EUVL R&D Status of Korea
2009 International Workshop on EUV Lithography

National Program Leader
- Jinho Ahn (Professor, Hanyang University)

Members
Industries: Samsung, Dongjin Semichem, IMT
National Labs: Pohang Accelerator Lab., National Center for Nanomaterials Technology
Sub-programs

Development of the Core EUVL technology for 22 nm node

- EUVL R&D Program
  - Mask Fabrication
    - Multilayer Absorber stack
    - Patterning
    - PSM
    - Metrology
  - EUV Resist
    - Resist design Characterization Simulation
  - Mask Cleaning
    - UV-LSC Equip.
    - Cleaning process Evaluation
  - Infrastructure
    - MET
    - Out-gassing
    - AIMS
    - Optical constant

National Center for Nanomaterials Technology

Sponsors:
- Samsung Electronics
- Dongjin Semichem Co., Ltd.
- IMT
- Hanyang University
- Sungkyunkwan University
- Hanyang University
- OSTECH
- PAL
Program Roadmap
Recent progress on EUV mask

**EUV Mask Fab Infrastructure**

**Optimization of E-beam writing**

**Inspection Techniques**

**Etching Technique**

**Simulation**

**Image Transfer Characteristics**
Recent progress on EUV resist

Resist Optimization

<table>
<thead>
<tr>
<th>Unit</th>
<th>Resolution</th>
<th>Photo-speed (@50nm, L/S)</th>
<th>LER (@50nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07’ 4Q</td>
<td>&lt; HP 32 nm</td>
<td>20.0 mJ</td>
<td>5.9 nm</td>
</tr>
<tr>
<td>08’ 2Q</td>
<td>HP 28 nm</td>
<td>6.2 mJ</td>
<td>5.3 nm</td>
</tr>
</tbody>
</table>

LBNL test results

Exposure: LBNL MET
Illumination: Ann (0.3/0.55)
Inspection: L/S 1:1
Film Thickness: 50nm

Dongjin DHE-1128

07’ 09. LBNL test result

Dongjin DHE-1158

2008.05. LBNL test result
Recent progress on cleaning technology

**Damage-free cleaning process**

- Position of maximum thickness, $t_{\text{max}}$ of Plume
- Gap distance, $D_{\text{gap}}$

**Shock wave modeling**

- Particle movement analysis under shock wave
  - Distance: 2.2 mm
  - Center

**Particle contamination/detection**

- Laser shock wave analysis
- Cleaning Tool Development

EUV Lithography Mask Sample (Al$_2$O$_3$/TaN/Ru/Mo-Si ML 50)
Recent progress on evaluation infrastructure

- EUV Beamline and Test Bed at Pohang Accelerator Laboratory
During the coming 3 years .....

- **Samsung**
  - Mask Development for 32nm Technology node
  - EUV PPT set-up & exposure
  - EUV PSM Technology Development

- **Dongjin Semichem**
  - Commercial EUV Resist Development

- **Hanyang University / PAL**
  - Accelerated contamination study
  - Mask & Resist Evaluation Support
International Collaboration

Mask Blank
Mask Inspection
Standardization

Full field exposure using alpha demo tool

KEUVL
Mask
Mask Cleaning
Resist

Resist evaluation
Mask evaluation

Hyogo University

Microscope
Mask lifetime