Outgas Research Activity in EIDEC

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IEUVI Resist TWG 2011
Agenda

1. EIDEC Outlook

2. Outgas Research in EIDEC
   - Tools & Procedure for Outgas Evaluation
   - Role of EIDEC
   - Result of Preliminary Test

3. Summary
EIDEC Outlook

【1】Concept
・Succeed to MIRAI-Selete accomplishments
・Globally open consortium
・Mask and resist dedicated development program
・Strategic partners for mask infrastructure

【2】Target Feature Size: 16 nm hp - 11 nm hp

【3】Period: 2011/3 – 2016/3

【4】Location: AIST(*) Super Clean Room

(*) AIST: National Institute of Advanced Industrial Science and Technology

【5】Development programs
・Blank Inspection technology program
・Pattered mask Inspection technology program
・EUV Resist Material research program
・EUV Resist out-gassing Control program
Tools & Procedure for Outgas Evaluation

Electron Beam

- Contamination Layer Growth on Witness Sample (WS)
- Measurement of Film Thickness of Contamination Layer
- Cleaning for Surface of WS with Contamination Layer
- Measurement of Non-cleanable Components

EUV

- Resist Film
- Ellipsometer
- Gas
- X-ray
- XPS

WS stage

WS

EUV w/ Univ. of Hyogo

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Role of EIDEC for Resist Outgassing

For NXE3100 Generation (Near Future: 2011~2012)

-To setup the infrastructures for EUV resist outgassing qualification
  - EB-based method proposed by ASML
  - To fix the uncertainty of EUVOM-9000

-To check relevancy of the EB-based method

-To have function of EUV resist outgassing qualification

For NXE3300 and beyond generation (Far Future: 2012~)

-To check adequacy of current methodology leveraging high power EUV facility in New SUBARU

-To clarify guideline of modification of resist qualification
  - Cleanable / Non-cleanable contamination
Role of EIDEC for Resist Outgassing

NXE3300 (2013~)
- NXE3300 for next generation
  - Same as 9000?
  - EB or EUV?

NXE3100 (~2012)
- NXE3100 Resist Qual. Protocol
  - EUVOM-9000 by ASML

Resist Qual. Protocol
- Correlation

Guideline
- This work
- Current work
- Contamination in scanner
- Less Correlated

With higher power EUV light
- This work

With low power EUV light
- This work

EB

EUV

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# High Power EUV Tool for Contamination Test

**Collaboration with Univ. of Hyogo**

<table>
<thead>
<tr>
<th>Vacuum Conditions</th>
<th>High Power EUV Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>~235 mW/cm² (on WS)</td>
</tr>
<tr>
<td></td>
<td>~75 mW/cm² (on Resist)</td>
</tr>
<tr>
<td>Base Pressure</td>
<td>&lt; 2 x 10⁻⁶ Pa</td>
</tr>
<tr>
<td></td>
<td>Controllable</td>
</tr>
<tr>
<td>Pressure during Contamination Test</td>
<td>~1.2 x 10⁻⁵ Pa</td>
</tr>
<tr>
<td></td>
<td>Controllable</td>
</tr>
<tr>
<td>Pumping</td>
<td>~2000 L/s</td>
</tr>
<tr>
<td>Temp. of resist wafer</td>
<td>Not controlled</td>
</tr>
<tr>
<td>Total exposed area</td>
<td>~12 inch wafer (8 inch x 3 wafers)</td>
</tr>
</tbody>
</table>

- The experimental setup is attached to the 10.8-meter-long undulator of the synchrotron radiation facility (New-SUBARU).

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The contamination film is identified by ellipsometry.

The thickness was ~3 nm, but correlation with other metrology tools is necessary.
Modeling of Substrate for Ellipsometer

- The model fits with measured value well
- Ru (5nm) / ML can be treated as a bulk film
Summary

- EIDEC has started as the technological successor of MIRAI-Selete project in April 2011.

- EIDEC will play a role of representative of the resist suppliers who has joined EIDEC.

- EIDEC has already set most of desired tools for outgas evaluation. EB-based tool will be installed in Dec.

- EIDEC has obtained the result of preliminary outgas testing using high power EUV light with Univ. of Hyogo.

- EIDEC will make clear the behavior of non-cleanable components with EUV and EB.
Acknowledgement

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END