



# **Panel Discussion**

## **(Defect Printability Mask Standardization - Attributes and Possibility)**

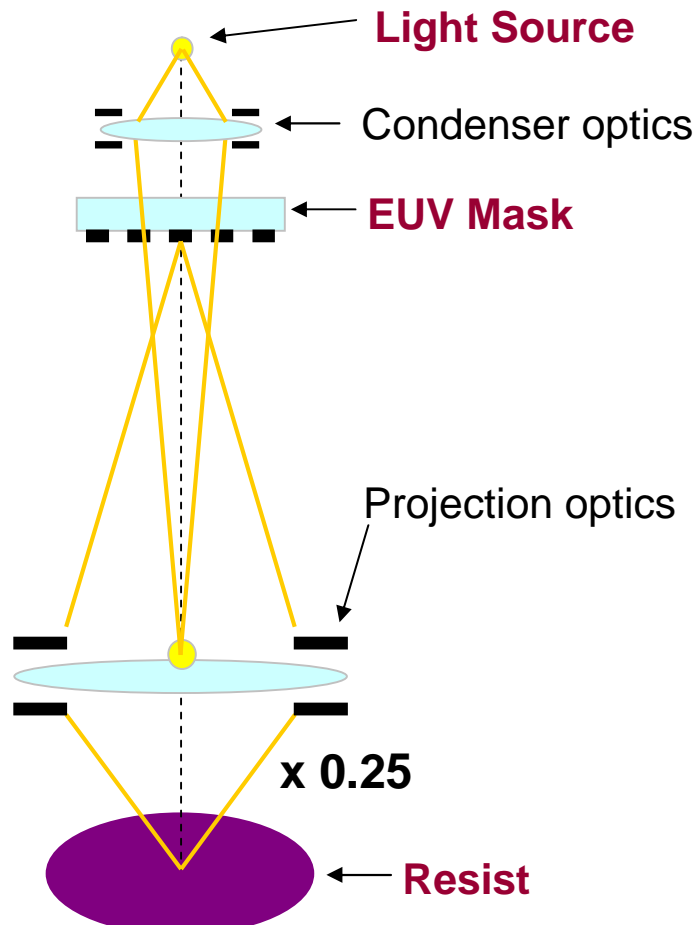
Sean Huh

SEMATECH / Samsung

Oct 22, 2009

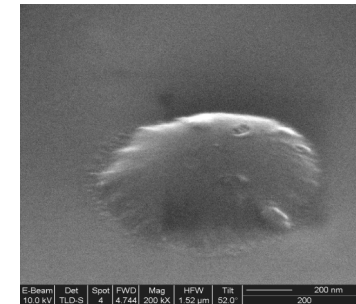
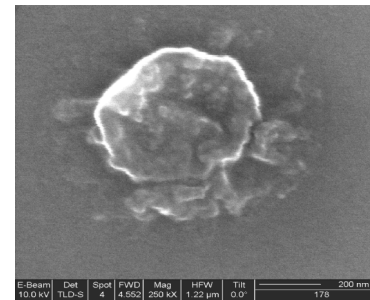
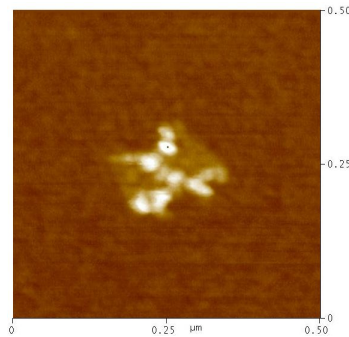
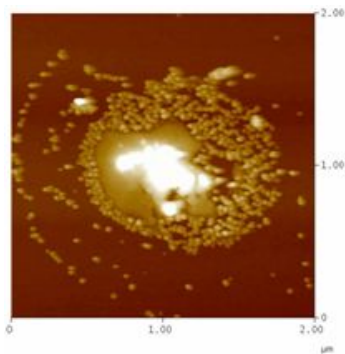
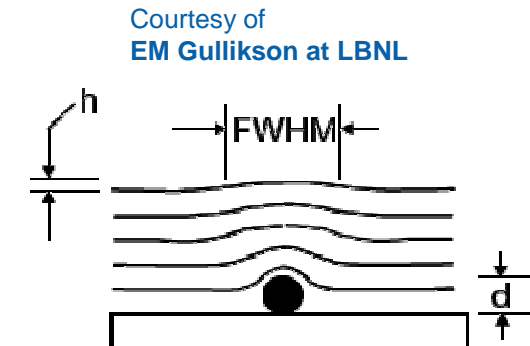
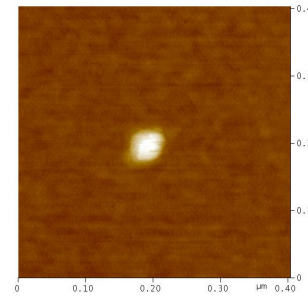
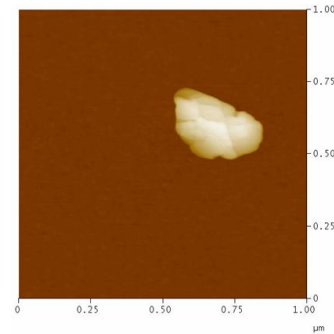
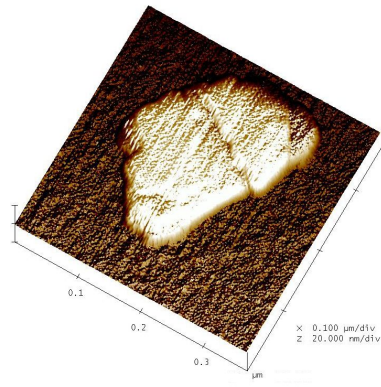


# What specific problems we want to address in the printability study?



- Light source
  - 13.4nm wavelength makes very sensitive to the phase of the defect on the blankmask.
- Defect on the blankmask
  - Pit, bump, particle, scratch, etc.
  - Profile and sidewall : Real or ideal profile
- Defect on the patterned mask
  - Absorber defect can be inspected and repaired.
- Resist
  - Resolution, LWR, diffusion length
  - We don't understand for resist effect with EUV light.

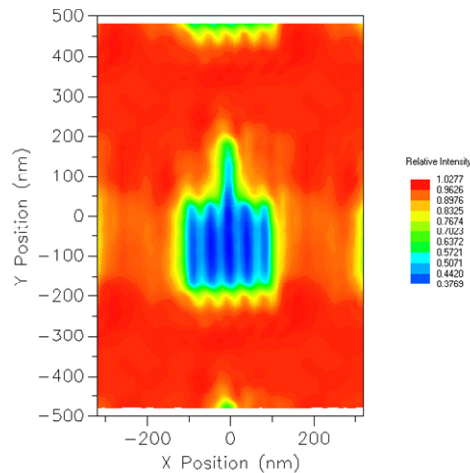
# What attributes of the test blanks and masks should be addressed?



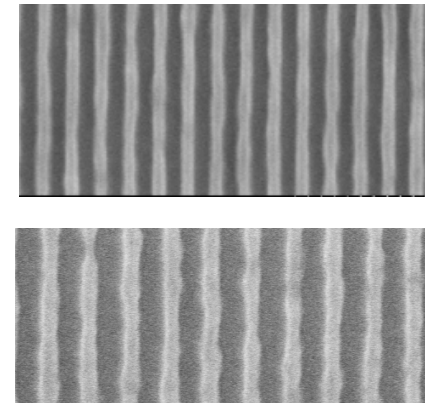
- Native defects come in different shapes and compositions.
- We need to understand which term is dominant factor for the defect printability.
- Size, height, shape, and location are all important to understand the defect printability.

Courtesy of Abbas Rastegar in SEMATECH

# Aerial Image Vs. Resist Image



Aerial Image simulation



Resist image

*S. Wurm, et al., Solid State Technology 52,  
(1 Feb 2009)*

- In EUVL, lots of contrast in the aerial image on the mask is lost in resist image considering very short wavelength of EUV to pattern size.
- Just aerial image simulation can't tell the real world on resist image.
- Resist parameter
  - Resolution : We have to understand of the minimum printability of defect
  - LWR : It is difficult to recognize if this is LWR or defect printability.
  - diffusion length : Defect will be smoothing after acid diffusion.
- We need to make precise resist model for EUV simulation.

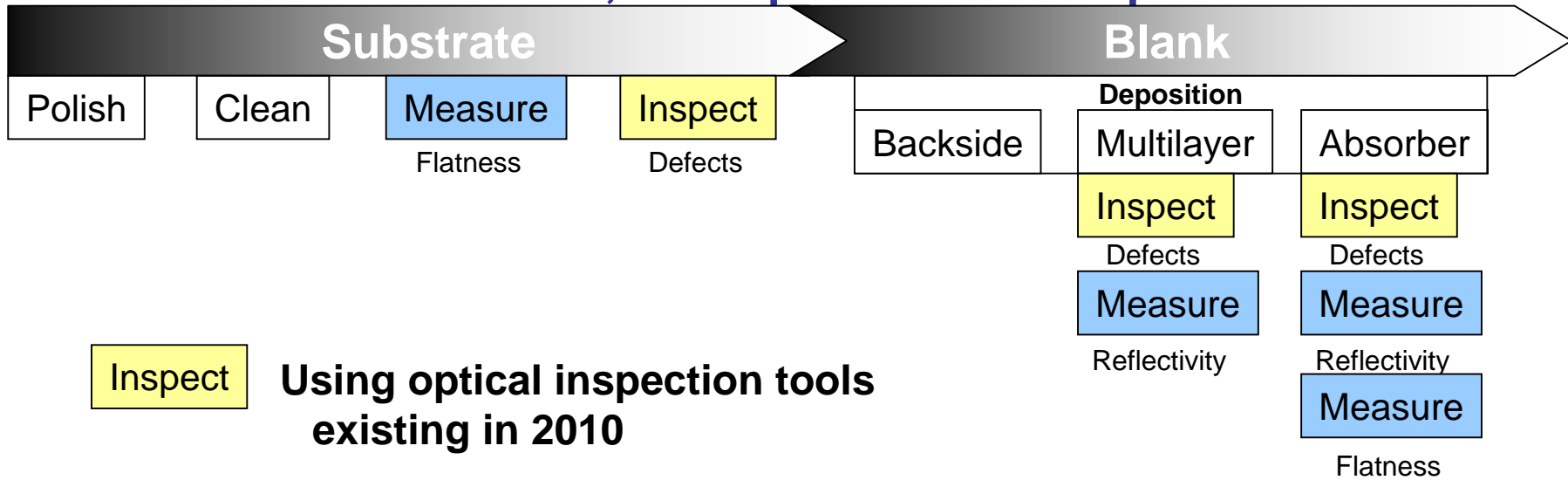
# The pros and cons of PDM versus native defects



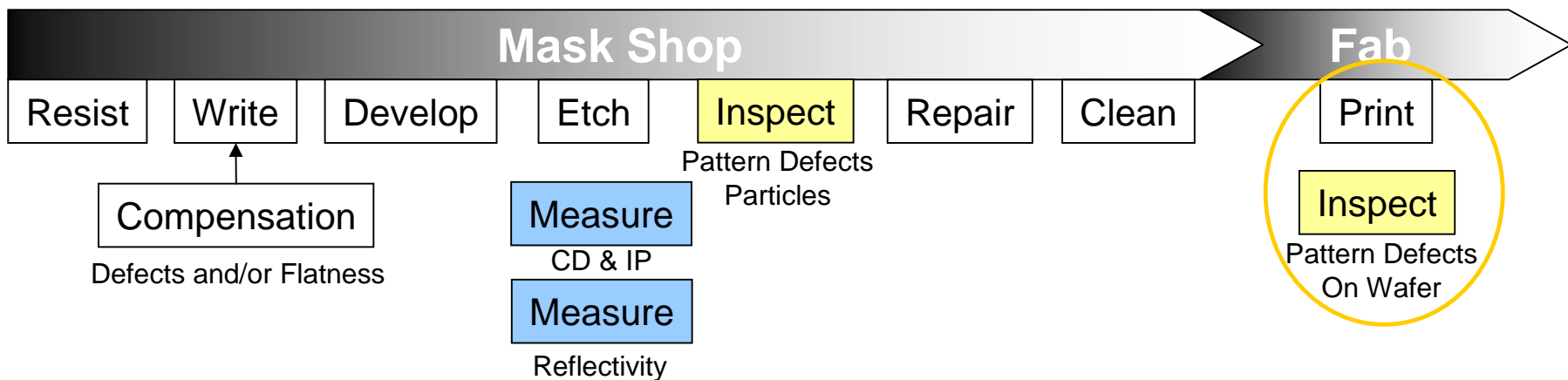
	Simulation	PDM	Native defect
Defect profile	Ideal	Ideal	Arbitrary
Effect on the mask	Aerial Image simulation	Need AIMS™	Need AIMS™
Effect on the resist	Need resist parameter	OK	OK
Pros	Early study of sub resolution limit today Set up the specification of defect	Easy to make various defects	Understand real world
Cons	Different simulation shows different results We need model to predict the real world	Hard to vary defect profile Can't represent real world	Hard to get various defects

# Likely mask flow for 2011 Pilot Line

## For device masks, not process improvement



**Inspect** Using optical inspection tools existing in 2010



# Conclusion



- There is little study on resist parameter in defect printability simulation. This makes difference in the experimental and simulation results.
- We have to choose the role of simulation and experiment carefully. Otherwise it will mislead the defect printability in EUV lithography
- We need to see the defects on the EUV mask. Required infra-structures are,
  - Substrate inspection
  - Blank inspection
  - Pattern mask inspection
  - EUV AIMS™
  - Wafer inspection