EUV: The Path To HVM

LDP Technology Status

July 2011
With years of experience at LPP (Jenoptik) and DPP, XTREME has gained a deep understanding of the technological challenges.
XTREME’s Learning Edge

- Enabling HVM = Reaching technology maturity BEFORE the transition to HVM

- **1997:**
  - Fraunhofer ILT initiates research on EUV light source

- **1998:**
  - Fraunhofer ILT 1st Gen system

- **1999:**
  - Philips Extreme UV 1st alpha platform (Xe) at Customer

- **2000:**
  - Philips EUV/XTREME alpha @ IMEC @ CNSE @ Selete

- **2001:**
  - XTREME 3100 (LDP)/ASML NXE:3100 @ IMEC
## Requirements for an EUV Source

<table>
<thead>
<tr>
<th>EUV SCANNER</th>
<th>EUV Source</th>
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</thead>
<tbody>
<tr>
<td>Imaging</td>
<td>Clean Photon (&amp; Spectral purity)</td>
</tr>
<tr>
<td>Yield</td>
<td>Stability (Dose, Timing …)</td>
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<tr>
<td>CD uniformity</td>
<td></td>
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<tr>
<td>Iso-Dense Bias</td>
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<tr>
<td>Maximum Throughput</td>
<td>Power</td>
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<tr>
<td>Effective Throughput</td>
<td>Duty Cycle and Availability</td>
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The Technology Concept: The Best Of Both Worlds

Laser-assisted Discharge Plasma

Traditional LPP

(LDP)

Stable

Scalable

Traditional DPP
Laser-assisted Discharge Plasma (LDP) Technology Concept

Tin Supply Disc

Tin Film

Trigger Laser

Liquid Tin Bath

EUV in $2\pi$

Plasma

Capacitor Bank

Cooling
LDP Technology Concept – Tin Fulfills Multiple Roles

Tin as wheel protection

Tin as electrodes

Tin as conductor

Tin as dynamic coolant
From Technology To Product

13.5 nm

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Integrated with ASML NXE:3100
LDP Source Shows Good Dose Stability In Actual Operation

Test Mode

Exposure Mode

10-3\07July\2011-07-05\PDC_Data\ifc_chuck008001.mat

\text{(Dose(i) / Dose\text{ nominal}) - 1 [%]}

\text{measure time / second}

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XTREME’s Sources for NXE:3100 – Overview

- XTREME has committed resources and multiple sources are in-house
  - 3 R&D sources (Aachen)
  - 2 product sources (Alsdorf)

- To enable EUV to transition to HVM, XTREME has also additional sources
  - For qualification x1 (Alsdorf)
  - For reliability testing x1 (Alsdorf)
Looking Forward ... HVM

- Next Gen source’s architecture is finalized
Why LDP Will Be The Technology of Choice

- LDP uses **power more efficiently**
  - LDP converts wall-plug power directly into EUV plasma

- LDP is **smaller**
  - LDP architecture also takes up less space in cleanroom + subfab

- LDP keeps the lithography optics **cleaner**
  - LDP also prevents the contamination of the scanner and reticle

- LDP lithography **optics last longer**
  - LDP has proven debris mitigation technology for many years in Alpha phase
The Key Take-Aways

- **PROGRESS HAS BEEN MADE**
  - XTREME’s 3100 source has been installed at Imec

- **THE DIRECTION IS CLEAR**
  - Power, stability, availability and predictability will converge to enable EUV to transition to HVM

- **THE CHALLENGES ARE IDENTIFIED**
  - There are still challenges ahead of us
  - The challenges are identified & plans have been developed
  - Focus Teams are in place to address those issues

- **WE BELIEVE LDP WILL BE THE TECHNOLOGY OF CHOICE**