



2023 OLED Components and Materials Report

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2. Foldable OLED Business and Exhibition Trends by company

2.1 Foldable product release trends by set maker

■ Huawei Mate X series

- Huawei released the 'Mate X3' in April 2023, and plans to release one additional ***** type ***** foldable phone.
- Like the Mate X2, 'Mate X3' has an in-folding method, size is 7.8 inches, and ***** is used for the cover window. Total sales of the Mate X3 are expected to be around ***** units.
- Panel suppliers are ***** and ***** , ***** is supplied by ***** , and hard coating company is *****.
- The size of the ***** model to be released in the second half is expected to be ***** inches, in-folding, and ***** I for the cover window.
- ***** was developed for the cover window but was not adopted due to *****.

Comparison of Huawei's 'Mate X' series

Model	Mate X	Mate Xs	Mate X2	Mate Xs2	Mate X3
Launch	2021.11	2022.04	2022.08	2022.09	2023.04
Folding type	Out-folding	Out-folding	In-folding	Out-folding	In-folding
Size [inch]	6.9	6.9	7.2	7.2	7.8
Display supplier	BOE	BOE	BOE	BOE	BOE, Samsung
Cover window	Universal	Universal	Universal	Universal	Universal
Cover window supplier	Universal	Universal	Universal	Universal	Universal

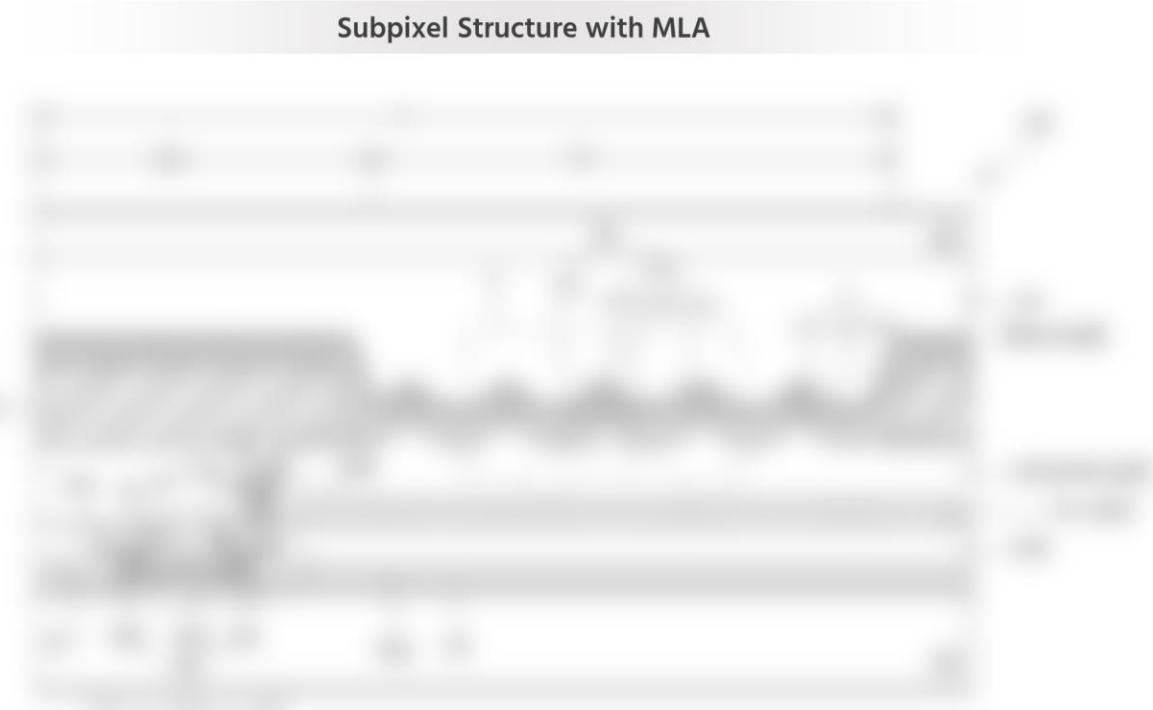
Source: UBI Research DB

3. Analysis of major OLED development status

3.1 Micro lens array

Meta-lit Lens Array OLED : LG Display

- The figure on the right is a cross-section of an OLED display device with MLA developed by LG Display. OLED displays are capable of higher efficiency and higher brightness, depending on the structure. A light emitting layer is disposed on the first electrode. The light emitting layer may include a single layer of light emitting material, and the light emitting layer may have multiple layers including organic layer, inorganic layer, organic layer to increase efficiency.
- The first electrode and the light emitting layer may have shapes according to the shape of the first electrode and the light emitting layer. The second electrode may have a shape according to the shape of the first electrode and the light emitting layer. Therefore, it is possible to configure a micro lens as shown in the figure.
- Because the first electrode forms a microlens, light bound inside the light emitting layer can be emitted at a higher angle than the light emitted by the second electrode. As a result, the light extraction efficiency of OLED is improved.
- In addition, since the microlens consisting of the first electrode, the light emitting layer, and the second electrode, are placed throughout the display, the light extraction efficiency is maximized.



Source: LG Display.

3. Analysis of major OLED development status

3.2 Encapsulation Technology

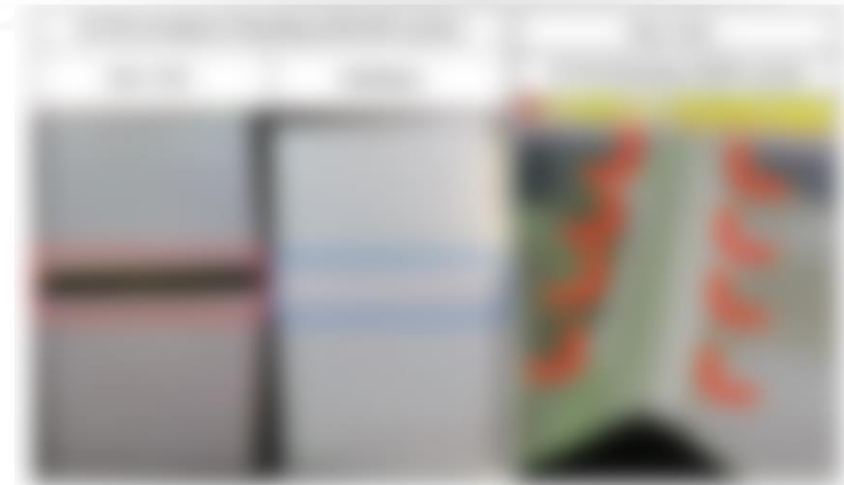
Development Direction of Encapsulation

- The development direction of encapsulation is also changing according to the diversification of OLED application fields such as wearable display, micro display, tablet IT products, and flexible transparent TV. Existing encapsulation technology focused on improving **water vapor transmission rate (WVTR)**, but next-generation encapsulation requires improvement in **mechanical strength** such as **flexibility** and **durability**, **flexibility**, **flexibility**, **flexibility**, **flexibility**. Oxide TFT is vulnerable to **mechanical stress**, requiring **flexible encapsulation** and **flexible encapsulation**, and securing **flexible encapsulation** due to high resolution.
- Samsung Display announced the **flexible encapsulation** multilayer in **flexible encapsulation** in which the **flexible encapsulation** was alternately formed with **flexible encapsulation** and **flexible encapsulation**. The same level of **flexible encapsulation** was confirmed at a thickness of about **50%** thinner than the conventional **flexible encapsulation** layer, and peeling occurred when a **flexible encapsulation** was formed with only **flexible encapsulation** as a result of the **flexible encapsulation** test, but **flexible encapsulation** showed excellent performance without peeling.

Flexible Encapsulation Evaluation



Flexible Encapsulation Result after Flexible Encapsulation Evaluation



Samsung Display, Flexible Encapsulation

3. Analysis of major OLED development status

3.4 Oxide TFT

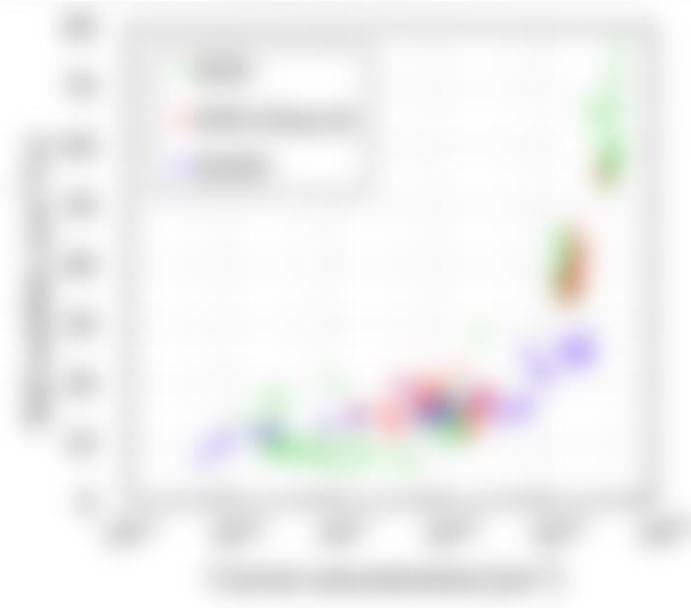
High Mobility Oxide TFT Development Trends

- **IGZO** and **IGZO** use **IGZO** **IGZO** **IGZO** **IGZO** to maintain **IGZO** **IGZO** **IGZO** at the **IGZO** **IGZO** level, while manufacturing TFTs with high mobility of **IGZO** **IGZO** or more, at the level of **IGZO** **IGZO** at the level of 2023. This is five times higher than the **IGZO** **IGZO**, and the **IGZO** **IGZO** **IGZO** is within ± 1 V.
- **IGZO** showed a high level of **IGZO** compared to **IGZO** **IGZO** **IGZO** because there was no change **IGZO** **IGZO** **IGZO** when the **IGZO** **IGZO** was changed **IGZO** **IGZO** **IGZO** to **IGZO** **IGZO** **IGZO**, and showed **IGZO** **IGZO** **IGZO** compared to **IGZO** **IGZO** **IGZO** **IGZO**.

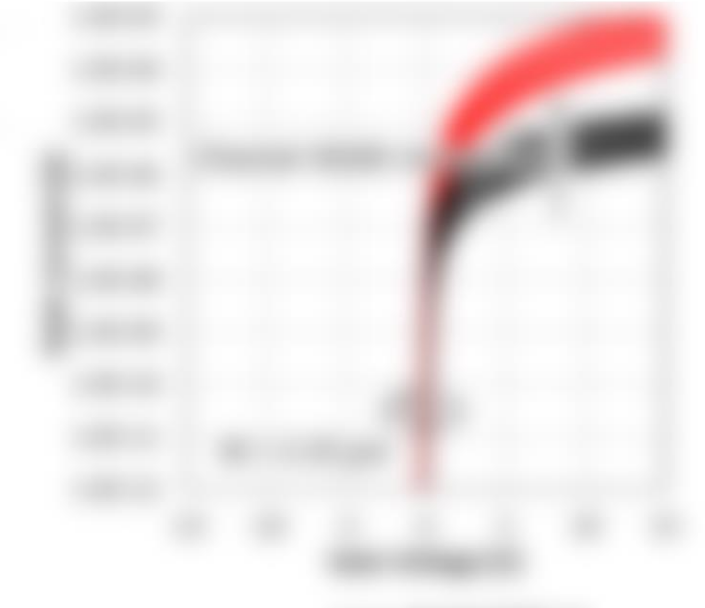
Features of poly-crystalline oxide semiconductor TFT



Hall μ -n plots of IGO and IGZO films on 4" & G6 glass



W/L dependence of IGO TFT (@ L=2 μ m)



Source: SID 2023 **IGZO**

4. Analysis and Forecast of OLED Panel Makers' Mass Production Capacity

4.1 Line Status by Panel Maker

■ Samsung Display Q1

- As of the first quarter of 2023, the overall yield of Q1, a QD-OLED production line, is ***** %.
- As of the end of 2022, the capa has been expanded from *****K per month to *****K and is expected to expand to 41K by the ***** of ***** and *****K by the ***** of *****.

■ Samsung Display 8.6G IT

- ***** of ***** K per month was decided for the ***** for ***** *****.
- Equipment orders are expected in ***** ***** ***** , equipment warehousing ***** ***** ***** , and mass production ***** ***** ***** .
- It is a ***** ***** type ***** ***** ***** ***** OLED mass production line, and the evaporator supplier is *****.
- ***** TFT will be applied as TFT technology to ***** ***** to which ***** ***** and ***** ***** are applied.
- ***** ***** ***** was also considered, but the possibility of introducing it is very low due to reasons such as ***** ***** .

4. Analysis and Forecast of OLED Panel Makers' Mass Production Capacity

4.1 Line Status by Panel Maker

BOE B12

- It is a ***** line, and mass production of ph-1 began in earnest from April 2022.
- LTPO TFT capacity is *****K per month, and additional capacity of *****K per month is expected to be secured by ***** at ph-2.
- From ***** , panels for ***** will be mass-produced in ph-2.
- Ph-3 is an ***** mass production line, and is expected to start trial production from ***** .
- Ph-3 is ***** and is aimed to mass-produce panels for ***** .
- The average monthly operating ratio of B12 in the first half of 2023 was analyzed to be *****%.

Monthly operating ratio of BOE B12 in the first half of 2023

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Average
Operating ratio							

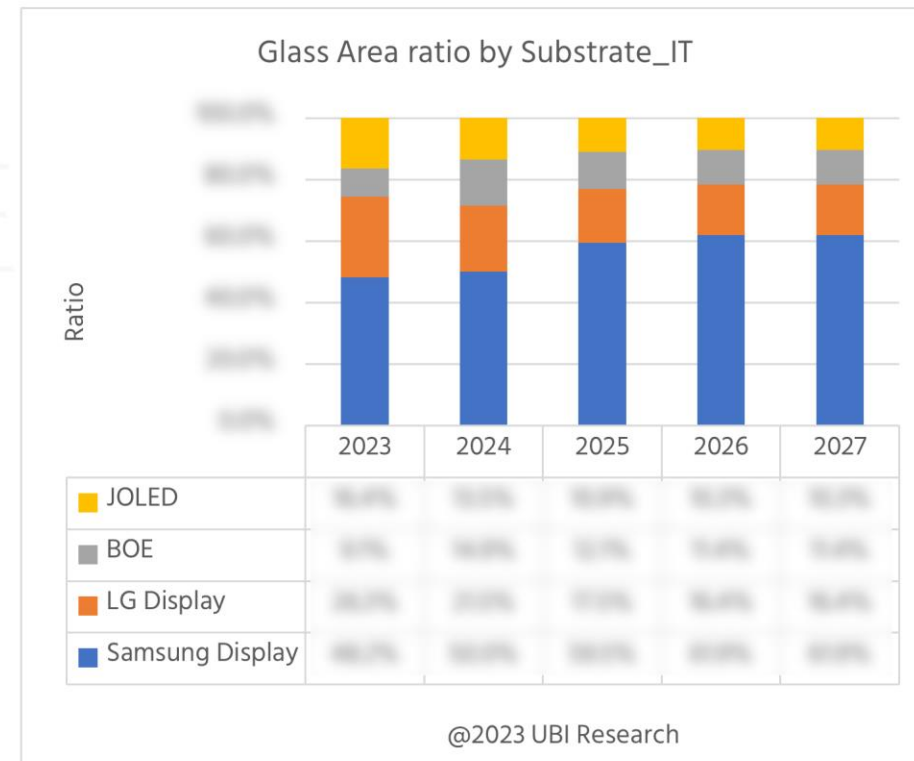
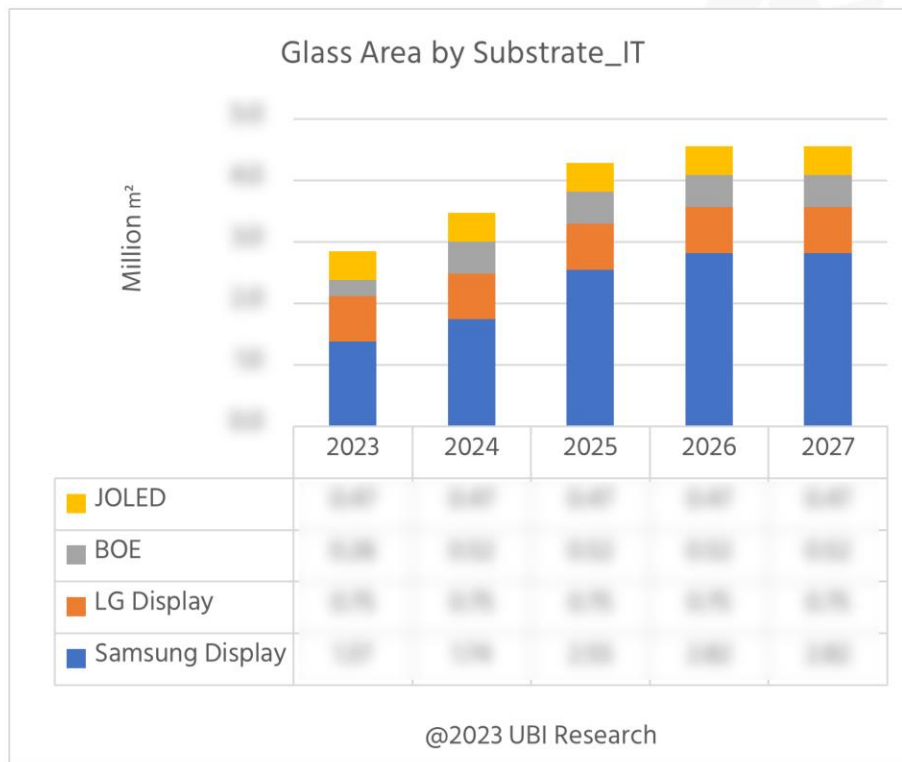
Source: UBI Research DB

4. Analysis and Forecast of OLED Panel Makers' Mass Production Capacity

4.4 Annual Medium and Large-sized OLED Substrate Area Forecast

For IT

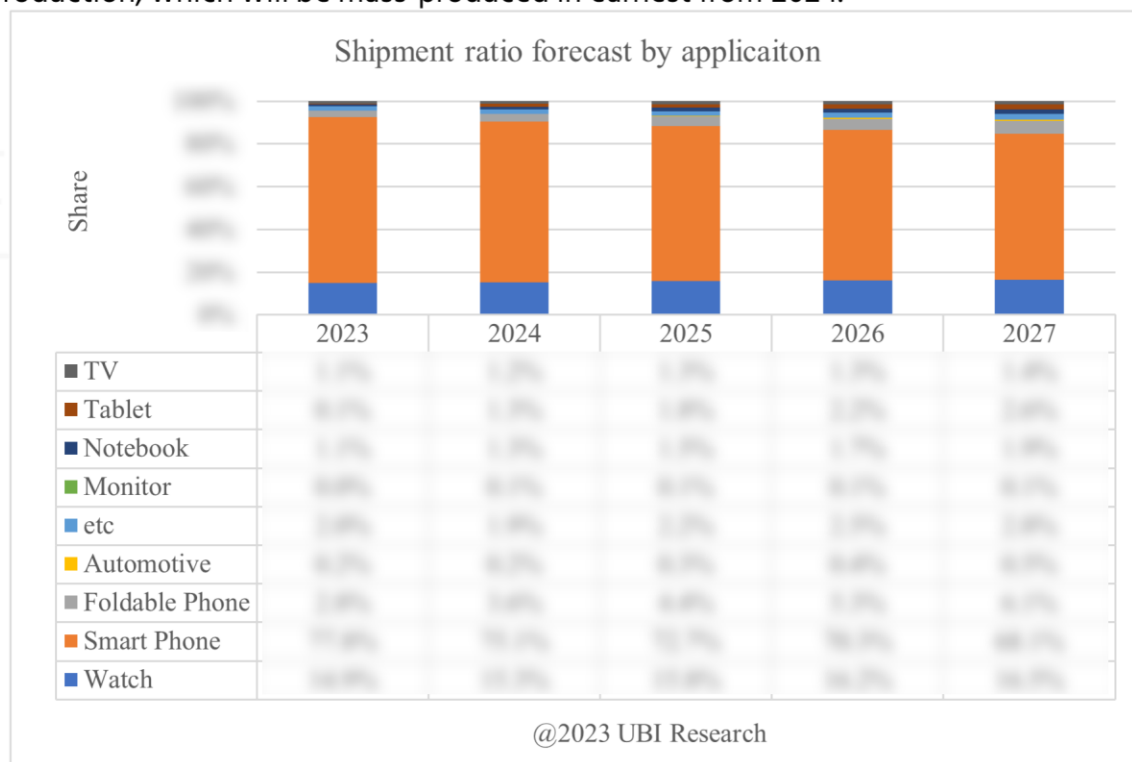
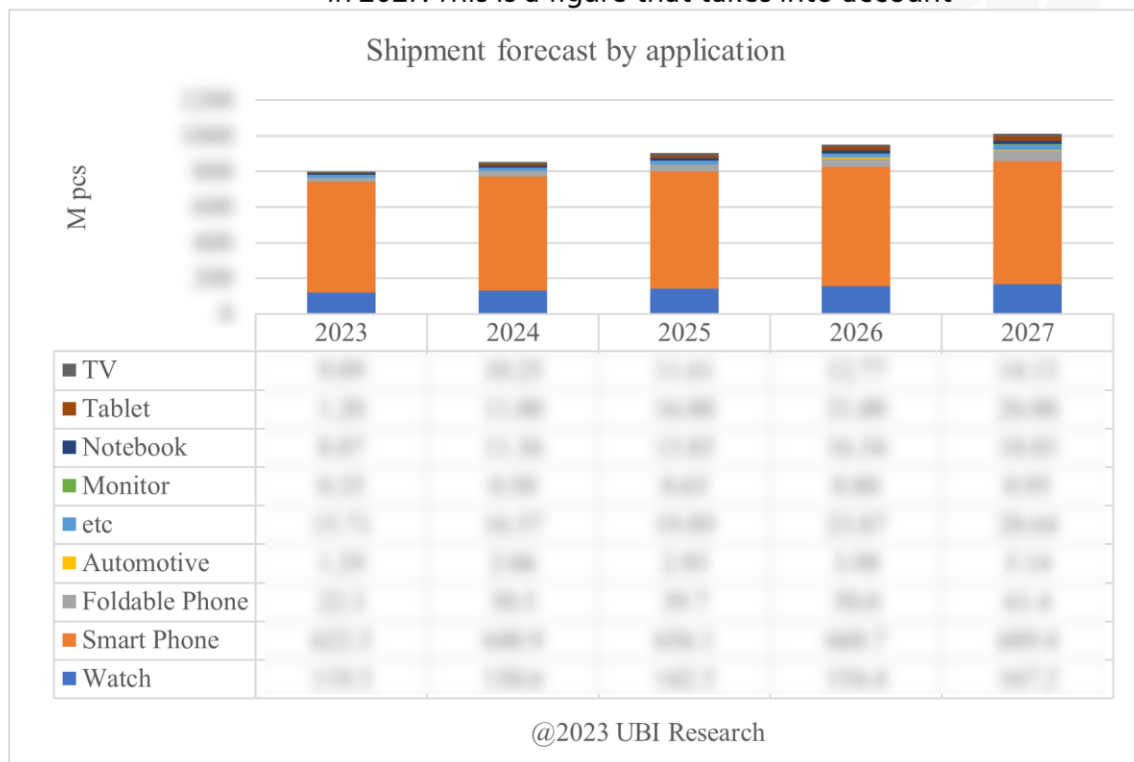
- Samsung Display's IT line capa is expected to expand to ***** million m² in 2027 as the ***** ***** is converted to an IT line in the second half of 2023 and the ***** ***** line is expected to operate in the form of pilot mass production from 2025.
- LG Display's capacity is expected to be ***** million m² from the second half of 2023 when the E6-4 line starts operating.
- With BOE's B12-3 line operating from the second half of 2023, BOE's IT capa is expected to reach ***** million m².



5. OLED Shipment Forecast

5.2 Shipments by Application

- OLED shipments for smartphones are expected to record ***** units in 2023 and form a market of ***** units in 2027 with an average annual growth rate of ***** %.
- OLED for TV mass-produced by Samsung Display and LG Display is expected to ship ***** units in 2023, record an average annual growth rate of ***** %, and record shipments of ***** units in 2027.
- OLED for Tablet PC is expected to ship ***** units in 2023, record an average annual growth rate of ***** %, and record shipments of ***** in 2027. This is a figure that takes into account ***** production, which will be mass-produced in earnest from 2024.





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