AIXTRON in EXCILIGHT project

Gintautas Simkus
Who we are

- Headquarter based in Herzogenrath, Germany
- Worldwide presence with 14 sales/representatives offices and production facilities
- Company founded in 1983 – over 30 years of experience
- More than 700 employees

- Technology leader in deposition systems
- More than 3,000 deposition systems delivered all over the world
- State of the art R&D center and demo facilities
- Annual R&D budget of approx. € 50 Million
Global Presence

**AIXTRON SE Headquarters**
Herzogenrath, Germany

Core of AIXTRON’s activities is the Technology and R&D Center near Aachen.

Focus on engineering and process development in MOCVD and organic semiconductors.

**AIXTRON Inc.**
Sunnyvale, California, USA

Focus on silicon applications for leading suppliers of DRAM and CMOS.

**AIXTRON Ltd.**
Cambridge, United Kingdom

Focus on the enhancement of material sciences and carbon-nanotechnology research.
**Our system solutions address multiple key markets**

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<td>• DRAM Dielectric and Metal Electrode</td>
<td>• LEDs for display: TVs, mobile phones, tablets, etc.</td>
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<td>• Flash Inter Poly Dielectric and Metals</td>
<td>• LEDs for lighting</td>
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<td>• Motor drives in industrial applications automotive and consumer electronics</td>
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*Fluctuating Equipment Demand*

*Increasing Equipment Demand Expected by: 2014/2015*

*Increasing Equipment Demand Expected by: 2015*

*Increasing Equipment Demand Expected by: 2016/2017*

*Increasing Equipment Demand Expected by: Beyond 2018*
Compound Semiconductors – MOCVD Planetary (1/2)

Product Description – MOCVD

- Planetary Technology: GaN LED, GaN HEMT, AlInGaP, Photovoltaics, Laser, SiC PE
- AIX G5 HT: 56x2”, 14x4”, 8x6”
- AIX G5+: 5x200mm
- AIX 2800G4-TM: 60x2”, 15x4”, 8x6”, 5x8”
- AIX G5 WW: 10x100mm, 6x150mm
- Established production platform at Tier One customers

"Single wafer performance with batch reactor cost benefit"

Product Features

- Unique Planetary reactor design
- Horizontal reactor type
- Core process know-how
- Individual control of each single wafer
- Ideal for large wafers
- Best-in-class on-wafer uniformity
- Unique w2w adjustment capability
- Lowest cost of ownership for large wafers
- Highest throughput 6”, 8” wafers
- Best-in-class precursor efficiency
Compound Semiconductors – MOCVD CCS (2/2)

Product Description – MOCVD

- Close Coupled Showerhead (CCS) Technology
- GaN LED
- Production: Crius eXL: 75x2”, 19x4”
- R&D: CCS 3x2”, 6x2”
- Proven production platform at HVM customers

“Higher capacity and more throughput with the showerhead performance you can expect from AIXTRON”

Product Features

- Patented CCS Technology
- Vertical reactor design
- Core process know-how
- Intrinsically uniform
- Wide process window
- Lowest cost of ownership
- High throughput
- Low gas consumption
The Unique Showerhead Principle

- High Efficiency
- Vertical Flow Design
  w/o Discontinuity in the Center
- Robust Design, easy cleaning

CoO
Yield
Uptime

Showerhead
Wafer
**Product Description – OVPD**

- Proprietary carrier-gas enhanced gas phase deposition approach for organic thin films*
- Based on AIXTRON’s core competence of carrier gas enhanced vapour phase deposition
- Free scalability: suitable for all relevant substrate generations
- Manufacturing technology applicable for OLED displays, OLED lighting, organic semiconductors, and organic photovoltaic

"Disruptive deposition technology for cost efficient OLED manufacturing”

**Product Features**

- High deposition rates for high throughput
- Reduced thermal stress for organic materials
- High material utilization efficiency
- Flexible process control
- Simplified scaling due to
  - Close Coupled Showerhead and
  - Decoupled source technology
- Flexible integration solutions for batch and inline
- Reduced number of deposition chamber and footprint
OLED coating technology – Perceived disadvantages of VTE

VTE

- **Efficiency**: < 70 %
  - Degradation of org. materials
- **Uptime**: frequent cleaning of chamber walls
  - frequent source refill (high vacuum)
- **Fixed**: layer sequence

OVPD

- **Economic**: Deposition (> 70 %)
  - No Degradation of organic materials
- **Uptime**: No parasitic deposition
- **Flexible**: No interruptions for source refill
  - No layer sequence
OVPD STEx Source

Reduced and constant thermal exposure of organic material

**STEx Source**
(Short Thermal Exposure Source)

- **Constant Source temperature** => three different rates subsequently
- Material is stored at room temperature in vacuum
- Material can be refilled without downtime

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**Graph:**
- **Runs**
- **Average**
- **R2R:**
  - Avg. Rate: 52.3 A/s, ± 0.7%
  - Avg. Rate: 26.3 A/s, ± 0.5%
  - Avg. Rate: 8.8 A/s, ± 0.6%

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**Notes:**
- **Material storage** $T = T_{\text{Evap}} - 200K$
- **Vaporizer** $T_{\text{Evap}}$
- **Substrate holder**

**Location (material path):**
- Aerosol Powder
- Vaporizer
- Showerhead

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**Diagram:**
- **Temperature**
- **Run 1**
- **Run 2**
- **Run 3**
OVPD Unique Advantages

→ **Efficient Material Utilization**  > 70 % (Gen 8 and beyond)

→ **High Availability**  No frequent cleaning

→ **Continuous Production**  Continuous source refill

→ **High throughput**  Highest deposition rates

→ **Overall capital efficiency**  Less chambers per line

→ **Flexibility**  Multiple sources/layers per OVPD
Organic Electronics – PVPD

Product Description – PVPD

- Modular system for deposition and insitu formation of functional polymer thin films
- Insitu formation of polymer thin films from vapor phase
- Based on AIXTRON’s core competence of carrier gas enhanced vapour phase deposition
- Deposition of functional thin films addressing a wide range of possible applications
- Wide range of applications for flexible electronics manufacturing

"Versatile deposition technology for Polymer-based thin films”

Product Features

- Modular system concept to enable different polymerization processes
- High rates for vapor phase deposition and film formation
- High material utilization efficiency
- Flexible process control
- Simplified scaling due to
  - Close Coupled Showerhead
  - Decoupled source technology
  - Modular source concept
- Flexible integration solutions for batch and inline
- Solution-free deposition technology
Organic Electronics Lab at AIXTRON Headquarters

- **Full OLED Device Capability**
  - Pre-Treatment
  - OLED stack Deposition by OVPD
  - Full or Split Device Stack in up to 3 OVPD PM
  - Optional: FMM patterning in one OVPD
  - Metal Deposition by VTE
  - Encapsulation – Glass Encap. in GB
  - Polymer Deposition by PVPD

- **Single/Multi Layer Capability on large scale**
  - Deposition on Gen3.5 (850mm x 750mm) Substrates with FMM
  - Deposition on Gen8 (2.2m x 2.5m) test area, Deposition performance validation via Si-Wafers and QCMs

OEC-200 Demo Cluster

OLAD - Organic Large Area Demonstrator
AIXTRON role in EXCILIGHT

- Preparation of layers and OLEDs by OVPD technique.

- Characterization of deposited organic layers and OLEDs concerning lifetime and degradation.

- Development of encapsulation methods for protection of OLEDs using flexible or rigid encapsulant.
Objectives

- Improve quality and uniformity of exciplex layers using OVPD technique.
- Develop encapsulation methods for protection of OLEDs using different techniques and sealants.
- Improve understanding of the relevant physical and chemical processes.
- Scale up the OVPD processes for future commercial OLED production.
Thank you very much for your attention.

If you have any further questions or require more information, please contact us at:

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