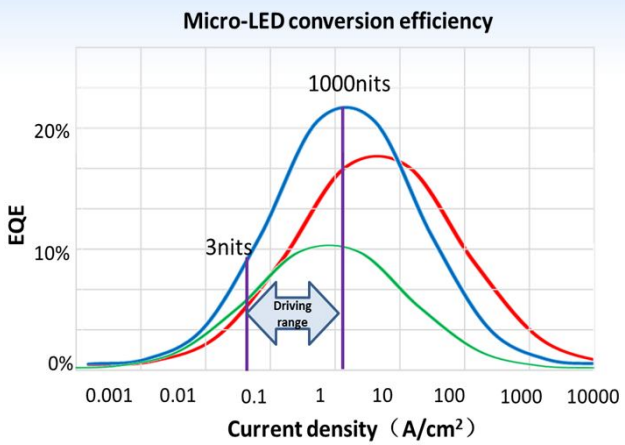
- ✓ Higher efficiency
- ✓ Optimize backplane structure

TFT voltage



- ✓ Decrease ΔV on drive unit

Drive mode



- ✓ PWM mode: working on higher efficiency area

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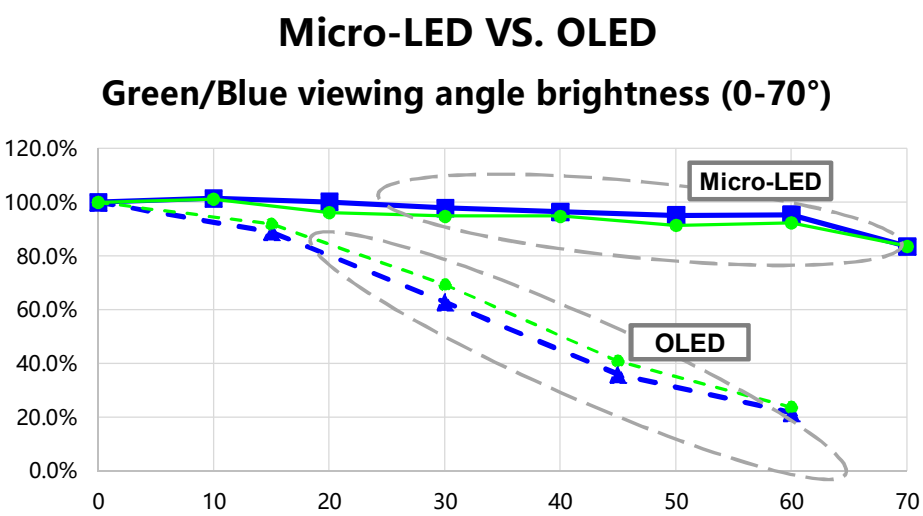
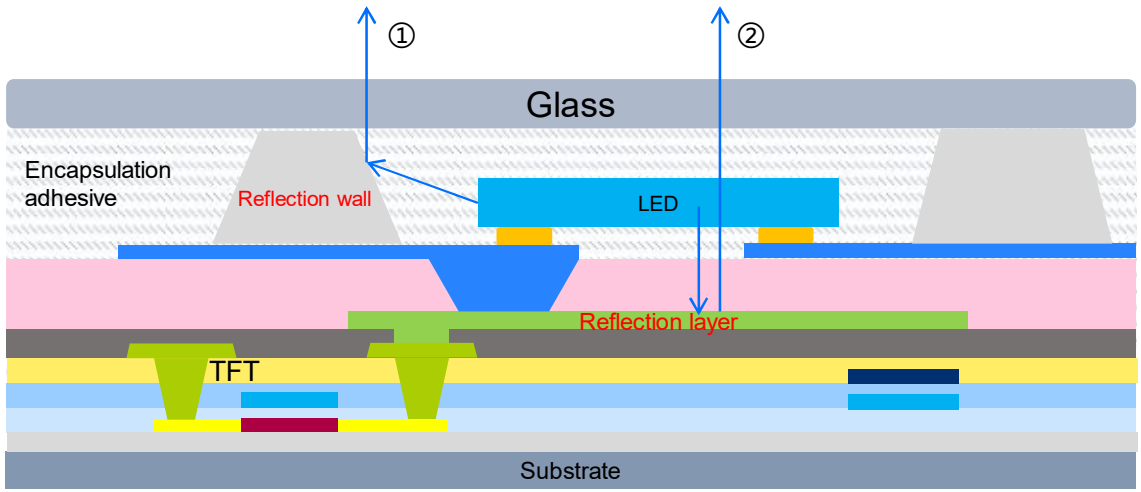
Challenges

Reduce power consumption - Optimize backplane structure





Challenges:

- LED has large light-emitting angle, causing light waste

Solutions:

✓ Reflection wall on backplane ①

✓ Reflection layer on backplane ②

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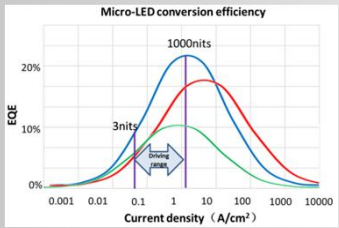
Challenges

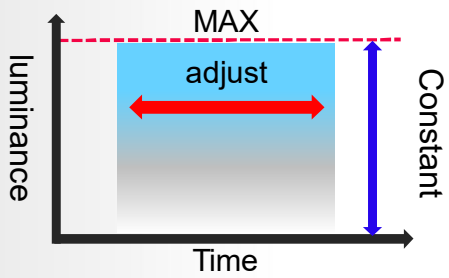
Reduce power consumption - Drive mode

Efficiency of Micro LED Chip

EQE



Current density A/cm2

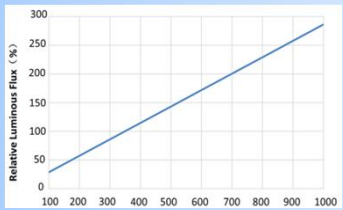


Power consumption：◎
Resolution：×

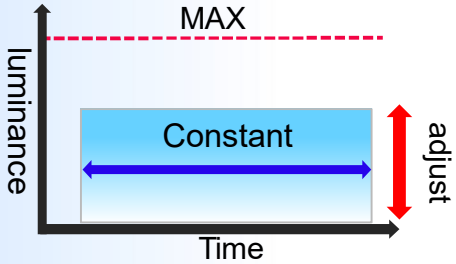
PWM

Luminance of Micro LED Chip

Luminance



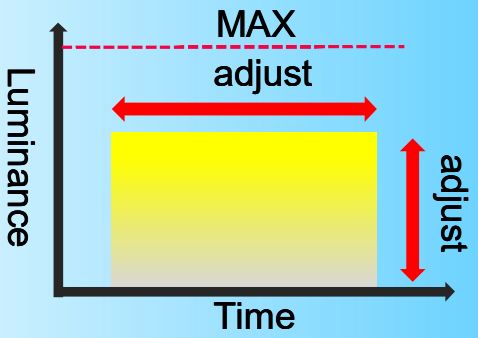
current mA



Power consumption：×
Resolution：◎

PAM

PAM+PWM



Power consumption：○
Resolution：○

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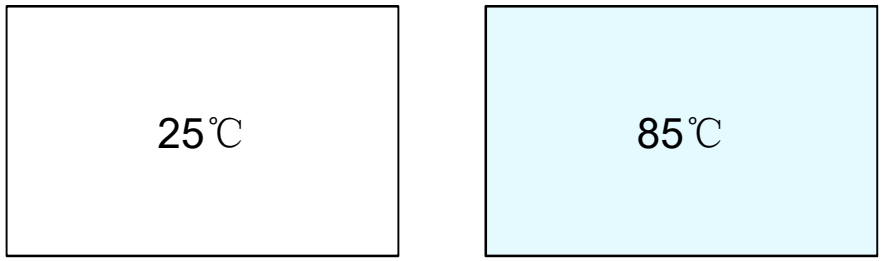
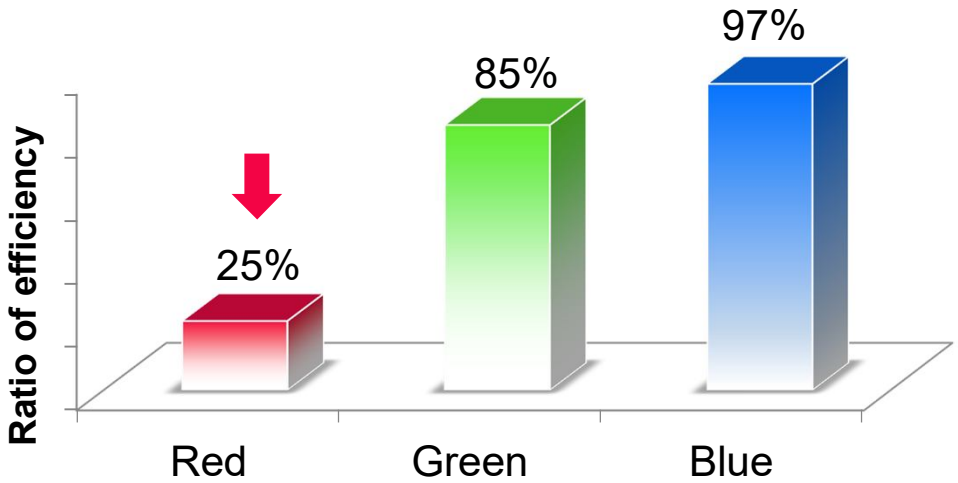
Challenges

Temperature stability



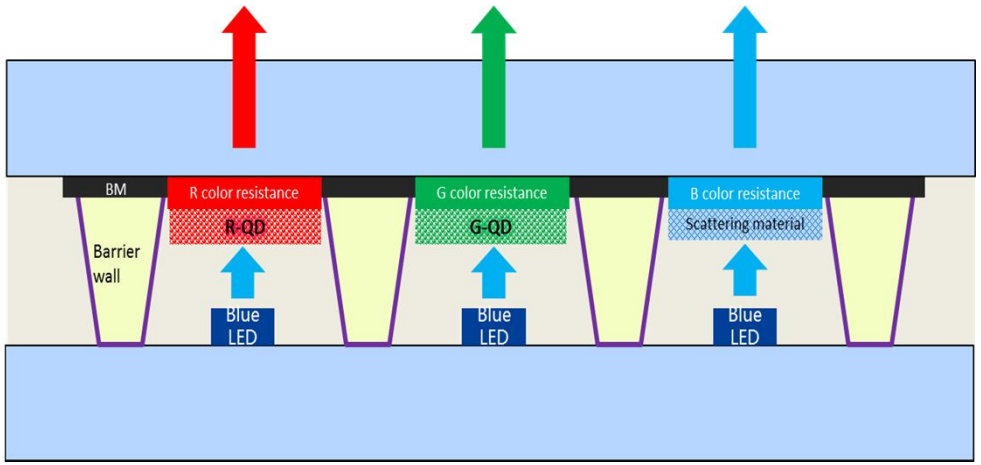
Efficiency VS. Temperature
(Eff85℃/Eff25℃ * 100%)



Solutions:

- ✓ Red chip temperature stability ↑↑
- ✓ Temperature compensation
- ✓ **Color Conversion solution without Red LED**

Blue LED + QD



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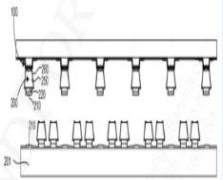
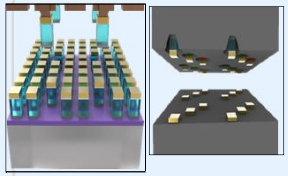
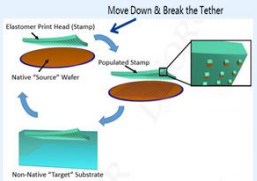
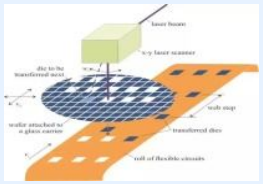
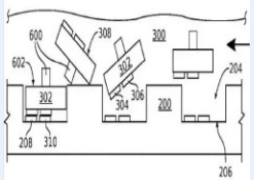
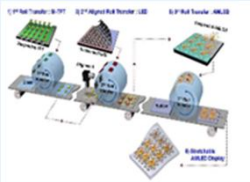
Challenges

Transfer

Item	Electrostatic stamp	Magnetic stamp	Elastic stamp	Laser Transfer	Fluid transfer	Roll transfer
Schematic diagram						
Core Technology	Electrostatic force	Magnetic material	Stretchable adhesive film	Dynamic peeling layer	Suspended liquid	Transfer roller
Transfer speed	★	★	★	★★★	★	★★★
Cost	★	★	★★	★★★	★★	★
Technology maturity	★	★	★★★	★	★★	★

Present Promising

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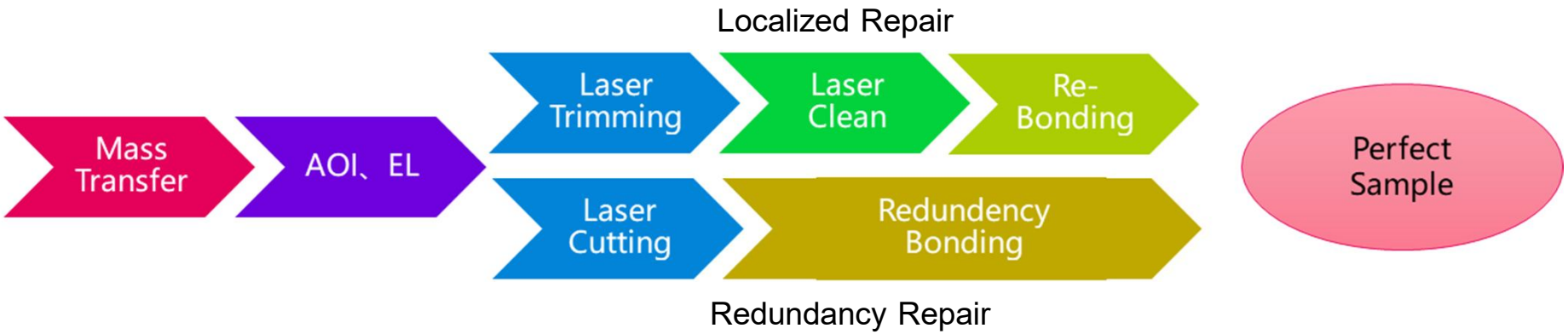
Challenges

Yield

Resolution	LED Chips	Yield	Defects
FHD	6.22KK	99.99%	622
		99.9999%	7
4K2K	24.88KK	99.99%	2488
		99.9999%	25
		99.99999%	3



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Development Progress of Tianma

7.56” Transparent Display

- Resolution: 720*480
- PPI: 114
- Transparency: >60%

7.56” Flexible Display

- Resolution: 720*480
- PPI: 114
- Bending radius: <50mm

5.04” Spliced Display

- Resolution: 480*320
- PPI: 114
- Border: <0.03mm

SID 2019 People’ s Choice award

CVIA 2020 Innovation award in Electronic vision industry

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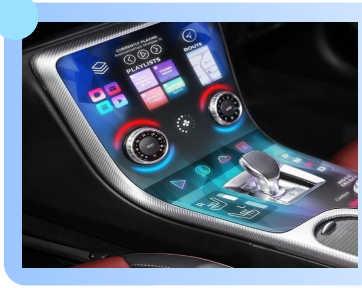
Summary

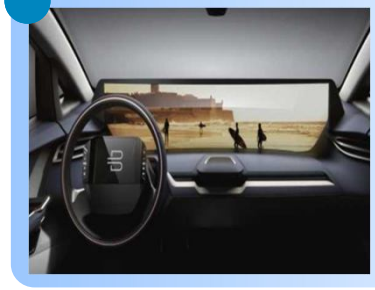
Expected Application Direction

- High performance requirements
- Low / medium resolution
- Low price sensitivity

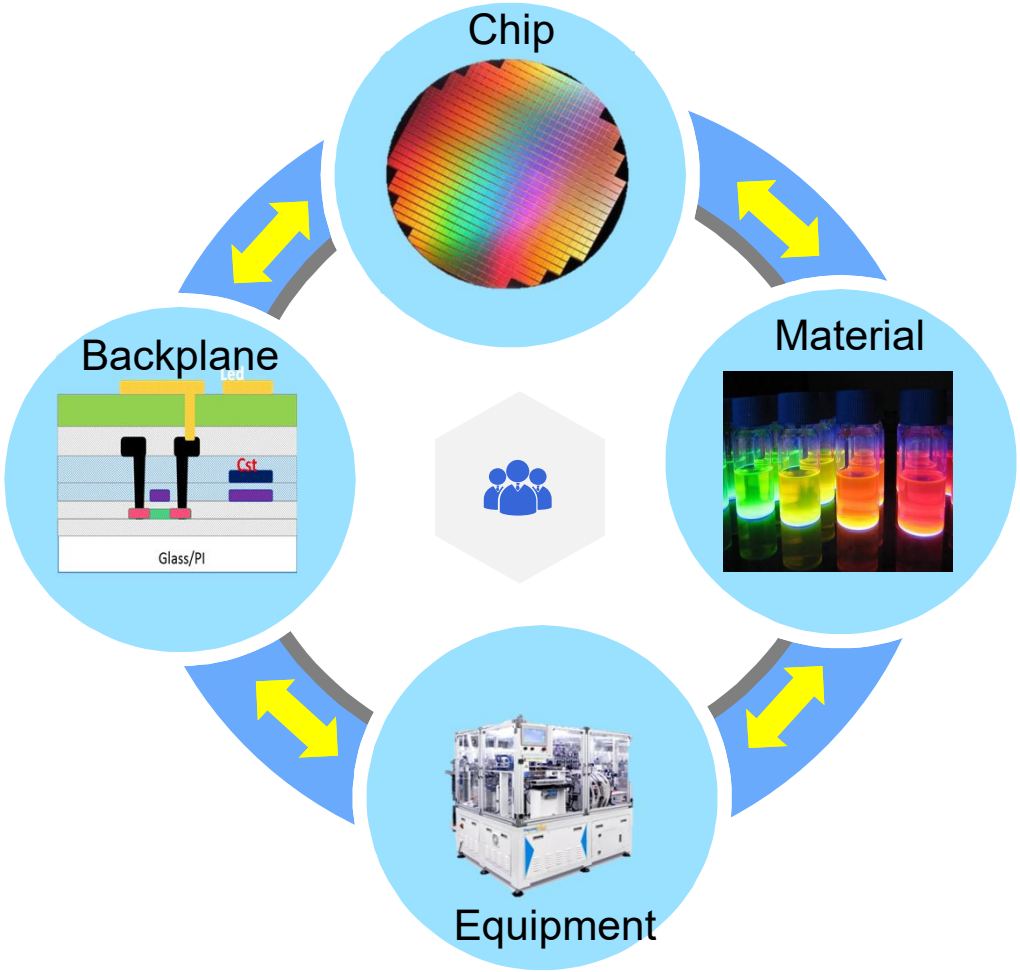


Flexible Display

Transparent Display



Splicing Display



Work together for win-win!

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