Technology Steps to the Pilot Production of EUV Mask Blanks in 2005

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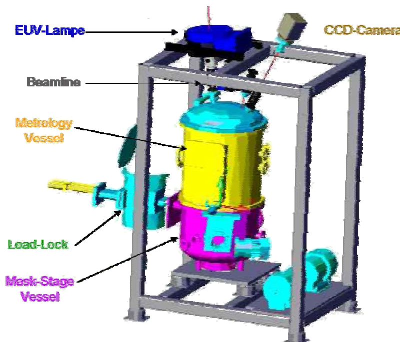
Schott Lithotec supports EUVL introduction with a broad range of products

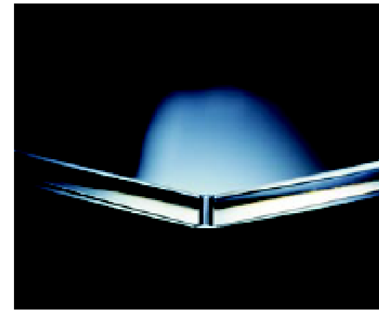
Litho tool Structures & Metrology

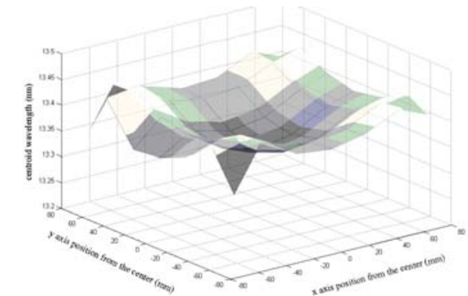


- Reticle and wafer stage ultralight weighted components
- LTEM mirrors substrates for optics
- Large scale LTEM boxes and structures

- Co-operation with AIXUV for development of the 1st high speed EUV reflectometer
- Pilot operation to high accuracy flatness measurement

Substrates & Mask Blanks





- Low Defect LTEM mask substrates
- Evaluation of flatness correction technologies

- Extremely uniform EUV multilayer coatings
- Low defect dry-etch optimized buffer and absorber

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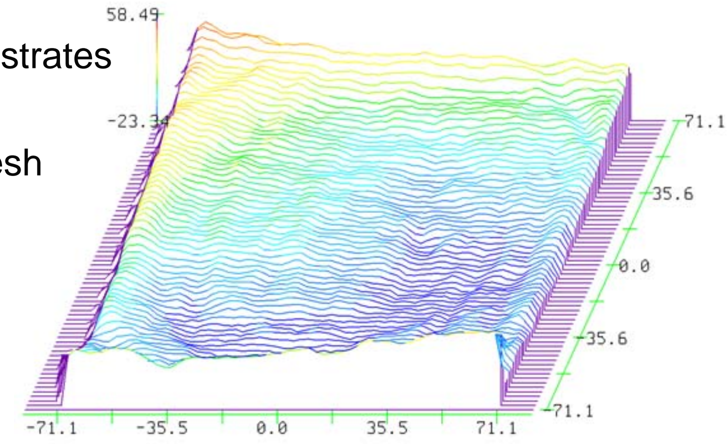
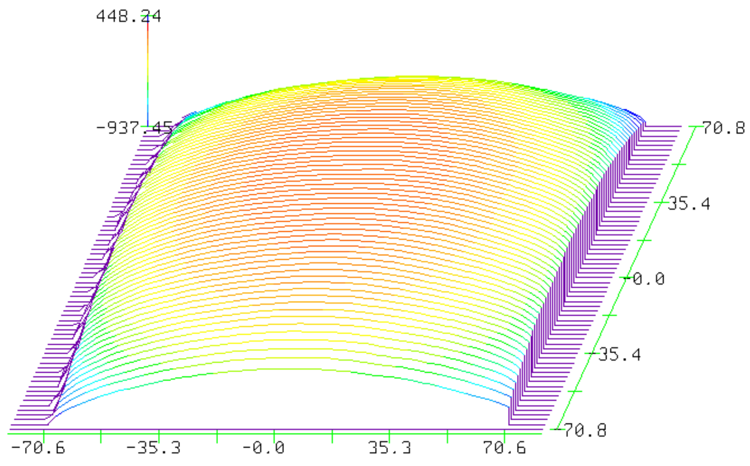
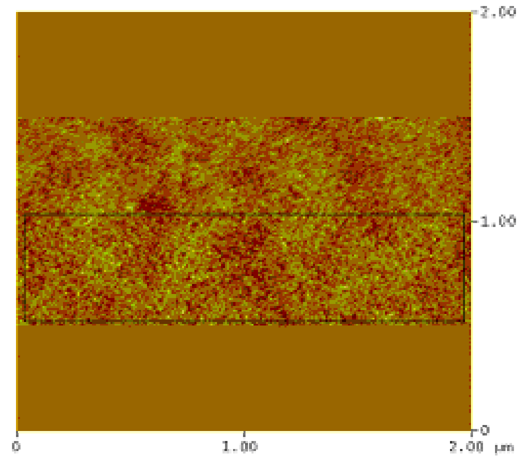
Ultra flat substrates available next year

- Flatness Correction below 100 nm P-V achievable for LTEM substrates
- Unchanged roughness after flatness correction and surface refresh
- LTEM 0.4/1.6 µm flatness grade under production





< 1.4 µm backside



Rms (Rq)	0.219 nm
Mean roughness (Ra)	0.175 nm
Max height (Rmax)	1.788 nm

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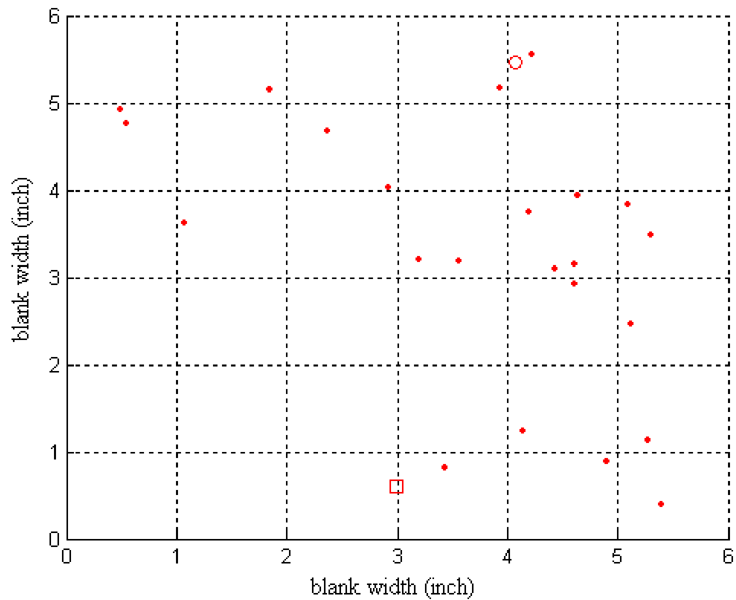
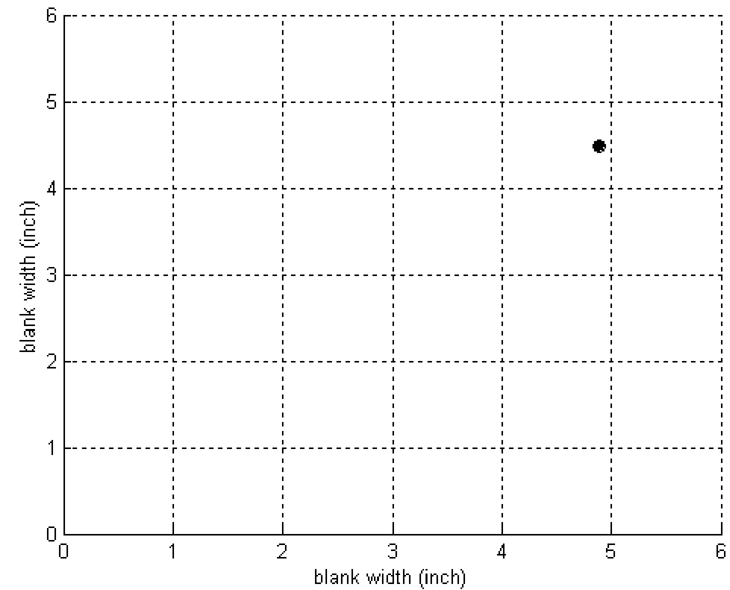
LTEM substrate defect level comparable to quartz

- Surface refresh re-establishes defect level after correction
- 1 defect larger than 0.2 µm for LTEM substrates





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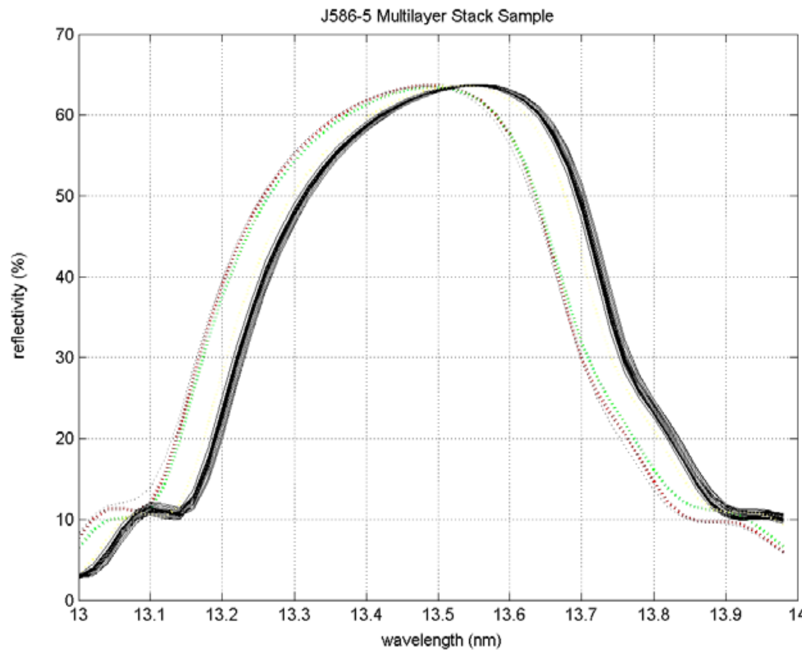
Low defect multilayer with excellent optical performance

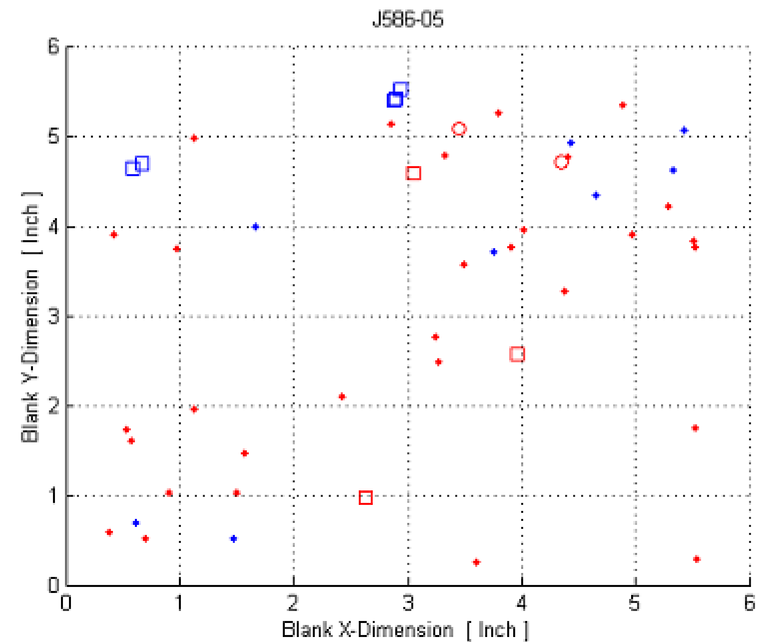
- Optical performance

R_{mean}	63.65 %	(3σ = 0.20 %)
λ_{50}	13.48 nm	(3σ = 0.06 nm)
FWHM	0.52 nm	(3σ = 0.004 nm)

- Low defectivity

  0.16 def /cm² @ 200 nm /cm²





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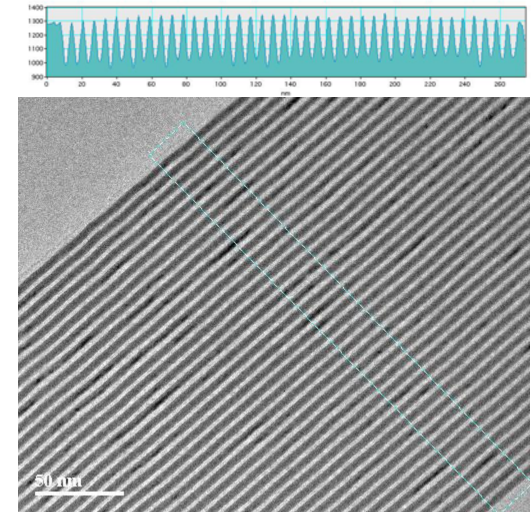
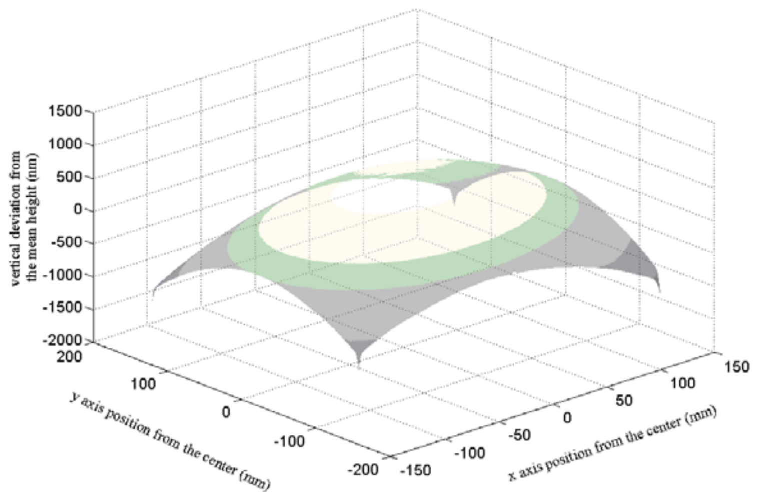
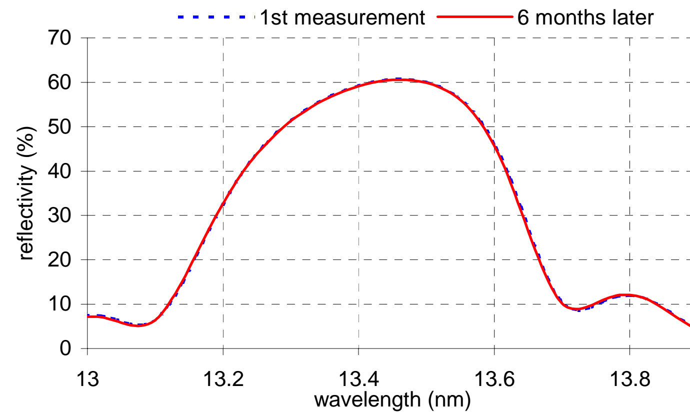
- **Good learning for multilayer properties**
  - Stress of the multilayer down to –350 MPa
  - Highly periodic deposition process
  - Long time scale stability







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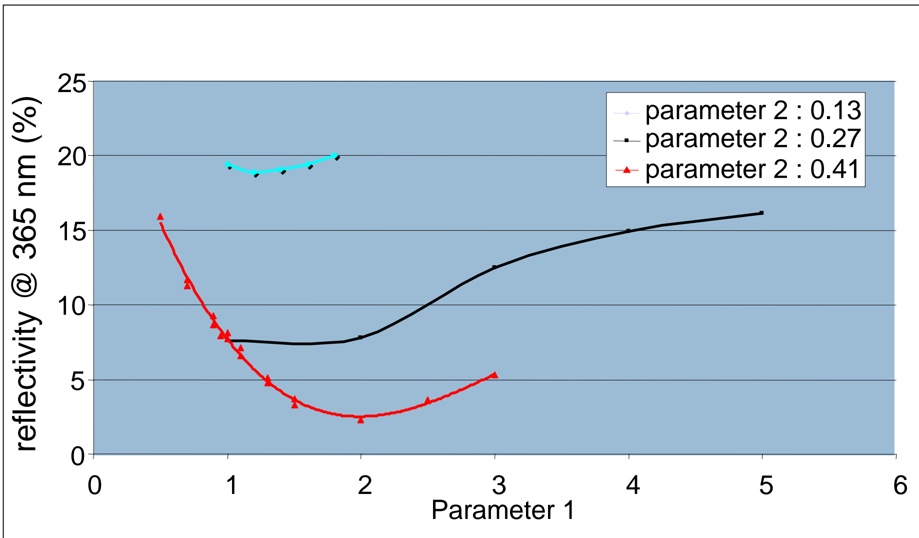
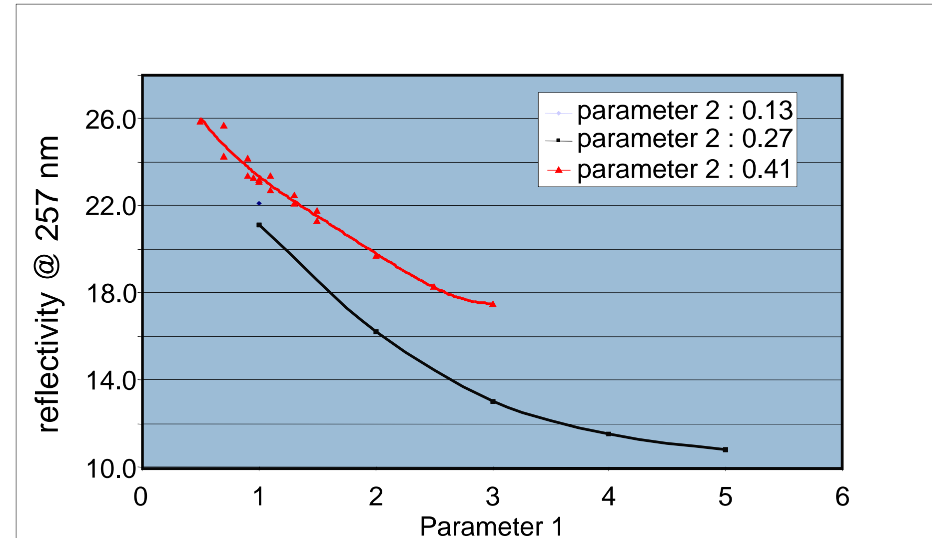
Our new alternative absorber material (AAM) is suitable for today and future inspection wavelengths

- Control of the optical parameters by layer structuring



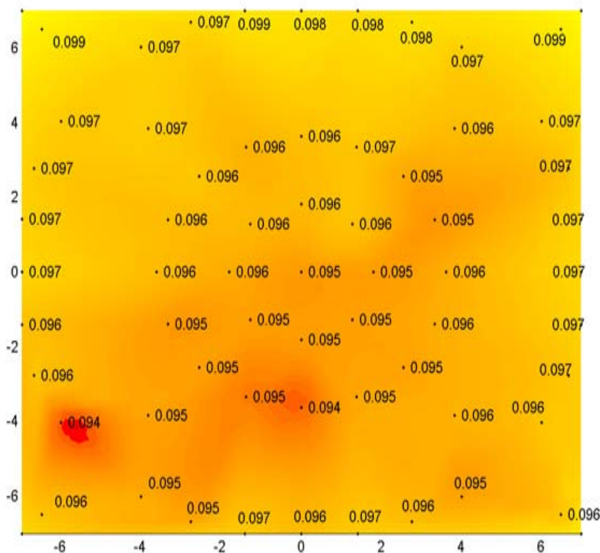


production-type and research grade wavelengths
can be used to inspect our masks

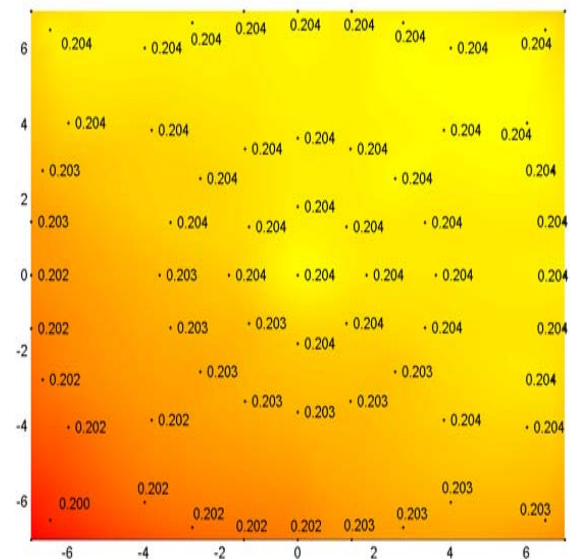
Uniformity of the absorber stack meets the demands of tomorrow already today

- Thickness uniformity of our SiO_2 buffer layer : 0,12 % (3σ)
- Thickness uniformity of our AAM system : 0.09 % (3σ)
- Optical response for both inspection wavelengths – uniformity better than 0.04 % (3σ)

3σ = 0.04% @ 365 nm



3σ = 0.03% @ 257 nm



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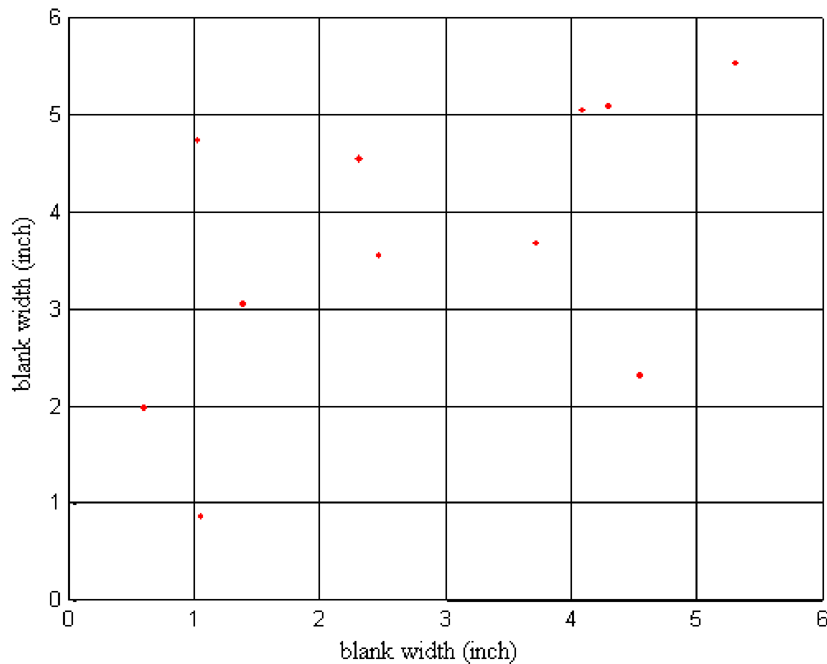
Defect level for absorber comparable to high end Cr quality

- Defects were at 0.3 def./cm²
- We recently achieve this new AAM sample :



14 defects > 0.2 µm PSL
=
0.06 def. /cm²

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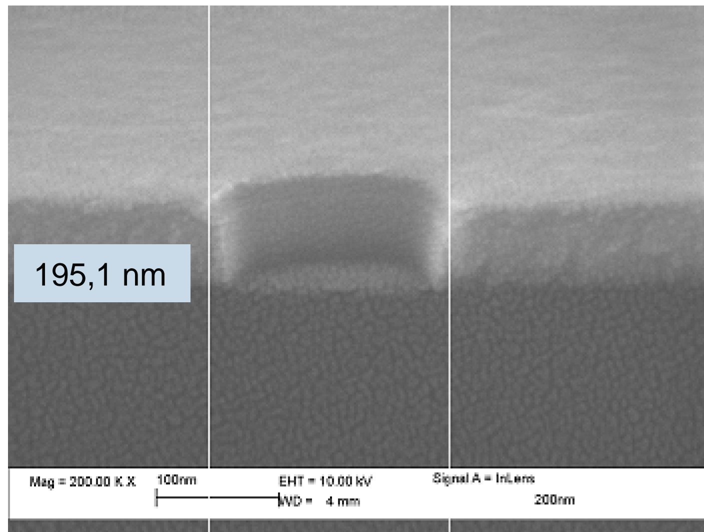
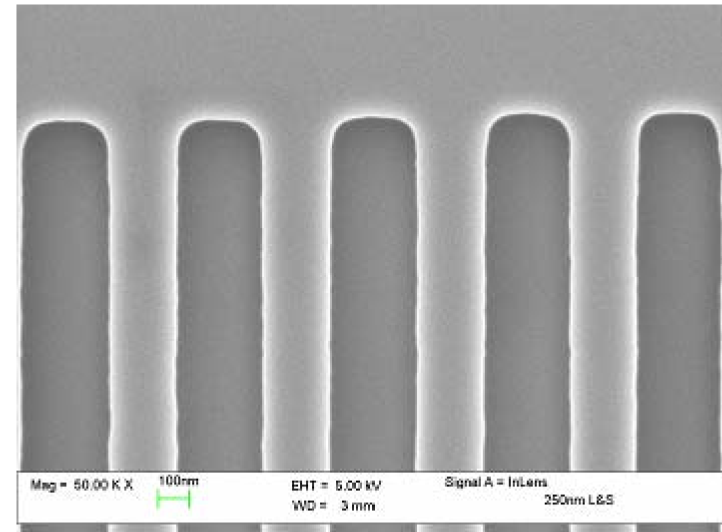
Dry etch performance of the new absorber much better than Cr

- High etch selectivity
- Sub-100 nm feature size achievable
- Etch bias nearly 0 with 100% over etch
- CD uniformity < 10 nm





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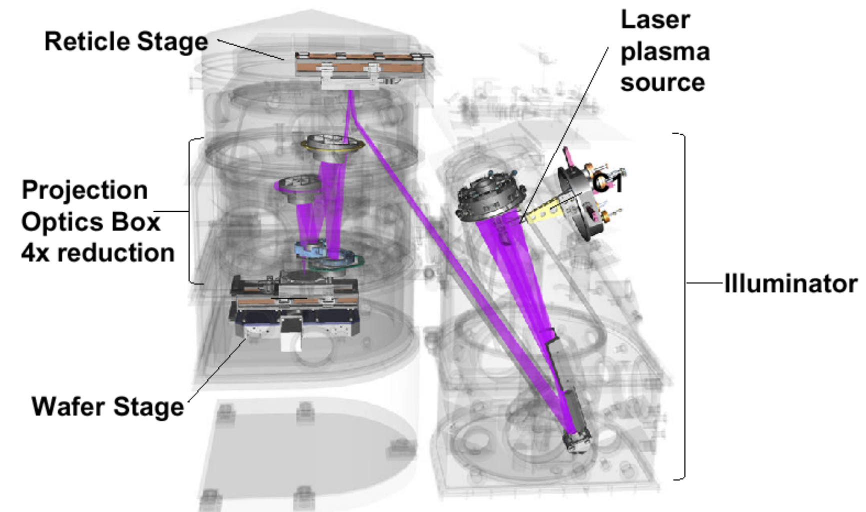
EUVL mask blanks from Schott Lithotec are available

- Purpose:
  - Supply low defect EUVL blanks for EUVL mask pilot lines
- Status:
  - Good multilayer performance achieved (high reflectivity and good homogeneity, also on LTEMs)
  - Low defect multilayers, SiO_2-Buffer and etch optimized new absorber material available
  - High conductive low defect backside coated mask blanks
  - Complete EUVL blanks on LTEM shipped
  - Alternative absorber mask blanks shipped
- Plan:
  - Stress improvement program for EUV layers
  - In house reflectometry operational Q1/04
  - Defect reduction program to 2005



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