EUV Mask Handling

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- Multilayer Deposition
- Fiducial Mark

**Blank Supplier**
- Absorber Deposition
- Absorber Inspection
- Blank inspection

**Substrate Supplier**
- Substrate/LTEM Inspection: M7360 (Optical tooling)
- Multilayer Deposition: M7360
- Actinic blank inspection

**Blank Supplier**
- Blank inspection

**Mask Shop**
- Mask Data Preparation
- Fiducial Mark Defect Map
- E-beam Writing as Pattern Shift
- Dry Etch
- Repair Review

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- Wafer Printing
- Pattern Inspection: 193nm, EBI, or Actinic Tool
- Pattern Inspection: EUV AIMS
- Pattern Inspection: 193nm, EBI, or Actinic Tool

Kearney, et al 2009 EMLC
SEMI Draft Document 4466B: “Mechanical Specification of EUV Pod For 150 mm EUVL Reticles”

1 Purpose
1.1 This standard specifies EUV Pod for the 150 mm Extreme Ultraviolet Lithography (EUVL) reticle. It is intended to ship, transport, and store a 9-inch reticle. It includes an outer pod and a protective inner pod. The EUV Pod is to be used when a conventional reticle carrier does not meet the requirements of EUVL.

2 Scope
2.1 This standard is intended to set an appropriate level of specification that places minimal limits on innovation while ensuring modularity and their inter-changeability at all mechanical interfaces. Many requirements given in this specification are in the form of maximum or minimum dimensions with very few required surfaces. No material requirements or micro-contamination limits are given in this specification.

2.2 Because of the high attenuation feature of EUV light, a conventional pellicle film cannot be placed in front of EUVL reticles. An inner pod is to protect reticles from particle contamination.

2.3 The EUV Pod has the following components and subcomponents. The baseplate of inner pod has two possible configurations depending on the intended usage. They are designated Type A and Type B. Detail configuration requirements for each are shown in Table 2.

Key:
- Required feature: •
- Optional feature: ○
Dual Pod features / Outer & Inner

* EUV reticle pod courtesy of Entegris, Inc.
**EUVL mask handling / storage technology development at Selete**

### Equipment Front End Module

- **EUVマスクキャリア**
  - 二重ポッド方式

- **二重ポッド型マスクキャリアの有効性**
  - 真空試験(保管、搬送、GV開閉)
  - 吸排試験(LL, ESC)
  - 大気試験(保管、搬送)
  - 総合試験

- **Adder with Dual Pod < 0.004 / handling**

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Evaluation of EUVL mask shipping with Dual Pod at SEMATECH

sPod shipping summary

1. All sPod data, including both SEMATECH and Intel data
2. Same data were published in public.

- Quartz (1X RT) @53+ nm
- Quartz (1X RT) @40+ nm
- Ru-capped Blank (1X RT) @45+ nm
- Patterned Mask (2X RT) @60+ nm
Issue and Discussion

- Technical Issue
  - There are still some risk of adder.
  - Dual Pod is not designed for shipping without very critical packaging specifications.

- Cost Issue
  - Use and maintain Dual Pod in maskshop and mask shipping will heavily increase EUV mask cost.

- Discussion
  - There will be frequent mask cleaning and re-qualification in FAB, anyway.
Proposed EUV mask handling flow

Substrate Supplier → Blank Supplier → Shipping

- Substrate Polishing → Multilayer Deposition → Absorber Deposition
- (Conventional) Shipping box

Mask Shop → Shipping → Wafer Shop

- SMIF pod
- (Conventional) Shipping case
- Dual pod
- Transfer in SMIF pod → Cleaning / Coat → Inspection
- Dry Etch → Inspection Repair → Cleaning
- Transfer in Dual pod → Cleaning → Wafer printing
- Storage
**Summary**

- Dual Pod is most clean EUV mask handling tool.
- However, there will be some risk of particle adder when shipping.
- Using Dual Pod during whole EUV mask manufacturing flow will add serious cost on the mask. So that, mask maker would like to use current SMIF Pod and shipping box in production line and shipping.
- Solution will be usage of Dual Pod in FAB for handling during exposure, mask cleaning, re-qualification, and storage.
Thank you