

An abstract, flowing purple graphic in the top-left corner, resembling a stylized flower or a dynamic, organic shape with multiple pointed, radiating elements.

# INITIAL LEARNING OF IN-FAB HANDLING (OF EUV RETICLES)

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# LEARNING CURVE FOR EUV RETICLE HANDLING

**GOAL:** reduction of particle adders

caused by

**ADT situation before MT-Pro**



- Mask not cleaned
- Shipping
- Manual handling
- SB not cleanable

...

# QUALIFICATION OF RETICLE HANDLING

Cycling tests done in the past for ADT:



Qualification of reticle handling inside the scanner via

I. pre- and post-cycling particle measurements on blanks qualified off-site *(originally FS only, but can also do BS)*

- ▶ Results very variable, **often high numbers of added particles**
- ▶ Probably dominated by **manual handling**, but also shipping
- ▶ Cannot separate possible adders caused by ADT

II. pre- and post-cycling exposures and wafer inspection *(exposure field on FS only)*

- ▶ This separates adders during handling/shipping from scanner-induced particle adders (reticle status “frozen” before cycling)
- ▶ **No evidence of particles added**

# LESSONS LEARNT FROM HANDLING OF ADT RETICLES

Particles on the back-side can have a clear impact on overlay performance of the scanner

## AVOID BACK-SIDE PARTICLES BY ALL MEANS

**For ADT reticles, particle control was not enough**

- ▶ Cleanliness of MANUAL handling, even in class I room, cannot be sufficiently assured.
- ▶ Reticle clamp contamination has occurred.
- ▶ Requires an invasive step to clean it.
- ▶ **Conclusion:**

**Manual handling must be banned.**

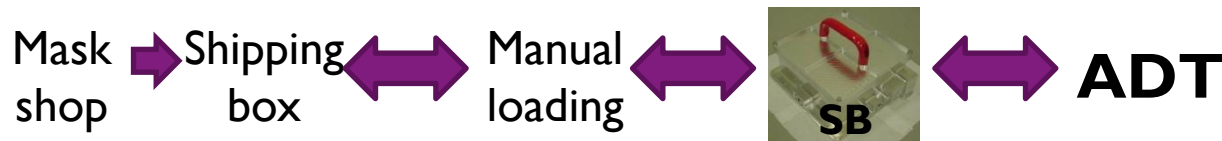


# LEARNING CURVE FOR EUV RETICLE HANDLING

**GOAL:** reduction of particle adders

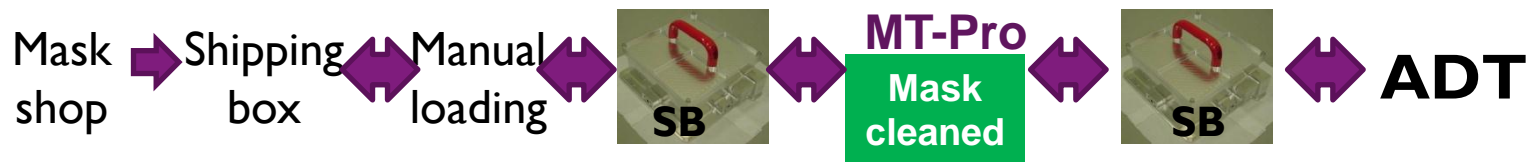
caused by

## ADT situation before MT-Pro



- Mask not cleaned
- Shipping
- Manual handling
- SB not cleanable

## ADT situation with MT-Pro



- Shipping
- Manual handling
- SB not cleanable

## Target situation for NXE3100 environment



- Totally free of manual reticle handling
- Cleanable EUV pod

# NOW ESTABLISHED PARTICLE MITIGATION STRATEGY FOR NXE

## Particle **AVOIDANCE**

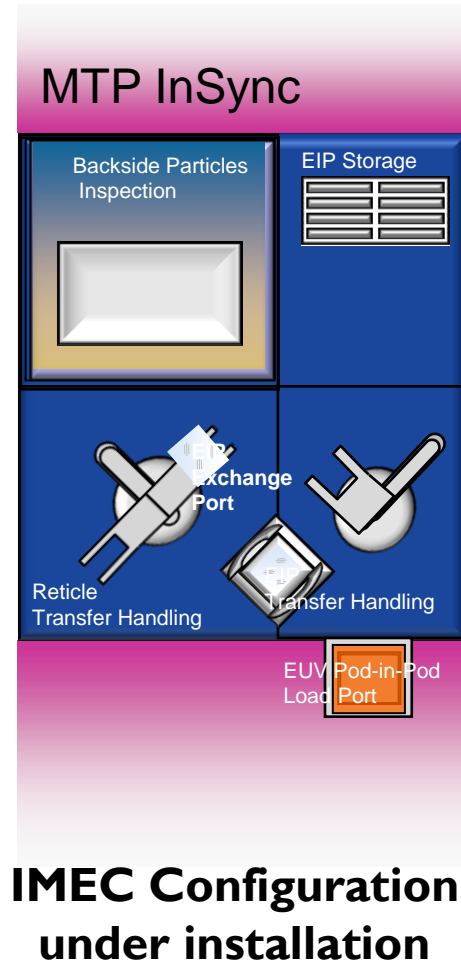
- ▶ All reticles must have their **own EUV pod**.
- ▶ **No shipment yet in EUV pods...**
- ▶ Temporarily: **Manual** reticle handling limited to the **very first load** into the EUV pod.



### *Temporary handling procedure*

- ▶ Clean before first use.  
This challenges mask cleaning for high frequency compatibility
- ▶ **Automated loading/unloading**  
(extension of the HamaTech MT-Pro cleaner: “InSync”)

# TOWARDS FULLY AUTOMATED EUV POD HANDLING: INSYNC



- IMEC configuration enables automated EUV inner pod handling and storage
- Interfaced to existing MT-Pro
- Particle qualification learning (see Brux@Bacus2011)
- Under installation
- **Now also integration of back-side inspection planned**

# DISCUSSION OF STATUS NOW

## REDUCTION OF PARTICLE ADDERS

Target situation for NXE3100 environment



- Free of manual reticle handling

- Cleanable EUV pod

“Type B”

Type A

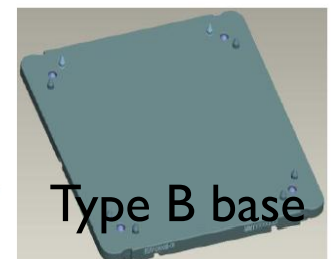
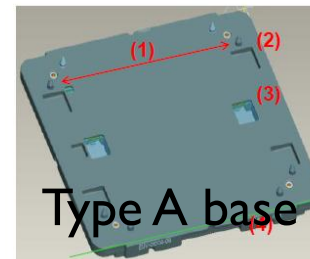
Installation InSync at imec almost complete

Cleaning recipe clearly more ready for routine use

On-site particle inspection: BSI tool on order !!

**EUV POD:**

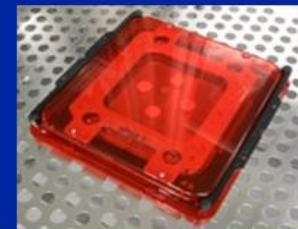
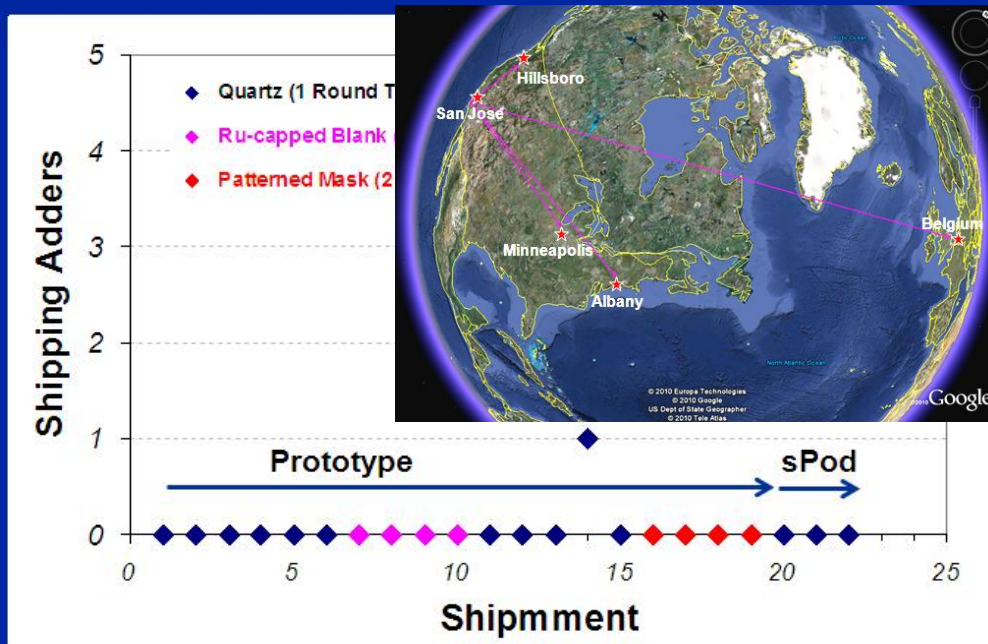
- limited/delayed availability !!!
- appears short term not shippable unless “in a 1m<sup>3</sup>” ??
- or need 2 versions ?!



# TYPE B FOR SHIPPING: EXAMPLE

## Particle Free Reticle Shipping

- EUV Pod design complies with SEMI std
- Shipping capability/particle control down to ~40nm sensitivity.



Prototype EUV mask carrier



Product of EUV reticle carrier / sPod



Shipping package with inner and outer box




- EUV Pod works in shipping

International Symposium on EUV Lithography October 2010

# EUV INNER PODS:TYPE A VS. “TYPE” B IMEC STANDPOINT (PRINCIPLE)

- ▶ **Shipping of Type A - “in a 1m3 package” is NOT attractive**
  - Gets support by (most ?) other NXE users
- ▶ Why can we not make use of the champion shipping data cfr. Sematech sPOD ???
  - → **Receive reticles in “Type B” from mask shops**
- ▶ **Assure **automated** reticle handling on-site “**whatsoever**”.**
  - + now realising on-site **BSI** for particle-free verification
- ▶ Even if this requires 2 types (*for now ?*)

# EUV INNER PODS: TYPE A VS. “TYPE” B IMEC STANDPOINT (EI52)

- ▶ **EI52 is ambiguous**,  
in such that parts of it ...
  - ... calls the presence of the front edge exclusion zones (“pockets”) **“not required”**:  
+/- OK, but should call it (at least) optional 
  - ... considers Type B = sPOD (considered as **“not present”** )  
Standard cannot say “edge grip **MUST** be used.”  
**There is no proof that edge grip is better.**
- ▶ It is fair that the “windows” are a hole in the removable pellicle, and should be avoided during shipping. It needs no proof.
- ▶ Discussion possible for the position of the pins in the base ..., but are they still used for containing the reticle ?
- ▶ Not clear about the need of the 4<sup>th</sup> difference ...

# EUV INNER PODS: TYPE A VS. “TYPE” B IMEC STANDPOINT (REALIZATION)

- ▶ Realising imec’s targets of full-automation **requires** compatibility with InSync, hence the “**pockets**”,  
“*whatever the name of the pod-type*”
- ▶ Now the available **Type B** is claimed to give **edge chipping ??** (called an implementation issue...)  
**The community needs, URGENTLY, both :**
  - a confirmation asap by dedicated testing  
(IMEC may be able to contribute ...)
  - in parallel to work on a mitigation for this “type B issue”  
*Note: mitigation of Type A made it non-shippable,  
except if via “the 1 m<sup>3</sup>” package*
- ▶ Is shipping in **RSP200** a temporary option ?
  - Not designed for shipping
  - But who has data of particle performance that can be shared ?
  - Reason it should be worse than a shipping box (clam shell etc.) ?

# FINAL NOTE ....

The real customer for EUV pod vendors is the scanner ...

**user.**

Yet,

- ▶ For use in the scanner the scanner vendor is the only party that can (and should) assure (& check for) compatibility  
*Type A goes until here.*
- ▶ For other use (incl. shipping):  
Reticle must be verified OK and monitored  
This is the responsibility of the scanner user.  
Scanner vendor is invited to *advise*.



**ASPIRE  
INVENT  
ACHIEVE**

**Thank You**

