IEUVI Resist TWG

Update IMEC

M. Goethals

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Outline

Contact information Interference lithography at PSI

Resist screening result with interference lithography

Up-date Excite program/follow up project

IMEC IIAP program

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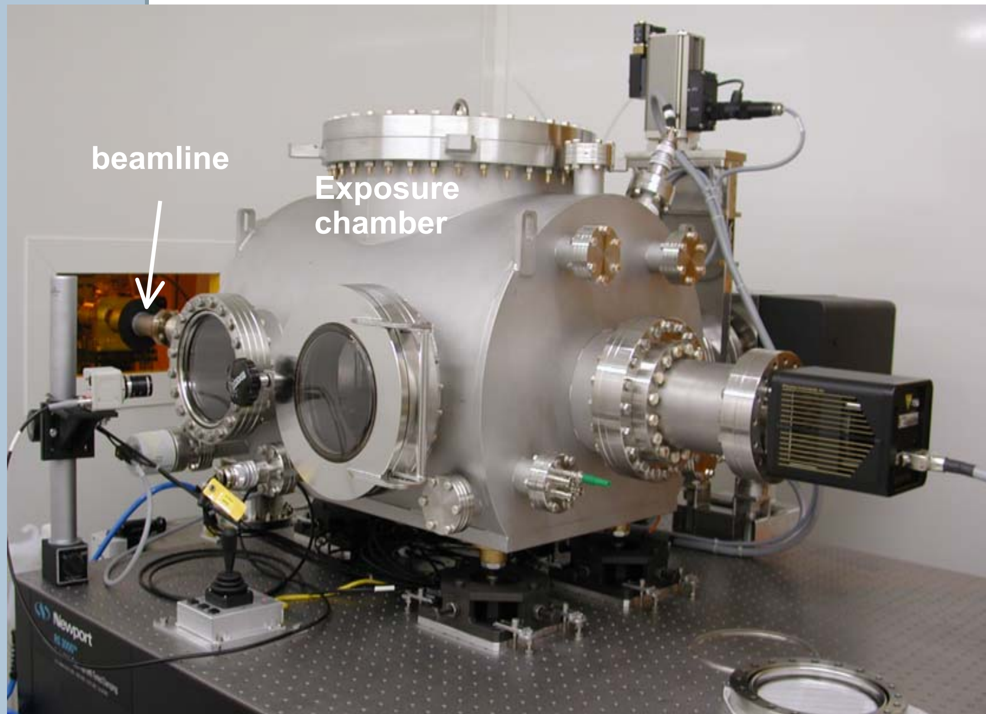
The Exposure System at PSI



- Located in class 1000 clean room
- Magnetically levitated turbo pumped
- Ion pump for extra quiet operation
- Vacuum during exposure ~10^{-6} mbar

- Fast in-vacuum beam shutter for exposure dose control
- Flux measured before each run; beam constant and stable thanks to “top-up” synchrotron operation
- Sample stage for 4, 5, 6 & 8” wafers
- Diagnostic elements for beam observation and flux measurement

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SWISS LIGHT SOURCE SLS

PSI interferometer access

Contact : Harun H. Solak

E-mail: *harun.solak@psi.ch*

Adress : *Laboratory for Micro and Nanotechnology*

Paul Scherrer Institute

CH-5232 Villigen PSI, Switzerland

Cost

Pay per shift (8 hours)

Price : 8000 ~CHF/shift (6100USD; 5150EUR; 720.000JPY)

Customer delivers the wafers to PSI
4-8 wafers can be exposed in one shift

http://lmn.web.psi.ch/ http://sls.web.psi.ch/view.php/beamlines/xil

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Practical way of working IMEC

Primed wafers (200mm) are sent to PSI

Processing at PSI

- Processing is manual, no wafer coat/develop track
- No filtration available, not in exposure area, not in process area
- Coating and soft-bake in process lab
- Transfer of wafers in standard or filtered wafer box to synchrotron
- Post-exposure hot-plate available next to the exposure chamber (limit PED effects)
- Transfer of wafers to process area
- Manual development and rinse on a spinner

Possibility for inspection of wafer under optical microscope (inspect presence of grating pattern)

Send wafers back to IMEC for evaluation

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Proposal for Control of Amine Contamination at PSI

- Possible routes to Amine contamination:
  - Post-coat delay (not sensitive for most resists)
  - During exposure (not for EUV; exposure in vacuum)
  - After venting of chamber, before PEB (very short delay, venting with clean nitrogen)
  - During PEB (most likely)
- Quick-and-Dirty method to reduce contamination
  - Apply nitrogen curtain over PEB hotplate (Effects on temperature and moisture? Use water bubbler?)
  - Initial results available
- More elegant to apply chemical filtration to entire exposure cleanroom
  - Use existing air flow for HEPA filters
  - Apply chemical filters after HEPA filters Four HEPA filters are present so four chemical filters will be needed (~650 Euro/filter)
  - Attractive 'upgrade' of PSI exposure room for More Moore or ExCITe-2 or for other customers ?
    Funding required !!

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Recent screening result of Chemically amplified resist

Roel Gronheid,M. Goethals, F. Van Roey

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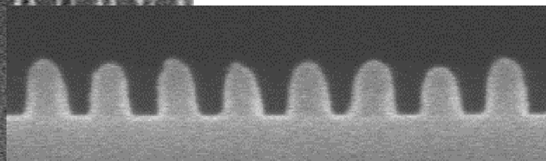
Result at TWG,nov 2005

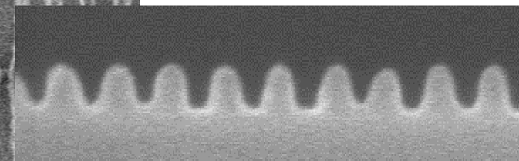
Chemically amplified resist

EUV-25: E_{size} ~7.5mJ/cm^2

40nm



32.5nm



30nm

25nm

	EUV-6	EUV-25
E_{size}	11mJ/cm^2	7.5mJ/cm^2
Exp. Lat. (50nm)	18%	11%
LER (3σ)	7.1nm	5.7nm
Resolution	32.5nm	32.5nm

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Recent resist screening result

Interference lithography

	Resist EUV-30
Resolution 1:1	32.5nm (X-section)
	25nm (top/down)
resolution contacts	not tested
resolution isolated line	NA
Depth of Focus	NA
Photospeed	12 mJ/cm2
Line Edge Roughness	6 nm (3 sigma)

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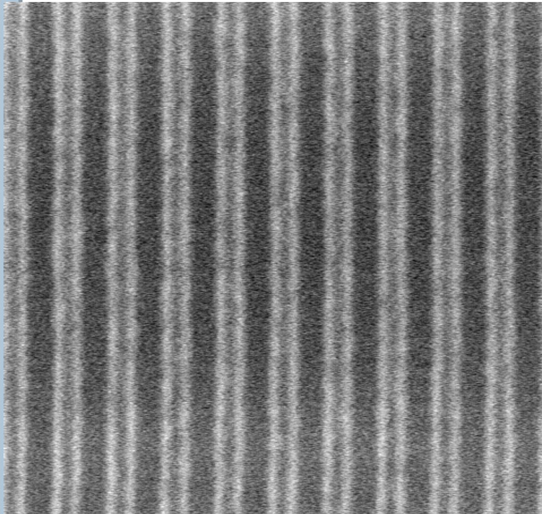
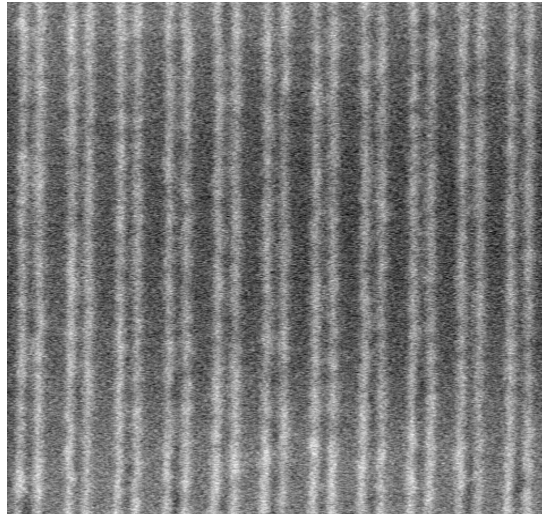
Resolution with IL
resist EUV-30

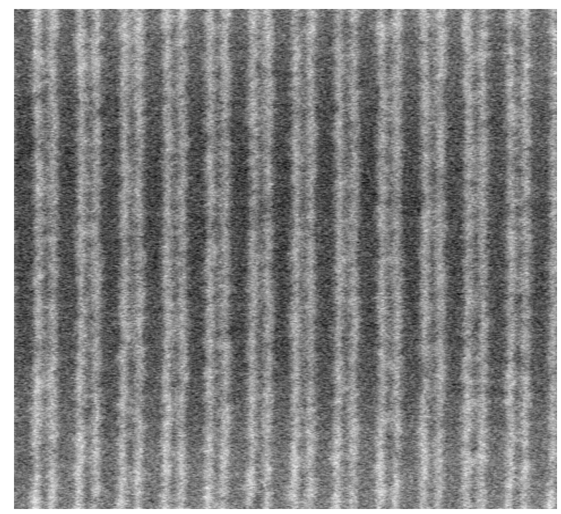
50nm



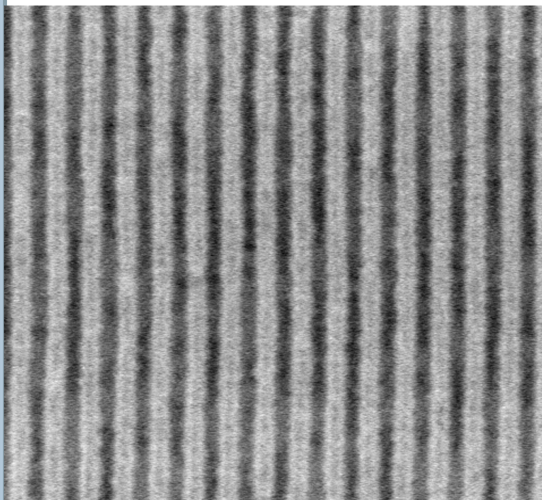
45nm



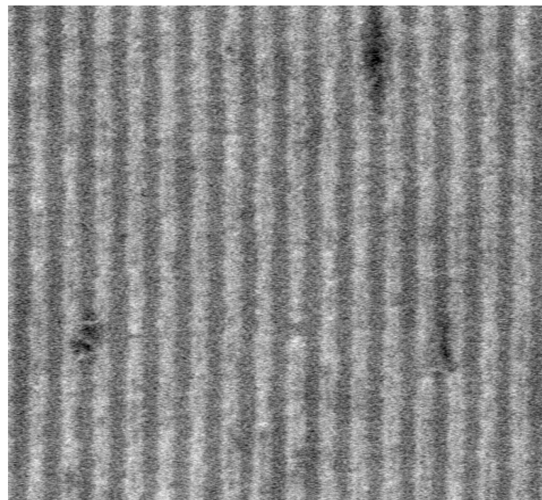
40nm



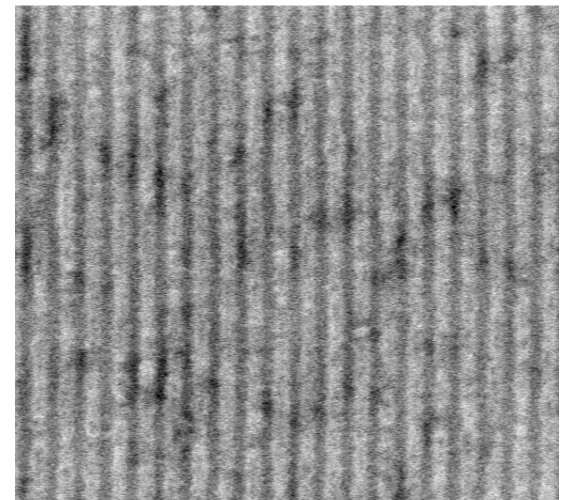
32.5nm



30nm



25nm



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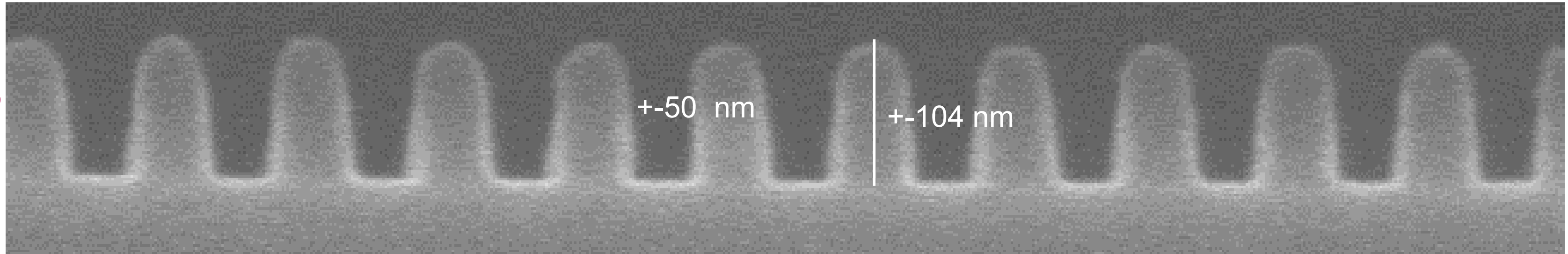
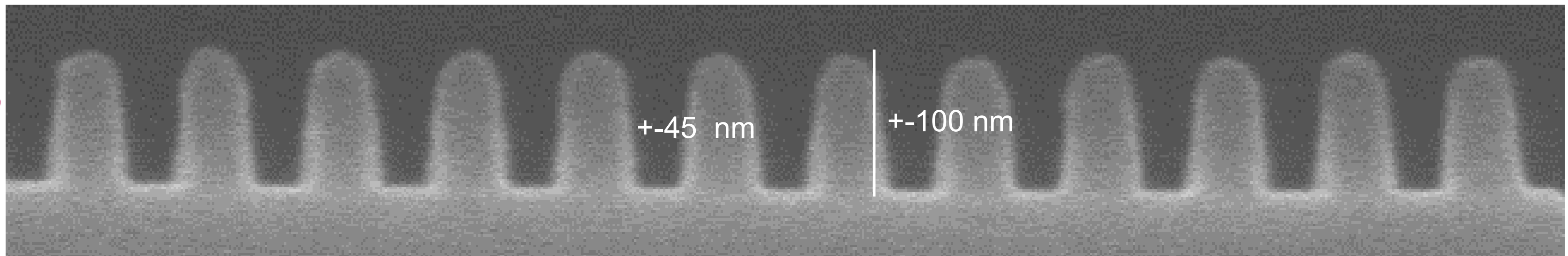
X-section pictures

resist EUV-30, 100nm resist thickness

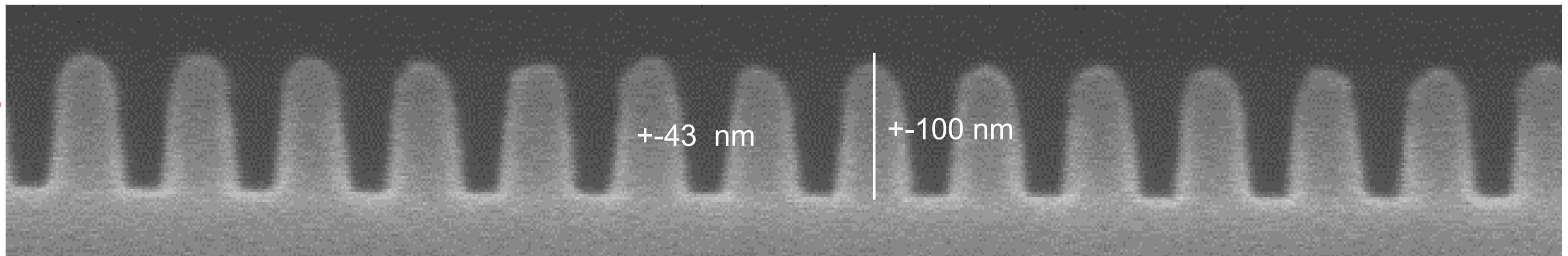
50 nm



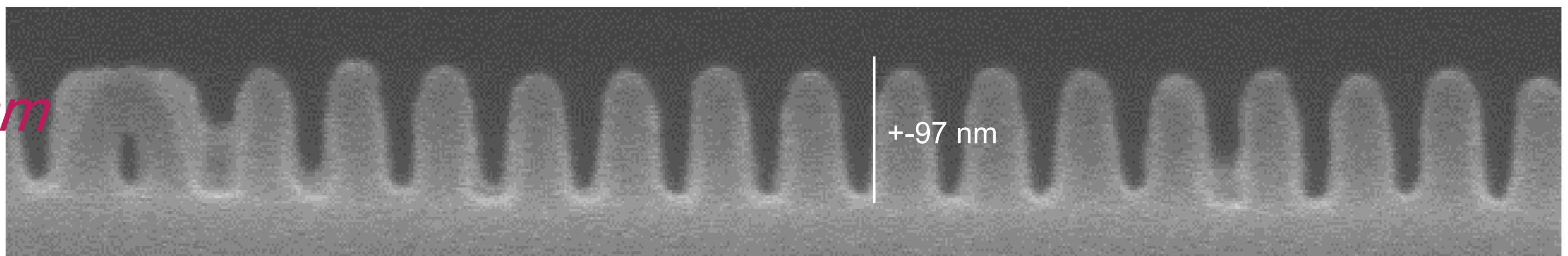
45 nm



40 nm



32.5 nm



Dose 12mJ/cm²

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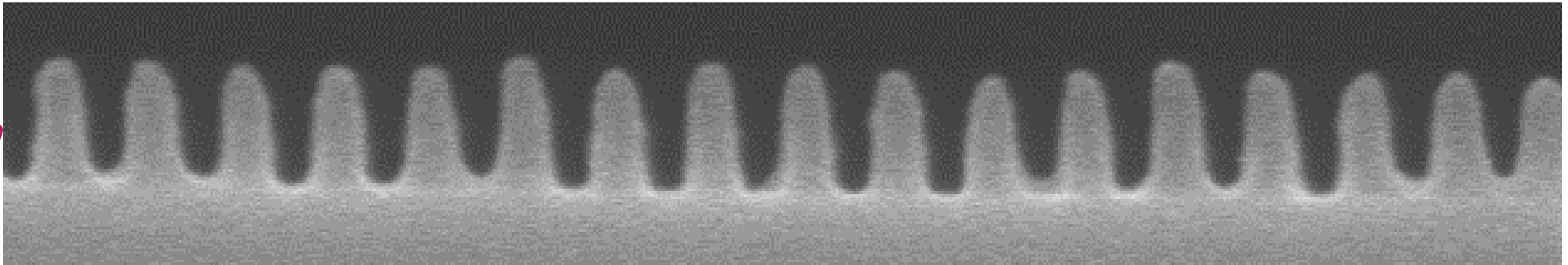
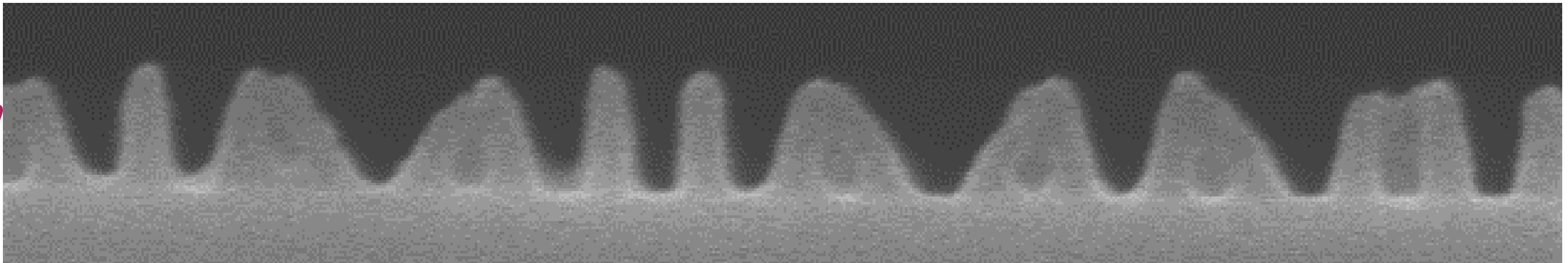
X-section pictures
resist EUV-30, 100nm resist thickness

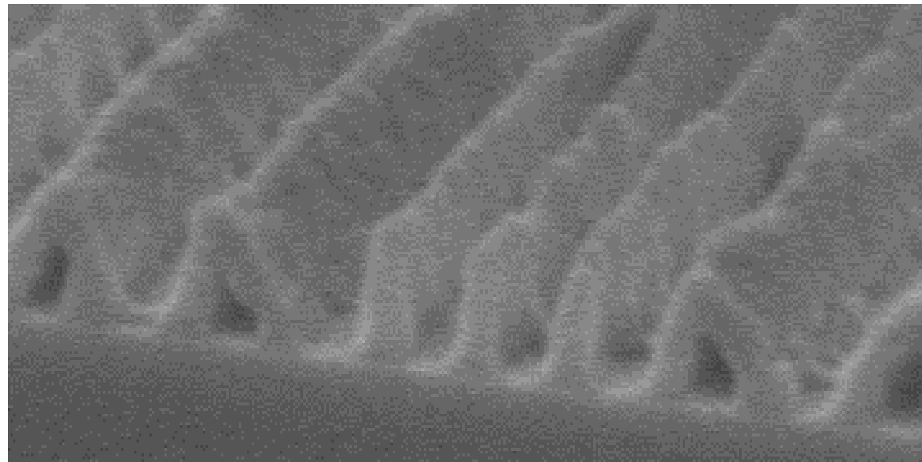
At increasing dose : pattern collapse

32.5 nm



32.5 nm





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Extreme UV Lithography

February 2006

M. Goethals, K. Ronse

2006 : EUV full field scanner introduction
2 ASML EUV ADT to ship in Q2

Timing

- Delivery to IMEC Q2 2006
- Operational Q4 2006

Work horse to drive further infrastructure development

- Resist development and integration
- 4x full field EUVL reticles

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IMEC EUVL program

Overall objective

To provide solutions for **32nm EUV lithography** and **patterning** by studying and understanding the key challenges and develop ways to overcome them.

Scope

EUVL **resist** and integration feasibility

EUVL **reticle** defect printability and handling

EUVL alpha **tool assessment**

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Selected projects

EUV resist and integration feasibility

1. Fundamental resist limitations
2. Resist benchmarking
3. Full field scanner access to resist vendors

EUV reticle defect printability and handling

1. EUV long term reticle degradation (due to C/O contamination)
2. (Programmed/repaired) Reticle defect printability study

EUV Alpha demo tool assessment

1. Long term EUV scanner monitoring
2. Fingerprint determination in terms of imaging and overlay
3. Flare compensation testing

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EUV resist and Integration feasibility

EUVL resist benchmarking

- Benchmarking of EUV chemically amplified resists and alternatives resist approaches from resist suppliers on the ADT tool at IMEC
  - Definition of benchmarking methodology and resist specs
  - Identify promising candidates for integration
- Set-up information exchange with other consortia (Sematech,…)
  - resist performance on MET tools and comparison with ADT
- Outgassing
  - Resist to meet ASML's outgassing specs
  - No outgassing set-up planned at IMEC
  - IMEC plans to rely on external source for outgassing data

Fundamental resist limitations study

- Identify limitations
- Explore solutions around them

Full field scanner access to resist vendors

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