

High Yield Equipment enables profitable OLED manufacturing

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External Use

Our Story





FOUNDED in 1967

Applied Materials began in a small industrial unit in Mountain View, California

OUR VISION

Our innovations **make possible** the technology shaping the future

OUR MISSION

To lead the world with **materials engineering** solutions that enable customers to transform possibilities into reality





Applied Materials Overview

Business Segments



Semiconductor System



Applied Global Service



Display and Adjacent Markets

Key Statistics





CA, USA Headquarters



90 in **17** Locations countries



~18,400

Employees

>11,900 Issued patents

Data as of fiscal year end, October 29, 2017



Applied Display and Flexible Technology Group (DFT/AKT)





1991 Founded



CA, USA Headquarters



25 in 7 Locations countries



R&D USA, Germany, Taiwan, India



Manufacturing Germany, Taiwan



Display equipment spending based on Applied estimates

6 | 6

TV Size Growth Fueling Gen 10+ Fab Investment



Large-size TV demand & area growth

Gen 10+ fab investment

13 Gen 10+ fabs* expected 2017-2021

Size Growth is Most Important Driver for TV Area Demand

Based on Applied estimates

*60K/m equivalent

Advanced TV Technologies Today - WOLED

- OLED TV growing due to superior performance vs. LCD
- But, adoption of current WOLED technology limited by cost structure



New OLED TV technology is needed to overcome WOLED cost challenge

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Future wave: RGB OLED TV



(Data Source: DSCC)

RGB OLED TV can achieve LCD cost parity and mass adoption with **materials improvement** (ink jet) and/or **equipment innovation** (evaporation)

Why OLED for Mobile Phones?



Image quality contrast ratio, color gamut, refresh rate, viewing angle

Form factor thin, light, unbreakable, curved

Roadmap necessary step toward foldable

Cost & Differentiation

Rigid, cost parity with LCD. Flexible massive differentiation



Mobile OLED Challenges - Backplane





Device performance & Yield requirements

PARTICLES >10x density reduction

UNIFORMITY 3x improvement

Advanced Materials and Device Design LTPS, LTPO, High-K

Mobile OLED Current Challenges - Frontplane



Future Wave: Foldable OLED Display



Enabling "Components-to-Process megatrend"Solving foldable Display technical challenges

*TFE=Thin film encapsulation

Requires Materials Engineering Innovation

Creates new opportunities for process/equipment providers



Display equipment spending based on Applied estimates

Complexity Drives Increased Capital Intensity



Based on Applied estimates

*Generation 8.5 60k/month capacity **Generation 6 30k/month capacity

Complexity Drives Increased Equipment Capex Intensity



Display Capex* "New Normal" >2x "Old Normal"

Future inflections with increasing process complexity provide further growth potential in Capex and SAM^{**}

* Display Equipment spending ** Served Available Market

Display equipment spending based on Applied estimates



Applied's Display and Flexible Technology Products

CORE PRODUCT PORTFOLIO





NEW PRODUCTS (launched in 2016)

Thin Film Encapsulation



In-Line SEM Review

E-Beam Tester



Roll-to-Roll E-Beam Evaporation PVD CVD





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E-Beam Review (EBR): Combined Semi & Display



Enflexor Gen6H: TFE Solutions for High Resolution Flexible OLED

Barrier Performance	Mask Depo	Buffer Technology
Excellent barrier performance Superior particle control Matching with inkjet buffer	Mask Technology and auto Mask exchange	HMDSO film property control Particle coverage technology
Yield performance Quick path to pilot/production Up to ½ Gen6 tool available	Eliminate etching process for contact	Path to foldable and rollable Enable rigid / TV OLED panel

100% Market Share at OLED Panel Leading Company



R2R Vacuum Processing Equipment

- Front Surface Contact Free
 - Web support from back eliminates contact-based defects
- Winding Versatility
 - ▶ Low-friction roller bearings and optimized load cell positions for precise web tension
 - ▶ Dual-bearing roller architecture to ensure roller-to-roller parallelism
 - Supports a broad variety of substrate types and thicknesses
 - Usable coating width 1.5 m



R2R Vacuum Deposition Equipment



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Conclusions

Adoption of new display technologies, such as flexible OLED mobile and RGB OLED TV creates many opportunities and challenges

We continue to develop equipment which addresses these challenges



