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**Title**

Analysis of Optics and Mask Contamination in SEMATECH EUV Micro-Exposure Tools

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**Author**

Wuest, Andrea

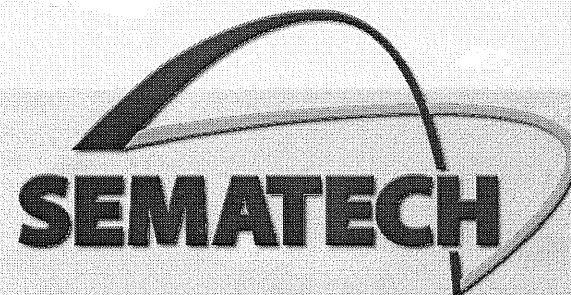
**Publication Date**

2008-08-29

# **Analysis of Optics and Mask Contamination in SEMATECH EUV Micro-Exposure Tools**

**IEUVI Optics Contamination/Lifetime TWG  
Sapporo, November 1, 2007**

**Andrea Wüest, SEMATECH  
E. Langer, AMTC  
C.D. Lin, SEMATECH  
Matt Malloy, SEMATECH  
Patrick Naulleau, LBNL  
Uzo Oko, AMD  
Erik Sohmen, Carl Zeiss SMT AG**



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# SEMATECH EUV Micro-Exposure Tools

- **SEMATECH North, Albany, NY**

- 0.3 NA
- Stand-alone

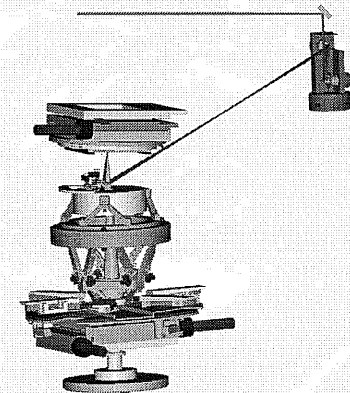
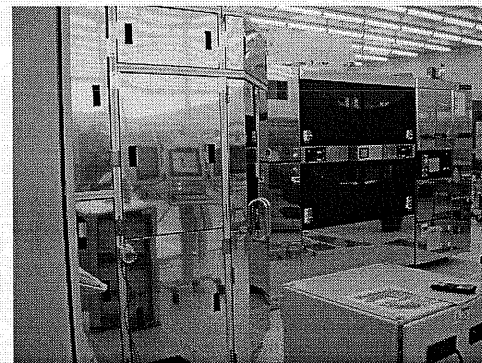
- **Lawrence Berkeley National Laboratory, Berkeley, CA**

- 0.3 NA
- Synchrotron-based

- **High-throughput resist testing tools provide leading-edge EUV lithography capabilities.**

- **Tools operations:**

- Albany: Mid 2005 - present
- Berkeley: Feb 2004 - present



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# Optical layout SEMATECH EUV MET

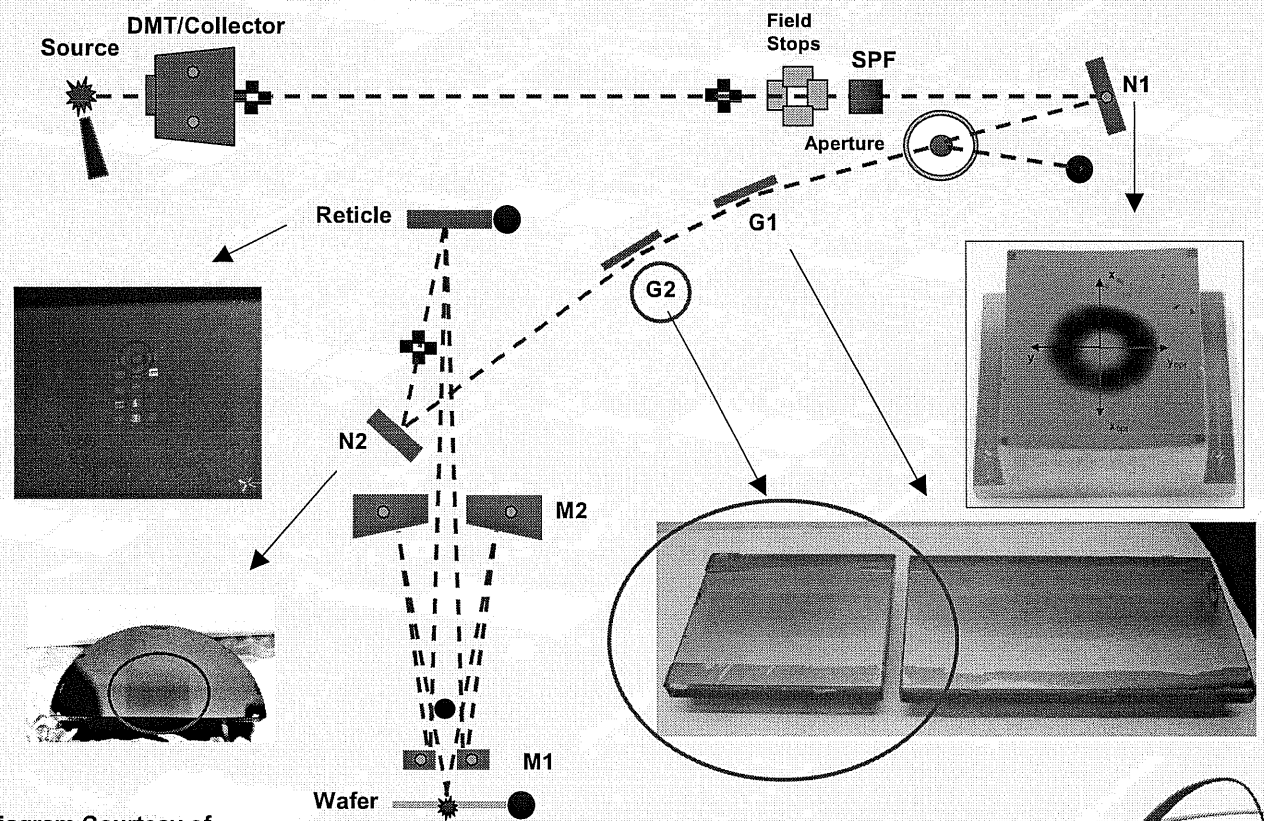


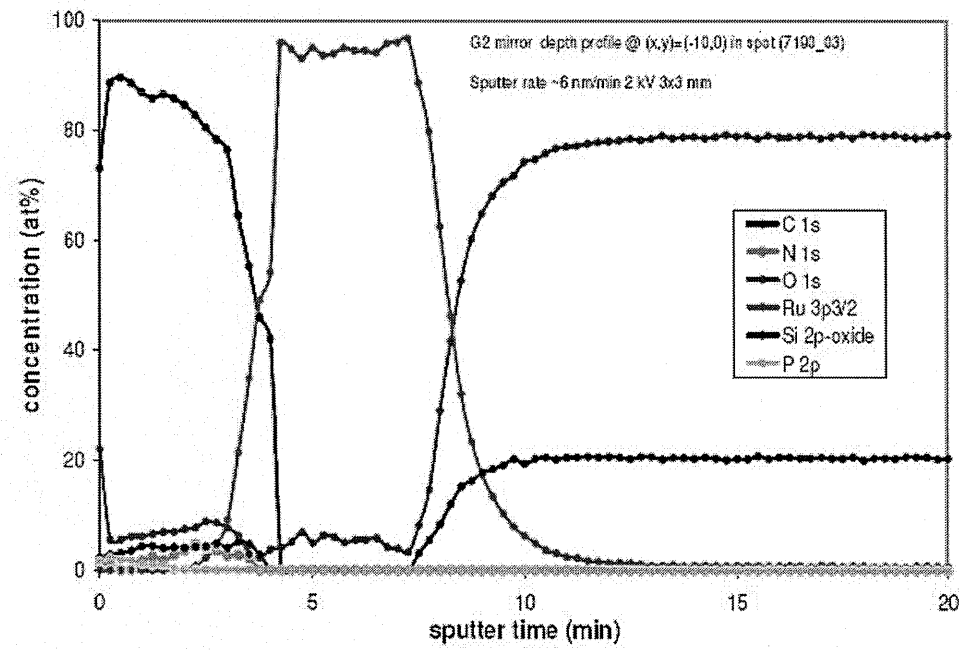
Diagram Courtesy of  
Matt Malloy, SEMATECH



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# Albany EUV MET – G2 Mirror

Measured depth profile of spot *inside* visible contamination.



	C	O	Si	P	N
%	74	20	2	2	1

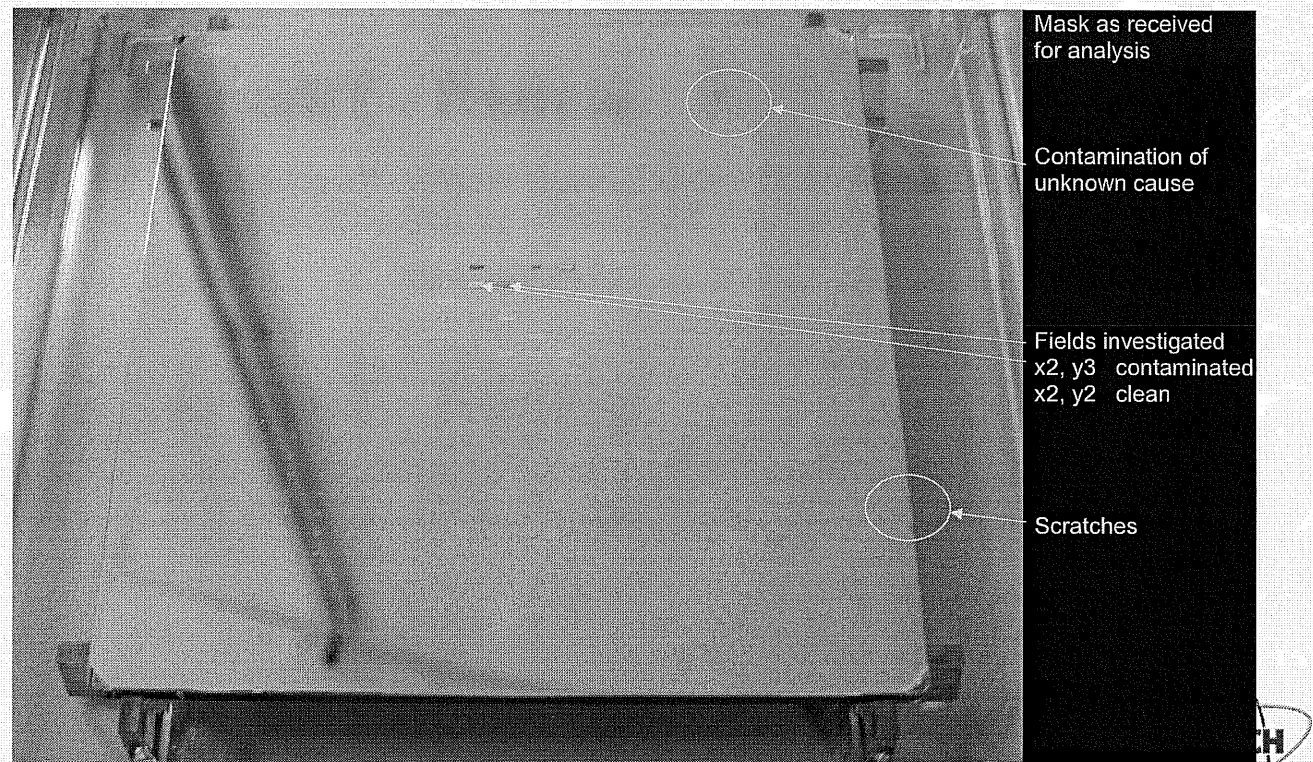
- **Carbon** contamination layer ~18 nm thick.
- **Phosphorous** present in large part of C contamination layer.
- **Silicon** present as SiO<sub>2</sub>, likely to originate from 'cracked silicones'.



## Berkeley MET - Reticle

- Analyze contaminants with different imaging, surface and chemical techniques
- Clean mask using standard cleaning protocol for EUVL mask

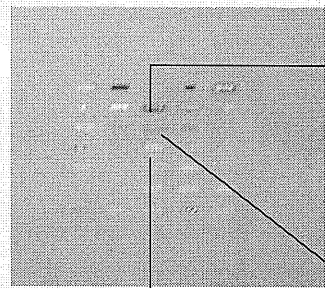
Optical picture





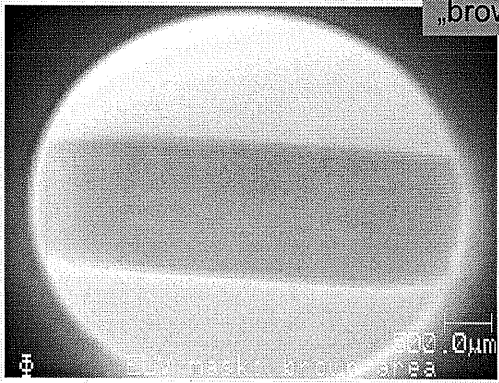
# Berkeley MET Reticle – AES Analysis

Measurement areas

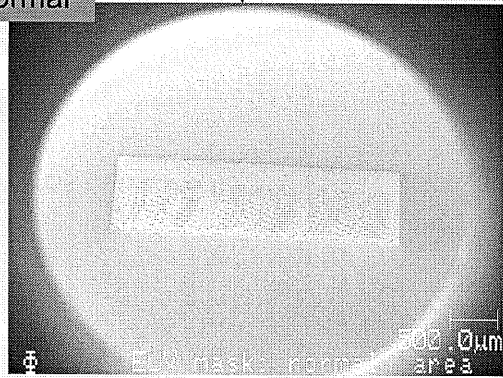


1 kV SE Imaging

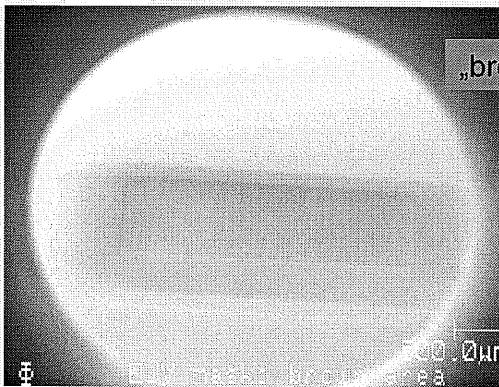
„brown“



„normal“

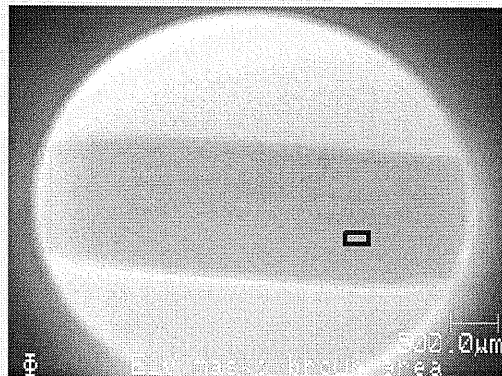
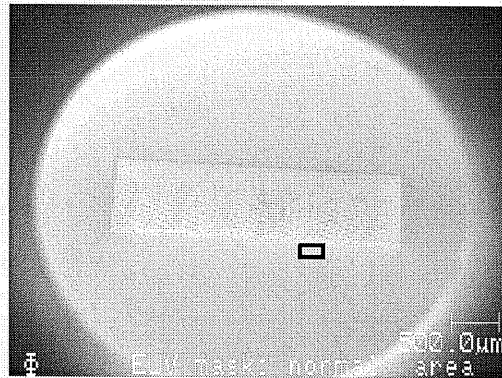


„brown“

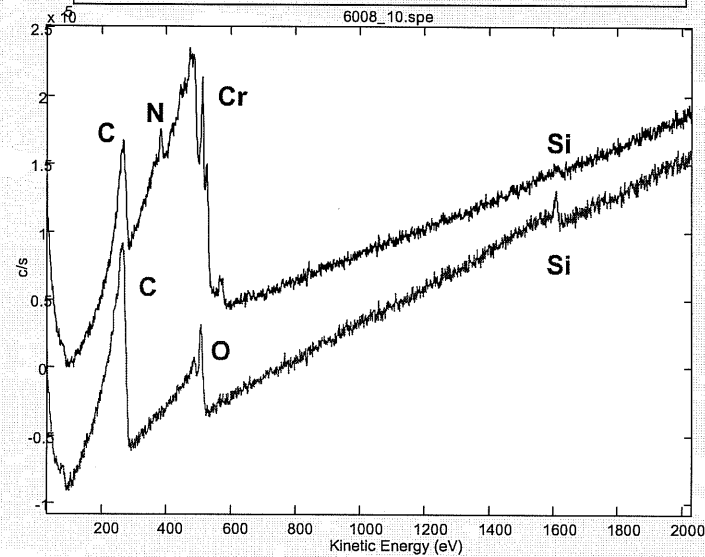


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# Berkeley MET Reticle – AES Results



AES survey spectra of the surface  
Measurement location



- C, O, Si detected in contaminated field.
- Cr, C, N, Si detected in clean field.
- Cr, N are from absorber layer.
- Si possibly from the Mo/Si multilayer, and buffer layer (SiO<sub>2</sub>).
- C (>6nm) is the contaminant.



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## Summary

- For both the Albany mirrors and Berkeley mask

Main contaminant is carbon.

Further analysis techniques will be applied.

Cleaning will be tested.

