Summary of October 14, 2002 SEMI EUV Mask Task Force

- 40 attendees from 22 companies or organizations signed in.
  - **Blank suppliers represented included Corning, Hoya, SAGEM, Schott Lithotec, Tosoh and Xenocs.**
  - **Mask users attending included AMD, IBM, Infineon, Intel, and Motorola.**
  - **Mask equipment suppliers included Leica, QED Technologies and Toshiba Machine.**
  - **Exposure tool suppliers represented included ASML, Canon and Nikon.**
  - **Mask suppliers represented included Photronics.**
  - **ASET, EUV LLC, ISMT, LBNL, LLNL and University of Wisconsin were represented.**
- Proposed changes to SEMI P37-1102 for EUV mask substrates were reviewed.
  - **A proposed change to the definition of CTE was presented by Corning.**
  - **A proposed change to the local slope and HSFR requirements was presented by LBNL.**
- Proposed changes to SEMI P38-1102 for EUV mask blanks were handed out but not reviewed. Proposed changes will be reviewed by email.
- A draft standard for chucking (SEMI draft 3419) was reviewed.
  - **Significant discussion surrounded the rationale for the standard.**
  - **University of Wisconsin presented modeling results on the effect of pin spacing, pin coverage and effective conductance on in-plane distortion of chucked EUV masks.**
  - **ASET presented that a 3-point mount was preferred in the e-beam, but they also stated the requirements for an electrostatic chuck in the e-beam system that would also satisfy the mechanical requirements of draft 3419.**
  - **ASML provided a revised layout for Figure 1 with a proposed 26 by 33 mm wafer field size limit.**

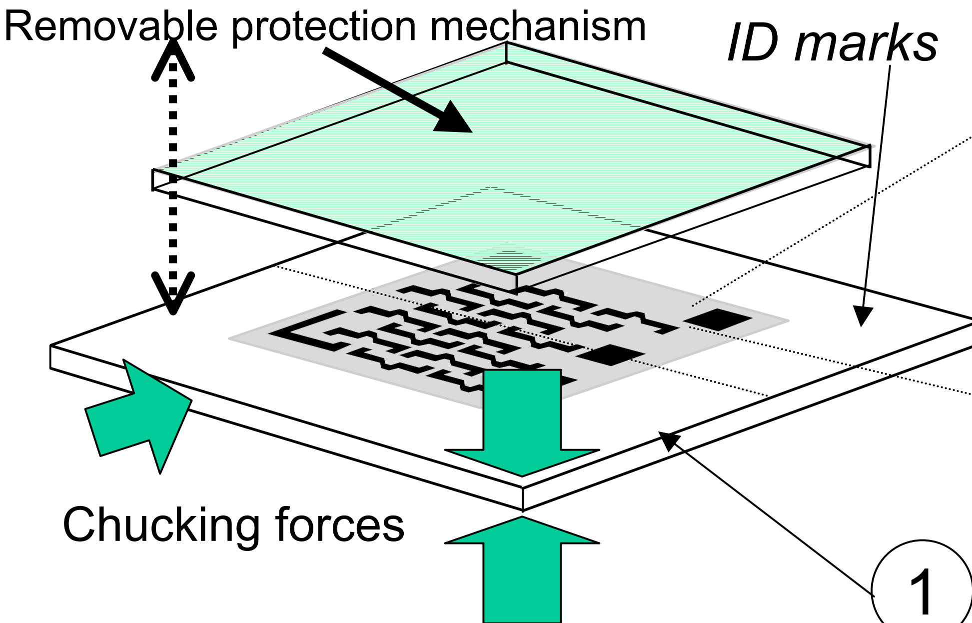
EUVL mask standards

4 *Storage container and attributes of removable protection mechanism (3553)*

Carrier standard drafted

3 Blue ballot 3688 issued

Multilayer coating material, absorber and buffer layers (P38-1102)



Buffer layer

Absorber

Multilayer

LTEM substrate

Cross-section of EUVL mask

1 *Mask substrate (P37-1102)*

First revision completed. Further revisions are proposed, but they might need to wait for establishment of chucking standard.

2 *Chucking in processing and exposure tools, location of ID and alignment marks (3419)*

Informational (blue) ballot issued

Become voting members of SEMI

- Participants in EUV Mask Task Force meetings are requested to become voting members of SEMI Microlithography.
  - **See www.semi.org**
- Anyone can become a voting member, but only one vote is tallied from each company or organization.
- To help gain a quorum on EUV mask ballots, which requires 60% of voting membership to cast a vote, a greater population of members interested in EUV is needed.

EUV Mask & Chucking Draft 3419 and P38

Place your image on top of this gray box. If no graphic is applicable, delete gray box and notch-out behind gray box, from the Title Master

Sunday, February 23, 2003
TechMart, Santa Clara, California

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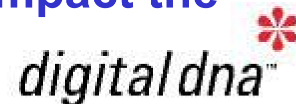
Timelines

- Blue Ballot draft 3419
  - **Co-chairs made motion on behalf of Scott Hector to proceed to blue ballot on 3419 at Semicon Southwest (Oct)**
  - **Sent out for comments on Dec 19, 2003 based on inputs from the Oct Meeting at Dallas (EUV workshop)**
    - **Responses obtained from Intel, Infineon, Canon, ASML**
    - **Accepting votes from 4 other companies**
- Proposed timeline for the yellow ballot is:
  - **Ballot Submission Date: April 24, 2003**
  - **Voting Period Starts: May 6, 2003**
  - **Voting Period Ends: June 5, 2003**
- The blue ballot results don't have any affect on going to yellow ballot. It is informal.

Comments-Intel

- In section 6.2, it says: "The mounting surface of the mask shall meet the flatness requirements defined in Table 1 over the mounting quality area shown in Figure 2."
  - **Section 6.2, Updated: "The mounting surface shall meet the flatness requirements defined in Table 1 over the mounting quality area shown in Figure 2."**
- Is "mounting surface" the surface of the chucking apparatus, not the surface of the mask. If this is true, please ask to clarify the point and modify the statement in sec. 6.2 2.
    - **If this "mounting surface" is really the surface of the mask, then we have problem about the flatness spec values defined in table 1. For example, the table 1 gives a lot of new local flatness specs (peak-to-valley flatness), including: 2.5 nm within 10 mm x 10 mm, 4 nm within 15 mm x 15 mm, and so on. As a reference, P37-1102 only requires 30 - 100 nm peak-to-valley flatness spec and it is a global error, not a local error. Please Clarify?**
  - **There was a wording error in 6.2 in the 3419 draft). “mounting surface of the mask” should be changed to “mounting surface”, which is defined in 4.2.3. Mounting Surface is the Chuck Surface; Local flatness specification is designed to limit the max. slope error. Thus, it should not impact the P37-1102 requirements**



Comments-Infineon

- The wording of 6.3.1 does not seem to be correct.
  - Section 6.3.1. The word “must” changed to “must meet.”
- In 4.2.2 and 6.3.2 you write: "Note that if Sp=Pp in 0 .....". What does "in 0" mean in this case ? For the reader it might be easier when you refer to Figure 5 for the definition of Sp and Pp when you first mention these parameters in 4.2.2
  - Sections 4.2.2 and 6.3.2. “0” should be replaced by “Figure 5.”

Comments Infineon (continued)

- **The item 6.2.2 seems to be the most central point of this chuck standard. It is my understanding that (except for thermal issues) the frontside flatness is the key parameter. I thought that the main reason for defining a standardized chuck is to guarantee a certain frontside flatness within the allowed budget, especially in order to avoid placement errors. Of course, this frontside flatness does not only depend on the chuck itself but also on the blank flatness and blank thickness variations. The main advantage of a standardized chuck would be that the chuck flatness is defined in such a way that in conjunction with the standardized blank flatness the frontside flatness stays within the allowed budget in all relevant tools. For this reason it seems difficult to me to leave this item open for discussion with the supplier.**
  - **Which supplier is meant in this case ? The chuck supplier or the blank supplier ? And who would be responsible, if the required frontside flatness is not achieved ? These questions would not come up, if chuck standard and blank standard would guarantee the allowed frontside flatness when both, blank supplier and chuck supplier would keep to the standard.**
- Concern about section 6.2.2 is valid. This statement is perhaps not needed in 3419 at all since the chuck surface flatness, mask substrate flatness and mask substrate low order thickness variations are specified in 3419 and P37, respectively. Users of the 3419 standard might allow for a larger than desired flatness error through 6.2.2. Thus, section 6.2.2 is removed from the document.

Comments: Canon

【Figure 1】

1) MOUNTING REFERENCE AREA and COARSE ALIGNMENT TARGET AVAILABLE AREA：**Size, position of each area should be specified.**

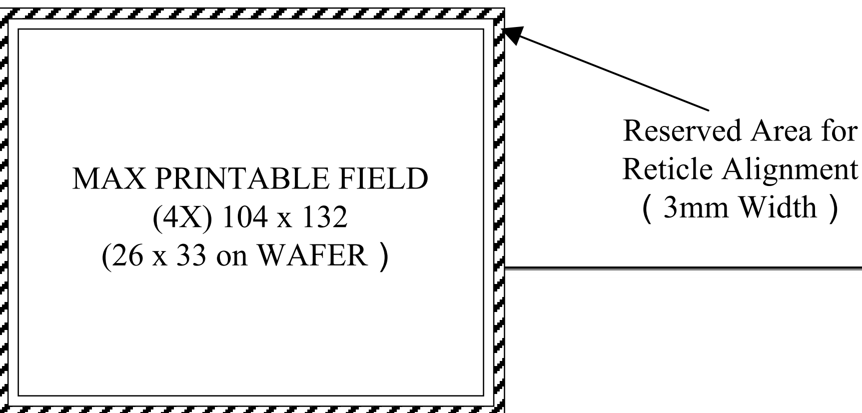
Addressed in ASML (2-23-03) proposal for drawing changes.

2) **MACHINE READABLE ID should be compliant with SEMI T11（Data Matrix).**

A reference to the T11 standard can be made in 3419.

3) **Reserved Area for Reticle Alignment should be allocated outside of MAX PRINTABLE FIELD.**

Addressed in ASML (2-23-03) proposal for drawing changes.



4)Values in Table2, 3, 4 should not be standardized, because they are reserved as means to meet the reticle chuck flatness standard such as Table 1, and otherwise it may constrain the freedom of chuck design. If the flatness standard show in Table 1 can be always met in the exposure tool, the mask pattern generator and the pattern placement metrology tool, Overlay error due to the reticle chuck flatness can be eliminated.

Table 1 specifies the flatness of the mounting surface (chuck), not the mask surface when mounted on the chuck. (There was a wording error in 6.2 in the 3419 draft). "mounting surface of the mask" should be changed to "mounting surface", which is defined in 4.2.3.

If the values shown in Tables 2, 3 and 4 are not standardized, the ability of the chuck to compensate for flatness errors in the various Legendre modes or flatness errors of the backside of the mask is not guaranteed. With standard values shown in Tables 2-4, the flatness errors specified in P37 can be relaxed.

Comments-ASML

- Table 4: ASML recommends deleting Period, Angle of sidewall and Pin Height parameters from the Table 4, since it is specific to the design of the chuck, and is only listed as "agreed to between supplier and user"
- Figure 5: ASML recommends deleting Figure 5, since Table 4 has been changed.
  - **If the proposed parameters and figure are eliminated, the pin period will not be pictorially defined. Including the parameters in the standard doesn't limit design options. The user and supplier may agree that the parameters are all zero or are not specified to allow design flexibility.**
- ASML recommends adding a fourth parameter: foundation stiffness, which specifies the stiffness of the contact between the reticle and the chuck
  - **If this parameter is added, it needs to be a measurable quantity and be precisely defined.**

Response Back Up

- The working group output from October meeting.
  - **Thermal budget and the roughness of the chuck surface should not be standardized to allow various suppliers to develop differentiating approaches. For instance, each exposure tool supplier may choose to allocate overlay error budgets differently allowing more or less error due to thermal expansion.**
  - **Various suppliers may choose different methods to mitigate the effects of particles, so the stiffness ratio should not be standardized at this time.**
- The standard P38 specifies the sheet resistance of the backside film.
- If the mounting standard is adopted, the requirements for mask substrate flatness in SEMI P37 will be modified to allow for flatness errors in certain Legendre modes as you propose.

Agenda

- 07:00 Continental Breakfast
- 08:00 Introduction / SEMI Guidelines
- 08:10 Pin chuck analysis – Roxann Englestad (University of Wisconsin)
- 08:30 Electrostatic chucking: EUV issues and related experiences at IOF – Gerhard Kalkowski (Fraunhofer-IOF)
- 08:50 Chuck design considerations – Winfried Arens (Berlinerglas)
- 09:10 Clamping pressure uniformity – Mike Sogard (Nikon)
- 09:30 Stress data – Pawitter Mangat (Motorola)
- 09:45 ASML Comments to SEMI Draft 3419 – Brian Blum (ASML)
- 10:00 Break
- 10:15 Doc. 3419 chucking standard progress – P. Mangat
- 11:15 P38 review – Scott Hector (Motorola)
- 11:30 SEMI P37 review – Thomas White (ISMT)
- 11:45 discussions
- 12:00 Adjourn