A New Absorber Material Enables EUV Masks With Enhanced Etch Control and CD Uniformity

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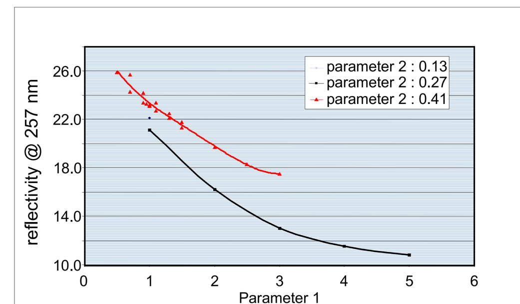
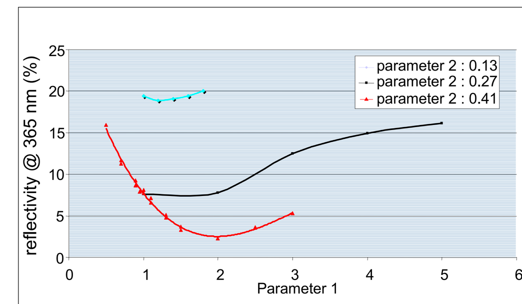
SCHOTT LITHOTEC, IMS Chips and Infineon Technologies develop a new alternative absorber system in order to fulfill EUV Lithography requirements. SCHOTT LITHOTEC realized the new absorber system and investigated its optical properties and defectivity while IMS Chips and Infineon Technologies processed it and improved dry etch process in order to achieve new best results with etch control, CD linearity and uniformity

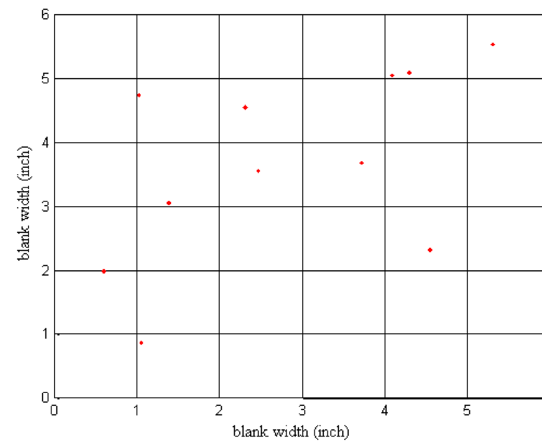
A new alternative absorber layer can be supplied in order to fulfill mask processing requirements

- New raw material with enhanced optical control and uniformity
- Layering optimization to fit inspection wavelengths
- Improved nano-structure to dry etching high quality response
- Defectivity comparable to binary standard absorber mask blanks





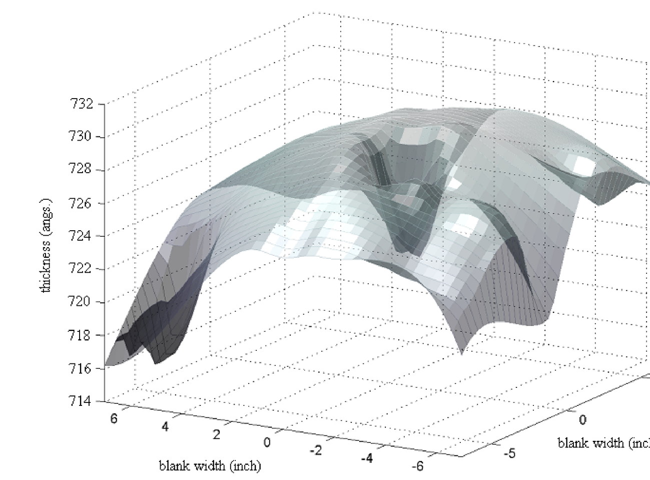
Investigations about layering onto the optical response of an AAM sample tuning two main parameters.



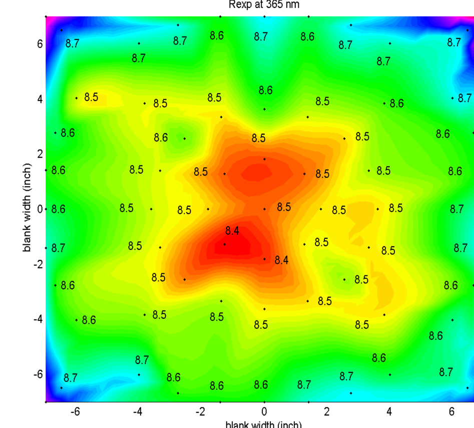
Defect scan of an AAM sample : only 14 frontside defects larger than 200 nm, that correspond to a defect density of 0.06 def./cm².

Uniformity and chemical homogeneity are one of our main concern in order to reach high quality mask processing properties

- thickness uniformity in standard product is better than 1,5 % (3σ)
- optical reflectivity at 365 nm under 10 % and at 257 nm under 22% within the same sample
- optical uniformity at 365 nm and 257 nm are respectively 0.3 % (3σ) and 0.1 % (3σ)



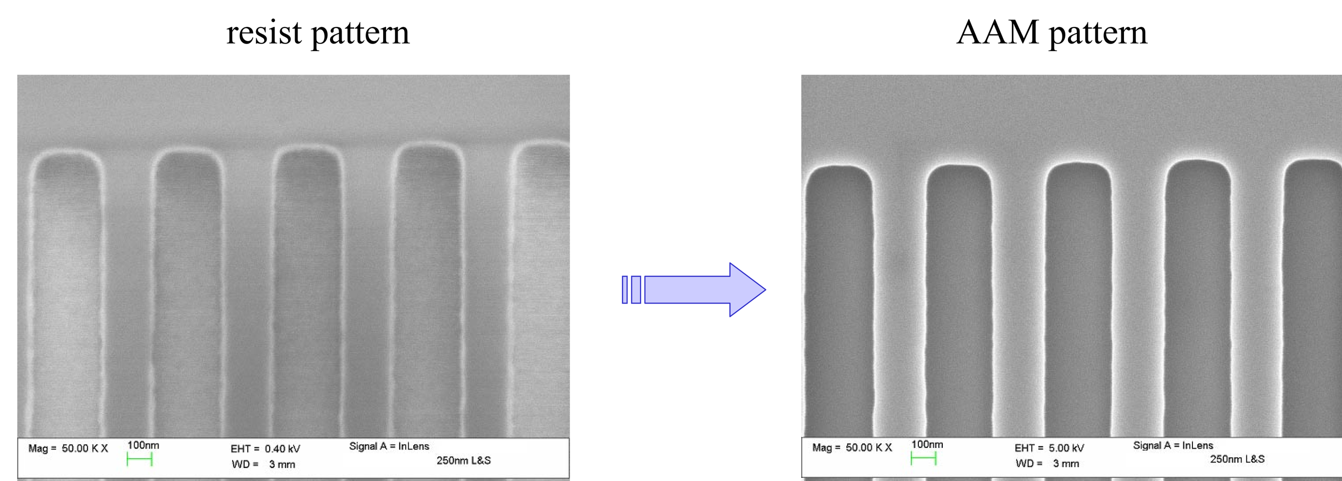
Thickness uniformity of an 72 nm AAM sample. The complete range is limited to 1.7 nm over 140 mm x 140 mm. The absolute standard deviation at 3s is less than 1 nm.



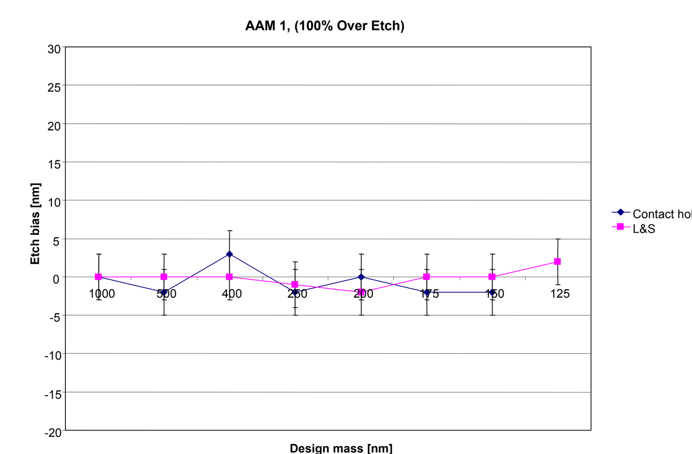
Reflectivity map of an AAM sample at 365 nm. The range for optical reflectivity is 0.4%.

Dry etch pattern transfer from resist to the absorber becomes trivial with AAM

- CD dimension tends to be smaller on to the absorber system
- Etch bias for both lines and contact holes are statistically close to zero
- Maximum variation detected in dimension shift is less than 2 nm



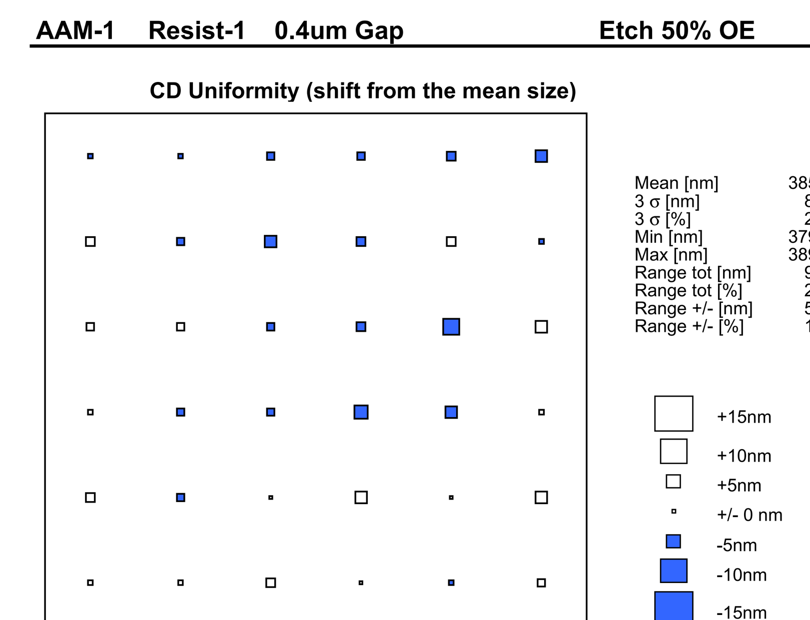
Pattern comparison between resist structure and absorber structure. Lines&Space dimension are nearly equal in each layer system.



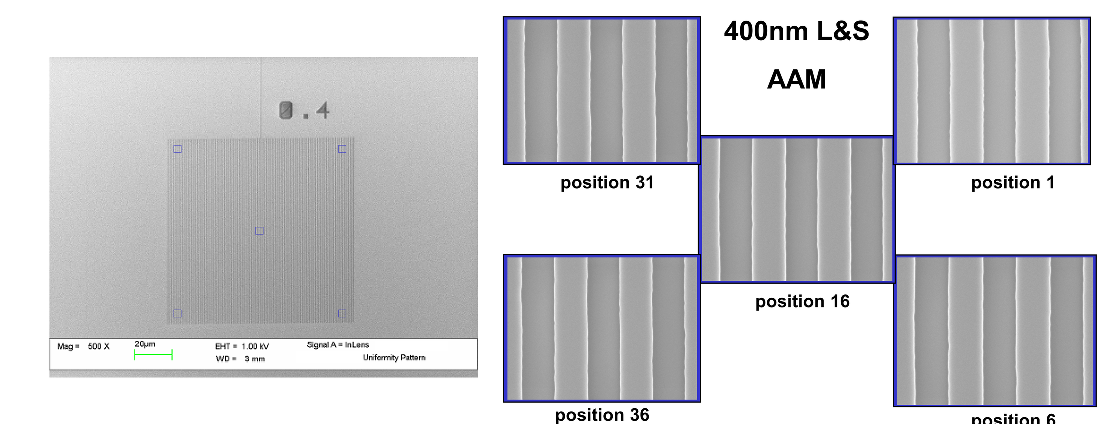
Variation of the etch bias over the absorber sample. This parameter whatever the size of the pattern is never above 3 nm

CD uniformity and linearity achievements towards EUVL requirements

- Different L&S size have been investigated with similar results
- Extreme high linearity all over a 4 µm 400 nm L&S sampling is achieved
- CD range over 140 mm x 140 mm is less than 10 nm
- Below 150 nm size contact holes have been realized



CD uniformity map over 140 mm x 140 mm. Absolute Standard deviation from defined 400 nm L&S is 8.1 nm.



Linearity of patterned lines over a 4 µm square 400 nm L&S pattern. Linearity is very uniform all over the sampling.

SCHOTT LITHOTEC, IMS Chips and Infineon Technologies develop a new alternative absorber system with strong potential :

- optical response focused to production-type and research grade inspection wavelengths
- Uniformity and homogeneity has a very good level without any specific effort
- Etch bias for any pattern size and type is practically zero
- Patterning this new absorber with sub-100nm features is already under investigation

Acknowledgement

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