EUV Lithography Programs at Albany NanoTech

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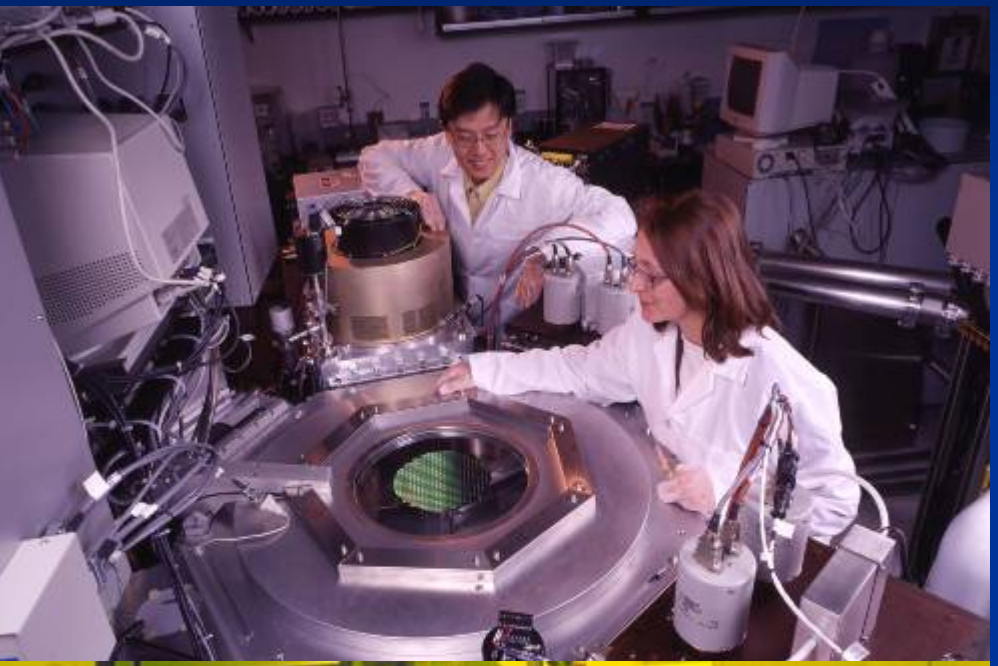
Outline

- Background
- Lithography Tools at ANT
- Facilities
- Programs
- Summary

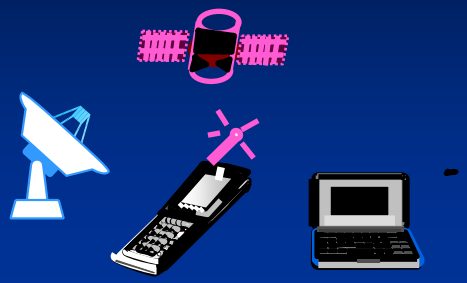
The NYS Center of Excellence in Nanoelectronics



- **The College for Nanoscale Science and Engineering: The first college in the nation for the education of the 21st century high tech workforce in nanosciences**

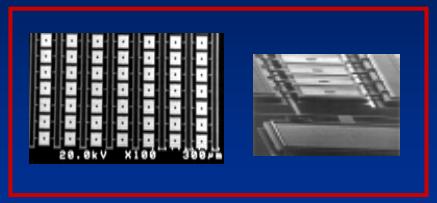
- **Albany NanoTech: National and international R&D resource for the academic & industrial nanoelectronics communities.**

ANT Technology Applications

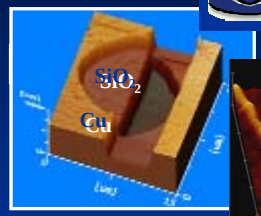


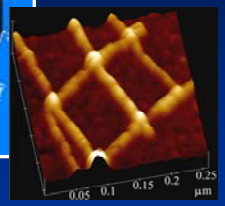
Pervasive Computing and Communication

Energy



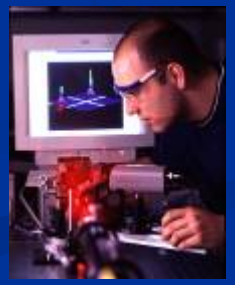
Nanophotonics





Advanced Devices & Nanomaterials

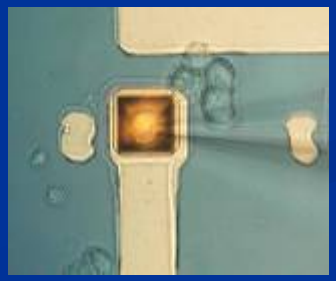
Economic Development



MEMS

Defense

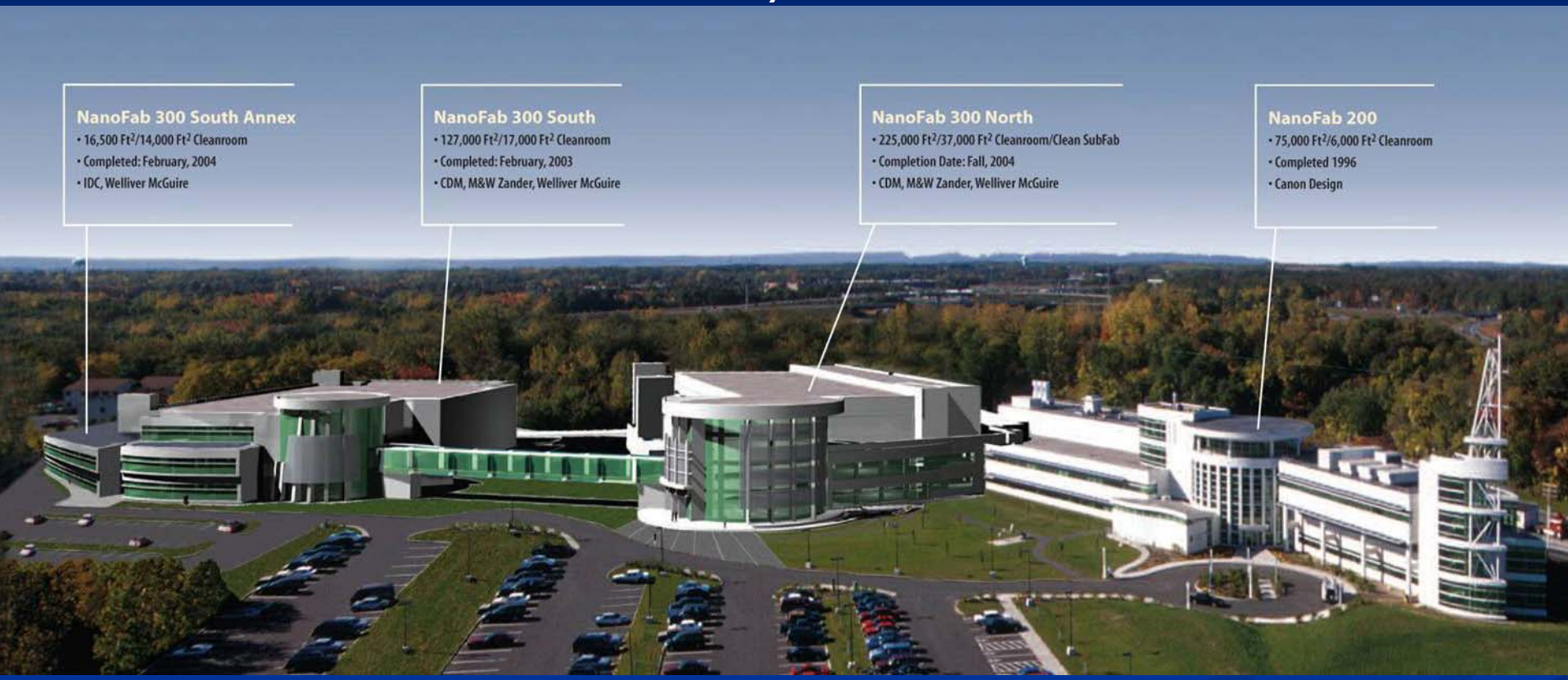
Biochips



Nanoelectronics Process Technology

State-of-the-Art Infrastructure

Shared-Use, Co-location Model



- 750,000 sq. ft cutting edge facilities (with 65,000 sq. ft 300 mm Wafer Cleanrooms).
- Over $2.4B in programs underway at the CNSE facilities (in addition to the brick and mortar above).
- Partners include SEMATECH, IBM, AMD, Micron, Infineon, AMAT, Tokyo Electron, ASML
- Over 600 personnel on site, 1600 people by end 2007 with current programs

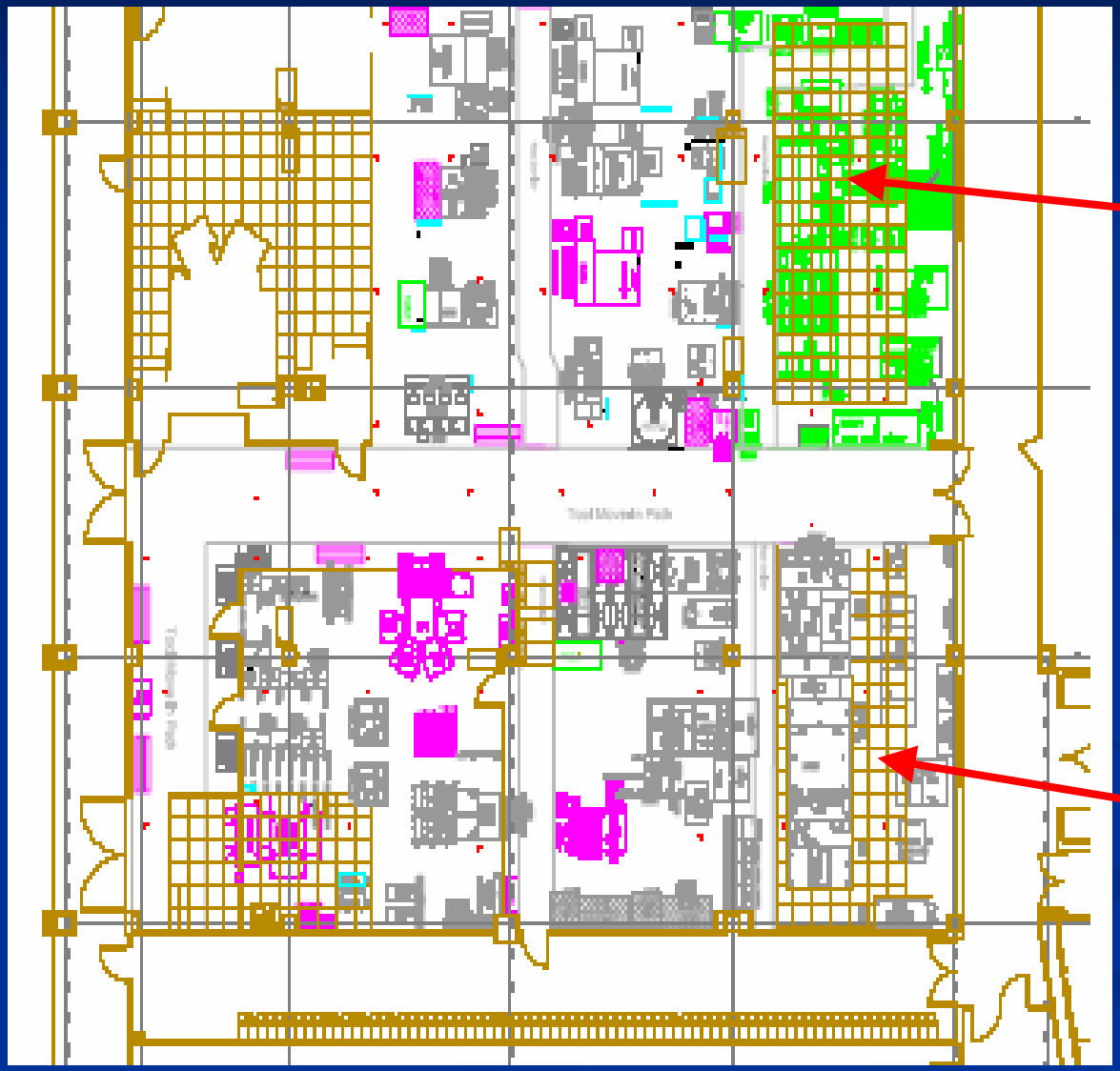
ANT's Strategic Partnerships with Industry

- SEMATECH North
  - $403M program announced 7/02
  - Focus on EUV Lithography Infrastructure
- TEL Technology Center America (TTCA)
  - $300M program announced 11/02
  - Focus on equipment and process technology R & D
- International Multiphase Prog. for Lithography Science and Engineering (IMPLSE)
  - $400M program with ASML, IBM & ANT, announced 1/05
  - Focus on 193 nm immersion and EUV
- IBM R&D Center
  - $450M program announced 1/05
- International Nanoelectronics VENTure (INVENT)
  - $600M program with IBM, AMD, Infineon, Micron & ANT, announced 7/05
  - Focus on 193 nm immersion and EUV
- AMAT-IBM-ANT
  - $300M program announced 9/05
  - Focus on materials, process, and equipment technology

Exposure Tools at ANT

Tool	Description
ASML AT:1150i	193 nm Immersion, NA 0.75
ASML AT:1200B	193 nm Dry, NA 0.85
ASML XT:1700i-P	193 nm Immersion, NA 1.2
ASML EUV Alpha Demo	EUV, NA 0.25

INVENT Cleanroom Layout



North

MSVII 157nm / ACT12 cluster

1150i / Lithius immersion cluster

NanoFab 300 North Cleanroom Layout

VHNA immersion cluster

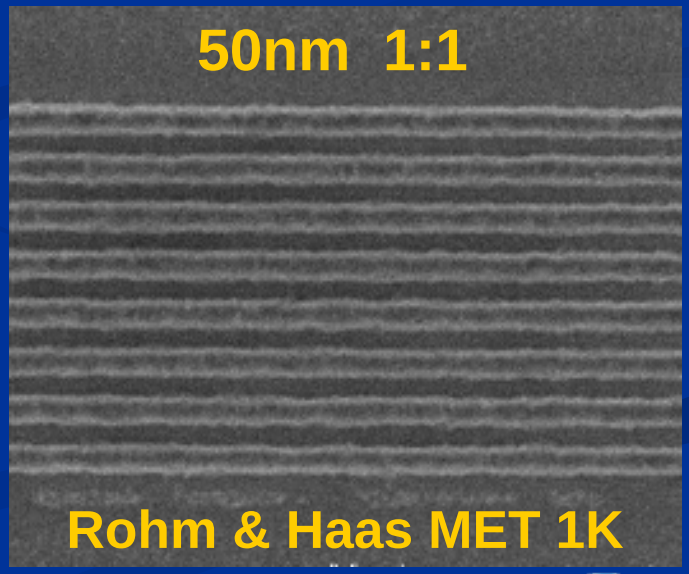
EUV alpha cluster

EUV Exitech MET

SEMATECH North EUV Resist Test Center

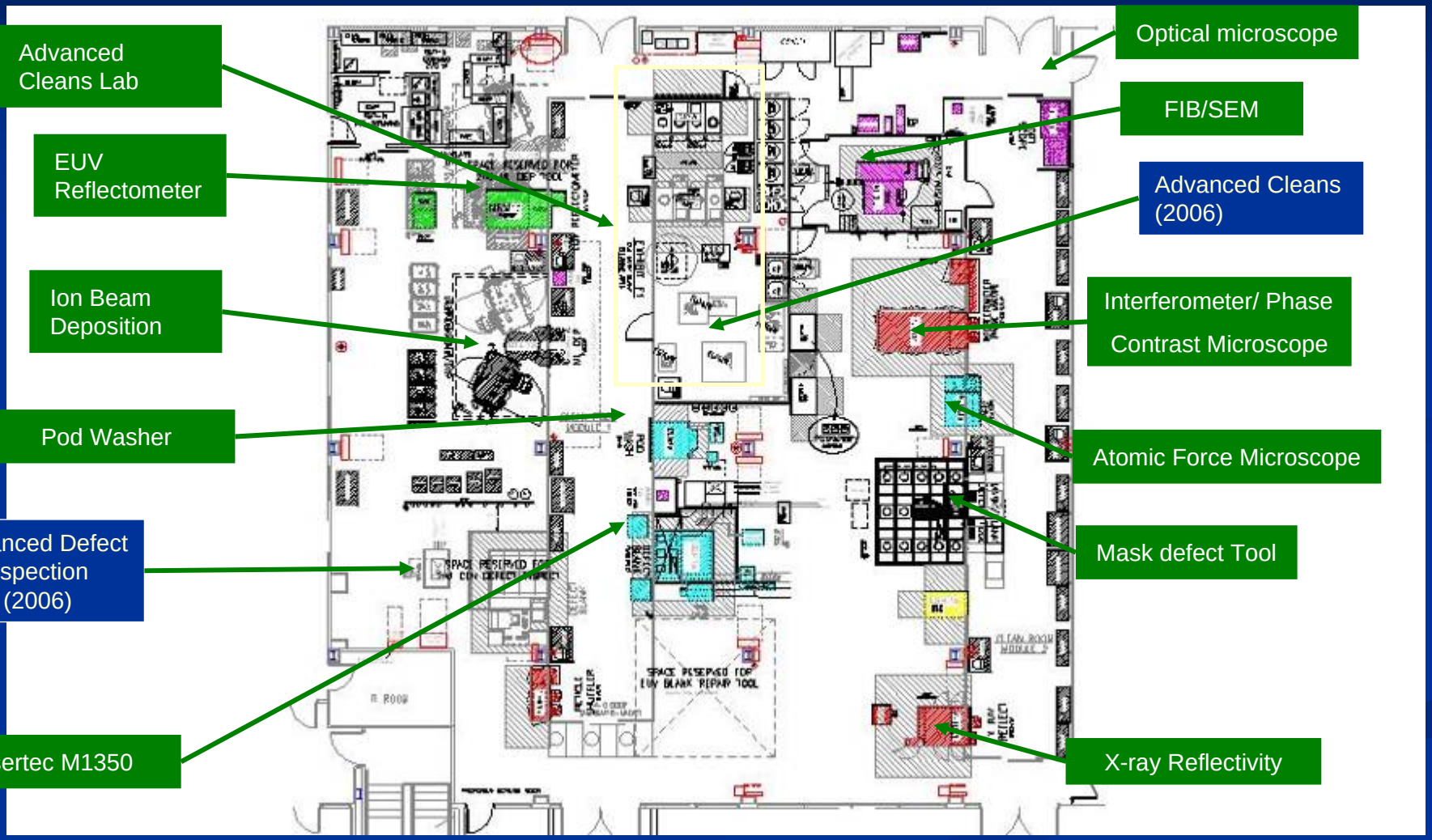
- The EUV Resist Test Center supports development of resists meeting production requirements. The EUV RTC can also support mask development
- The EUV RTC will accelerate EUV resist development by providing processing infrastructure to resist researchers.

Exitech MS-13 EUV Microstepper



SEMATECH North

EUV Mask Blank Development Center



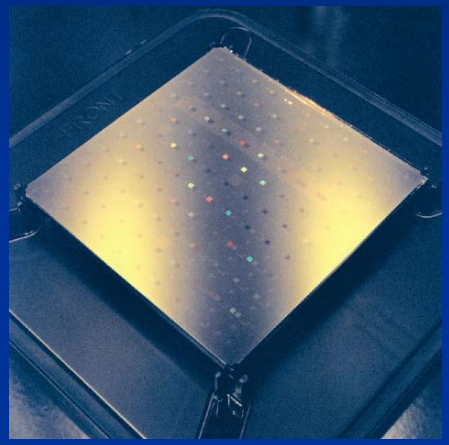
Installed | Ordered | Future

Total area = 655 m²

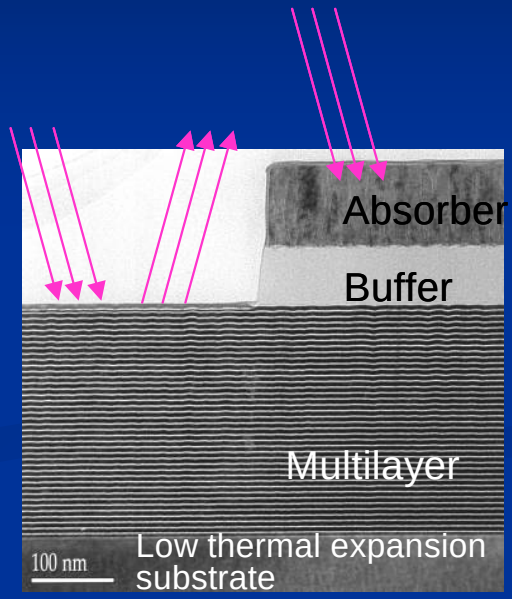
SEMATECH North

EUV Mask Blank Development Center

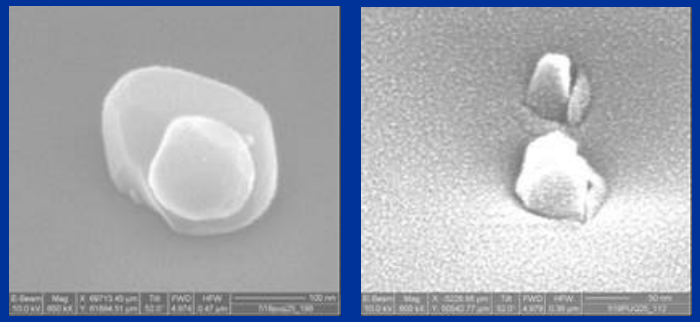
Accelerating the development of defect free EUV mask blanks in collaboration with commercial mask blank and equipment suppliers.



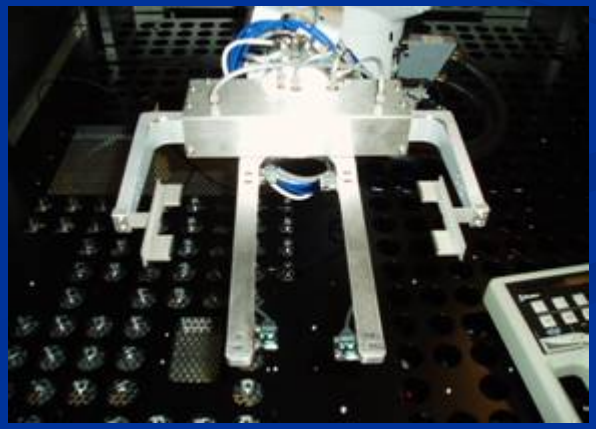
Patterned EUV mask



EUV mask structure



Typical EUV mask defects



Defect-free mask handling

Alpha Demo #1 Full-field EUV Scanner in Use by Q4 2006

Timing	Event
Q1 – Q4 2005	o Integration of Alpha Demo #1
Q1 2006	o First data on imaging, overlay, throughput
Q2 – Q3 2006	o Installation of tool in Albany
Q4 2006	o INVENT/IMPLSE commence development work

Alpha Demo #1 Full-field EUV Scanner Specifications

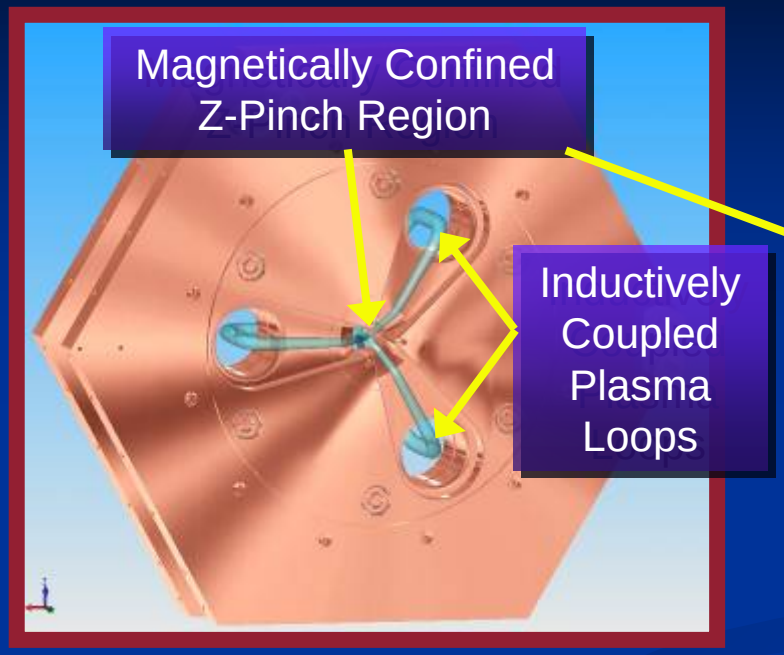
Parameter	Specification
NA Range	0.15 – 0.25
Imaging -- dense lines	40 nm
-- iso lines	30 nm
-- contacts	55 nm
Flare	16%
Overlay	15 nm
Throughput	6 wph

CDU = 10% resolution
Throughput is at 5 mJ/cm2

INVENT Program EUVL Plans

- Resists
  - Goal: Develop resist process for <=32nm node
  - Approach: Screening & characterization of promising commercial resists on Alpha Demo
- Reticles
  - Goal: Understand defect issues and lifetime under storage & exposure conditions
  - Approach: Establish methodologies for reticle cleans and metrology with suppliers
- Process
  - Goal: Assess EUVL process technology including RET & tool performance on imaging & overlay
  - Approach: Integrate EUVL tool in process flow
- Tool
  - Goal: Determine EUVL Alpha Demo tool performance and reliability
  - Approach: Work closely with ASML to meet INVENT member-specified tool performance

CNSE takes delivery of compact high power EUV source for advanced EUV research



EUV Source Schematic

View of visible light from Z-Pinch

- Electrodeless Z-Pinch™ EUV Source
- 10W in 1% BW (20W in 3.5% BW)
  - Continuous into 2π with Xenon
- 1 kHz repetition rate (controllable)
- Controllable source size and power

Compact Source Programs

- Development of actinic metrology methods
- Exposure induced resist outgassing characterization
- EUV mask imaging microscope
  - High resolution and stepper emulation modes
  - Mask contamination in the presence of introduced hydrocarbons
    - Effect of contamination on mask performance
    - Effectiveness of mask cleaning procedures

ANT Strategy to Address EUVL Critical Issues*

1. Availability of defect-free mask.
   - SEMATECH North MBDC
   - Mask Imaging Microscope R&D using Energetiq source
   - INVENT & IMPLSE program activities
2. Lifetime of source components & collector optics.
   - INVENT & IMPLSE program activities
3. Resist resolution, sensitivity & Line Edge Roughness
   - SEMATECH North RTC
   - INVENT & IMPLSE program activities

* Source: 3rd International Extreme Ultra Violet Lithography Symposium

Summary

- Albany NanoTech has six ongoing industrial consortia and 65,000 square feet of 300 mm wafer cleanroom.
- Albany NanoTech will take delivery of a high NA 193 nm immersion system and an EUV alpha tool in 2006.
- Albany NanoTech consortia and infrastructure have been developed to address lithography and other processing technologies to prepare for the 32 nm technology node and beyond.

We hope to see you all in Albany soon!

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Linda Somerville
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