2024 OLEDoS Industry and Technology Report

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2.3 Success Factors for the OLEDoS Industry

Since the release of Apple's Vision Pro in 2024, the wearable device and XR market has been in the spotlight, and new product development has been active. The success of the OLEDoS industry, a key component of XR devices, requires technological innovation, expanding market demand, reducing manufacturing costs, and building a supply chain ecosystem.

1.Technology innovation

- Requires technological innovation in semiconductor design for OLEDoS, Si-backplane foundry processes, OLED frontplane processes, and materials.
  1) Establish Si-backplane design and manufacturing process for zero dead pixels
  2) Secured mass production technology for ultra-high resolution (Real 4K) RGB patterning
  3) Develop high-efficiency, high-brightness, long-life devices: Power < 2W, Lifetime T95 > 500 hrs @ 10,000 nit)
  4) Improve user comfort: Develop technologies that are comfortable for extended use, including fatigue, energy efficiency, charging speed, etc.

2. Expanding market demand

- Market demand is one of the key success factors. As the most suitable XR device for utilizing AI functions, application SW needs to be expanded and convenience needs to be improved.
  1) Consumer electronics: Increased utilization as home appliances such as smartphones, monitors, TVs, etc.
  2) Increase work productivity: spatial computing, improved interactivity functions, etc.
  3) Expanding application areas such as education, military and Bio
  4) Replacement of demand for LCD-based entry-level XR (2K resolution) devices

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3. XR devices and companies with OLEDoS

3.2 Major VR and MR products and companies with OLEDoS

- **Apple**

  - Apple announced Apple Intelligence at its June 2024 developer conference, stating that it will lead the ecosystem as an "AI platform company" beyond hardware and software. Apple plans to use the AI-enhanced processors in a variety of IT devices and AI servers. TSMC began trial production of Apple's M5 (2nm process) chip in July 2024, with mass production expected to begin in the second half of 2025. Compared to the M4 chip (2nd generation 3nm process), which was first applied to the iPad pro released in 2024 and is being expanded to the MacBook series, the M5 chip is expected to improve performance by ***-***% and reduce power consumption by ***%.

  - Apple Vision Pro has a component cost of $*** or ***% of the retail price. The most expensive component is Sony's dual OLEDoS at $***, which is ***% of the cost of the device. The combined cost of the M2 (5nm process) and R1 chip, the driving processor, is $***, or ***%.

  - Apple is expected to unveil two new XR products in 2025 to help spread its AI platform and popularize XR devices.

    1) Vision Pro 2, an upgraded version of Vision Pro withthe M5 chip optimized for spatial computing.

    2) Entry-level Vision lite at the sub-$2000 level:

       - OLEDoS from Chinese companies such as Seeya and BOE, and 1500ppi OLED are being considered simultaneously.
       - Reducing the number of cameras and sensors and adopting A series processors for smartphones.

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4. OLEDoS manufacturers and product development status

4.17 Summary of OLEDoS production line progress in China

- OLiGHTEK started manufacturing OLEDoS in 2010, the first in China.
- In 2017, BOE co-founded BMOT with OLiGHTEK and others, with BOE holding 82.8% ownership.

Summary of the progress of the OLEDoS production line (8-inch) in China

	Maker	Location	Production date	Line type	Panel size	Budget	Capa	Application	Remarks
1	OLiGHTEK 奥雷德	Kunming	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
2	BCDTEK 熙泰科技	Anhui	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
3	BMOT	Kunming	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
4	萃松光电	Suzhou	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
5	QINGYUE 清越	Suzhou	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	Lumicore 昀光科技	Nanjing	[illegible]	[illegible]	[illegible]			[illegible]	
7	GUOZHAO 国兆光电	Nanjing	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
8	RAYVISION 睿显科技	Guangxi	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
9	China Ray 华睿光电	Gwangju		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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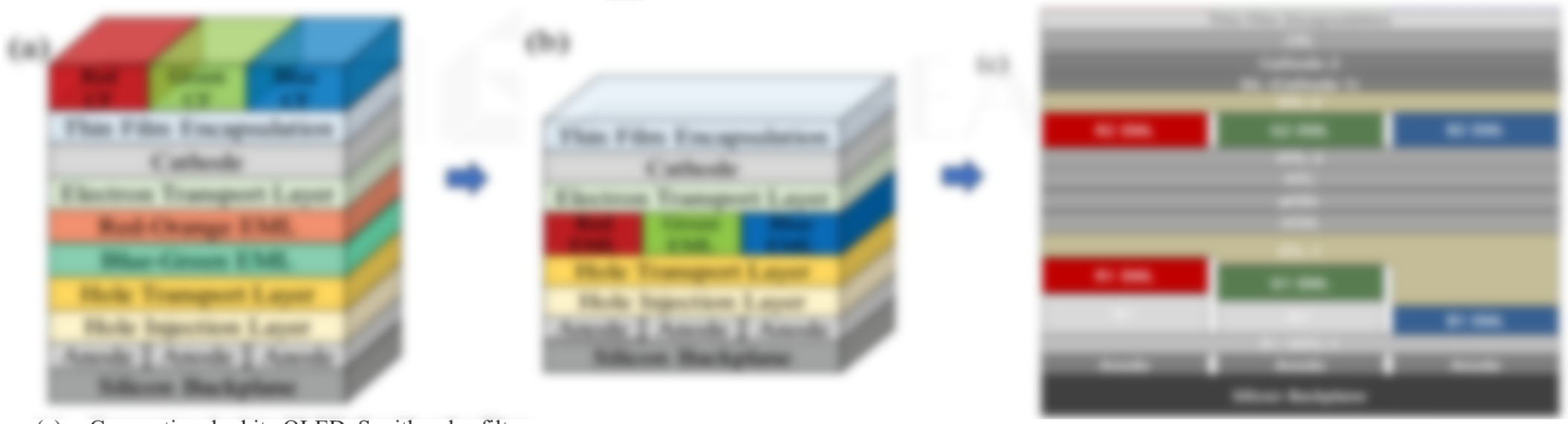
5. Key technical issues of OLEDoS

5.2 Future development directions of OLEDoS

- OLEDoS in mass production is a *** + *** method, and research is underway to introduce a *** structure to improve luminance and lifetime.
- *** structures have excellent image quality and luminance, but there are technical issues such as the need to increase the resolution of the *** used for *** material deposition to *** ppi or higher. Along with the development of ultra FMM, RGB patterning technologies such as *** process and *** are being developed.
- OLEDoS requiring high brightness of over 5,000 nits uses the *** structure to ensure lifetime. *** with a *** structure require **% more organic deposition chambers and ***% more organic material cost, but they have the advantage of increasing lifetime by *** times compared to single OLEDs.



(a) Conventional white OLEDoS with color filter
(b) Directly patterned RGB OLEDoS with red, green and blue
(c) Dual stack tandem RGB-OLEDoS structure

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6. Status of OLEDoS technology developments

6.2 Inter-pixel separation

- **Taizhou Guanyu Technology (KT&T)**
  - KT&T is focusing on the development of OLEDoS with *** structure, and has applied for many patents for device structure and process to prevent *** from ***.
  - Introduced *** and *** inside and under the *** to prevent *** and improve ***. Optimized the refractive index and thickness conditions of the substrate and optical materials by optical simulation.

Examples of improving optical crosstalk in KT&T's OLEDoS

Narrow FWHM (< 30nm) Boron-based blue light-emitting material

Source: UBI Research DB

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7. Status of OLEDoS material developments

7.1 Luminescent materials

- **Key Technologies for Developing High-Efficiency, Long-Life, and High-Color Purity Luminescent Materials**
  - OLEDoS is used under high brightness conditions of 5,000 nit or more, and its lifespan decreases quickly, so the application of *** structure is essential, and the development of materials with high efficiency and long lifespan characteristics superior to conventional AMOLEDs is required. In addition, since a pixel density of 2,000 ppi or more is required, it is important to secure the durability of the emitting material when applying the *** process.
  - The higher the resolution of the *** structure, the greater the risk of degradation of color characteristics due to ***, so luminescent materials are required to prevent this.

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