

An abstract graphic in the top-left corner consisting of several overlapping, flowing, purple lines that resemble a stylized flame or a dynamic, organic shape.

IMEC UPDATE ON OUTGAS QUALIFICATION

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OUTLINE

Outgas qualification capability at imec and 'round robin' activities

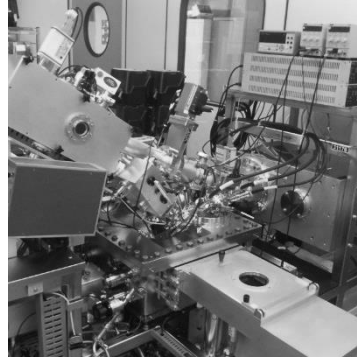
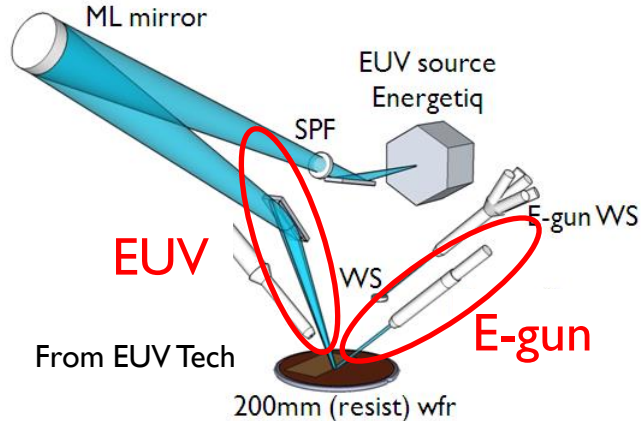
Alternative resist testing

Summary

IMEC OUTGAS TOOL INFRASTRUCTURE

Contamination Growth (CG)

tester at imec



NXE outgas qualification was certified first in mid'2012

Throughput : ~20 samples/month

No stage issues observed after the stage maintenance in May'2014, resulting in normal capacity.

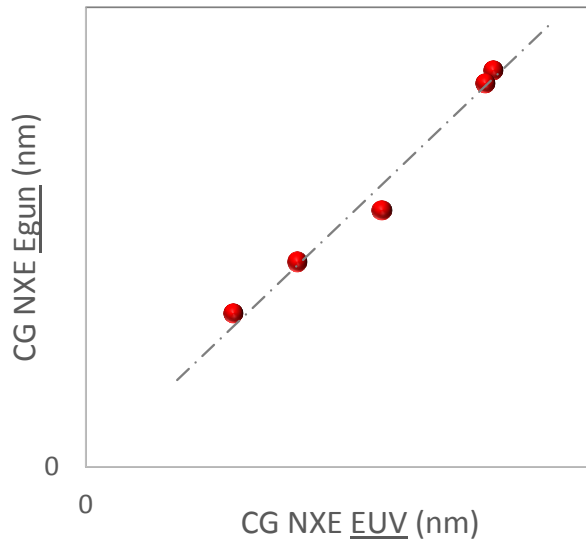
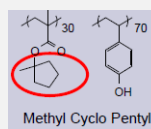
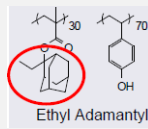
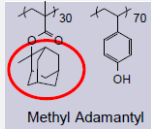
Imec tester has dual certification (both for **EUV** and **E-gun** exposure on wfr)

Main focus in last half year went to 'round robin' activities and alternative resists qualification/investigation.

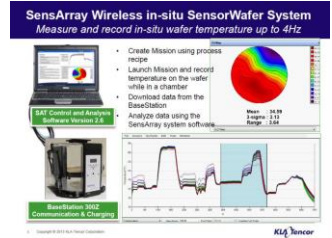
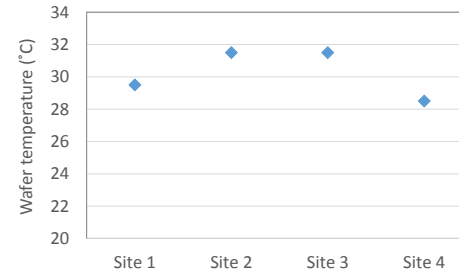
RR TESTING AT IMEC

Model resists provided by EIDEC

EIDEC distributed 5 model resists amongst the qualification sites for next step round robin; Two resists are expected to be high contaminating (CG = 7-10nm)

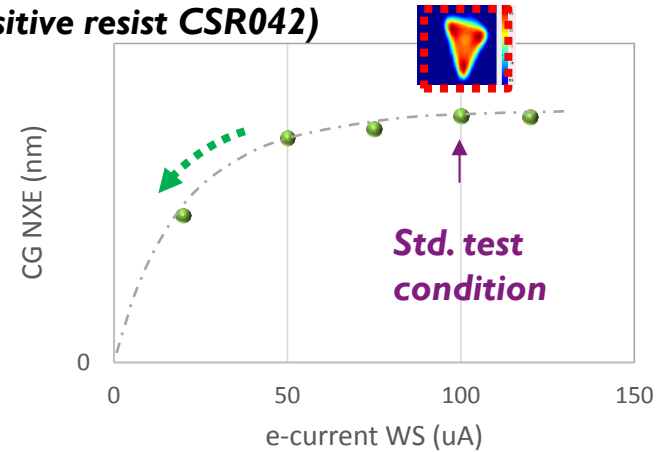


Good correlation between EUV exposed and Egun exposed CG results.



Temperature of outgas tester is in line with other test facilities

Contamination limited regime (CLR) ? (tested with CLR sensitive resist CSR042)



WS testing shows that std imec condition is in CLR !

Joined RR outgas test investigation in between EIDEC, NIST, Sematech, imec and ASML has been good collaborative work and could be extended towards alternative resist materials.

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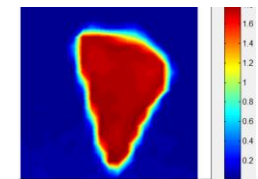
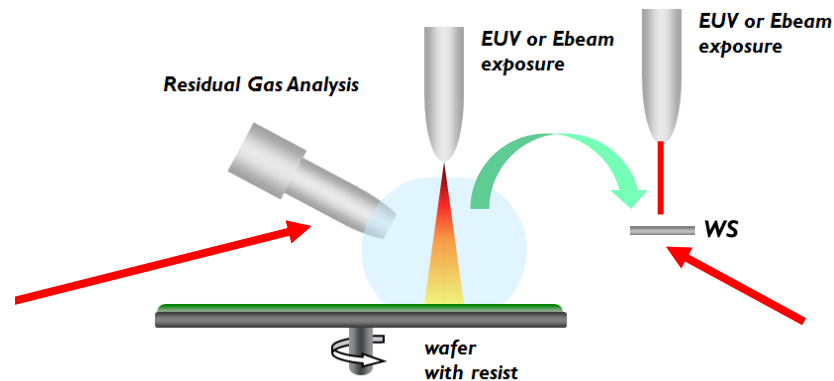
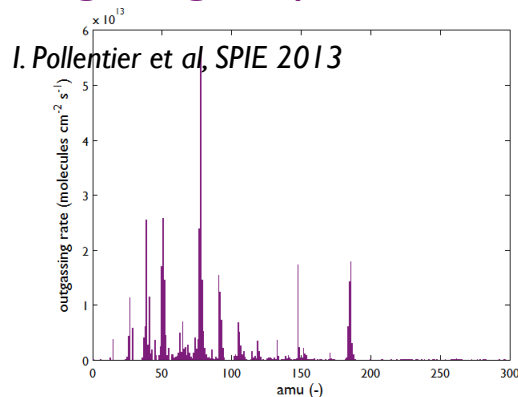
ALTERNATIVE RESIST MATERIALS

Alternative resist materials are currently investigated at imec in many kind of chemistries

- ▶ Molecular resists, nanoparticles, metal containing, ...

Outgas testing on these materials is ongoing by WS testing and RGA to address potential risk on scanner

RGA can provide information through species identification or COR (contaminating outgassing rate)

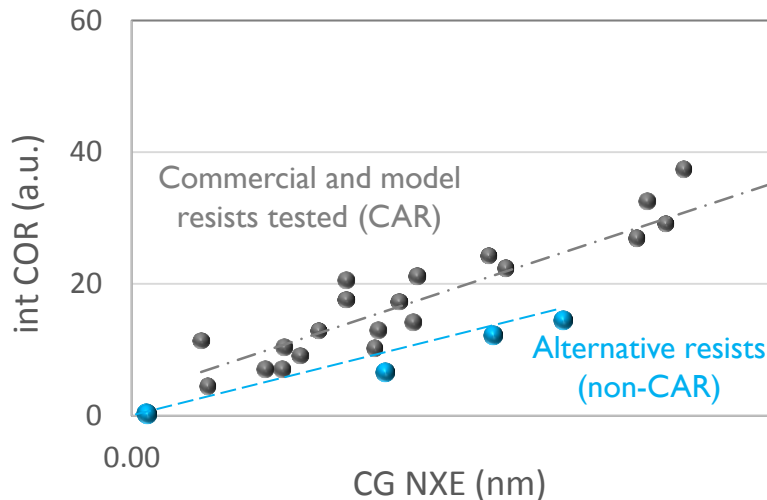


contamination growth (CG)

ALTERNATIVE RESIST MATERIALS

Standard outgas test results are promising for alternative resist materials

- ▶ Cleanable contamination is similar or even lower than typical CAR materials
- ▶ So far no clear non-cleanable elements found in XPS, e.g. metals

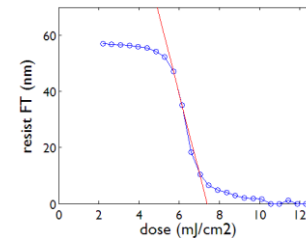
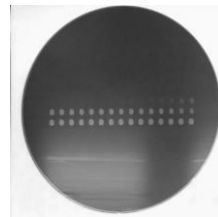
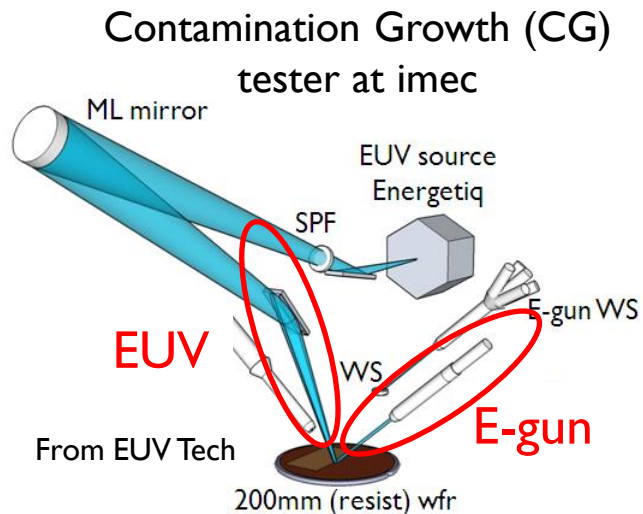


Outgas testing will be continued on novel materials, including investigation on possible adaptation of outgas procedure (H_2 – EUV environment)

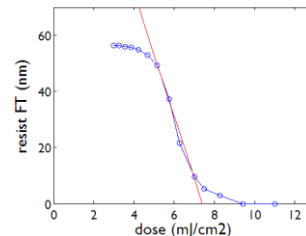
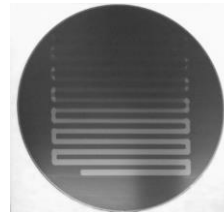
ALTERNATIVE RESIST MATERIALS

Outgas infrastructure is also used to pre-screen novel material

- ▶ Contrast curve testing, development rate monitor (DRM), ...
- ▶ Impact of material aging and delay effects
- ▶ Impact of process temperatures, developer types, ...



Contrast curve by timed exposures

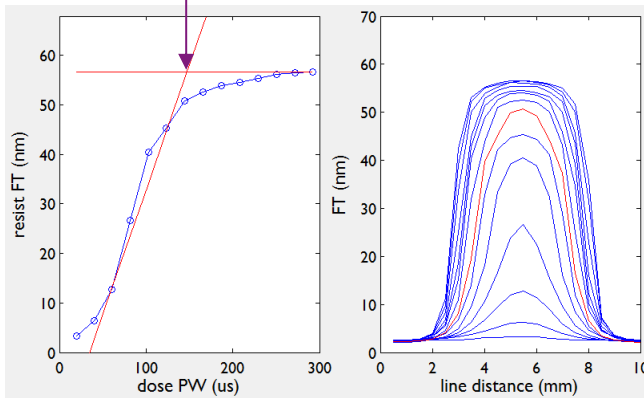


Contrast curve by scanned exposure with increasing (EUV or Egun) intensity

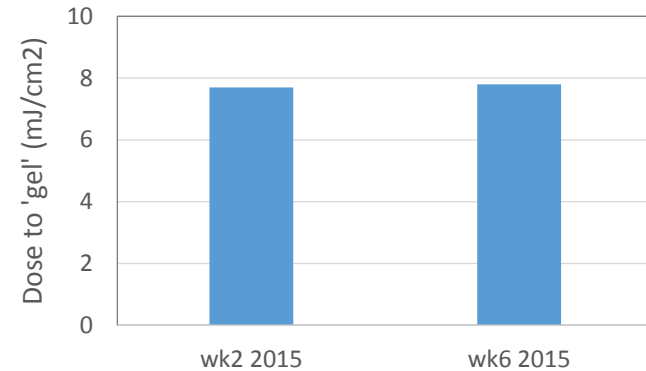
ALTERNATIVE RESIST MATERIALS

Example : aging and delay test of resist material

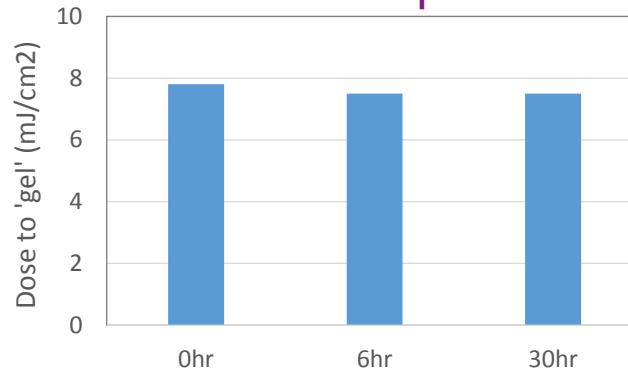
Dose to 'gel'



CC test done after 4wks of material aging shows no significant change in sensitivity



Very small change in sensitivity when delay between coat and exposure is varied.



ALTERNATIVE RESIST MATERIALS

More reports at SPIE on this :

Mon 23 February 1:50 pm: **Extending resolution limits of EUV resist materials**, Marie E. Krysak, Michael J. Leeson, Ernisse S. Putna, James M. Blackwell, Intel Corp. (USA). [9422-4]

Wed 25 February 1:40 pm: **Integrated fab process for metal oxide EUV photoresist**, Andrew Grenville, Jeremy Anderson, Benjamin L. Clark, Joseph Edson, Michael Greer, Kai Jiang, Michael K. Kocsis, Stephen T. Meyers, Jason K. Stowers, Inpria (USA); Alan Telecky, Inpria (USA); Danilo De Simone, Geert Vandenberghe, IMEC (Belgium). . [9425-29]

SUMMARY

Joined 'round-robin' outgas testing has been good collaborative work and can be continued towards alternative resists.

Imec continues outgas qualification of alternative resist materials and assess its risk for the scanner conditions.

Besides for outgassing, the outgas is now also used to accelerate the Lab-to-Fab transition of alternative EUV materials supporting the pre-screen of materials and processes prior their use on NXE scanner.

ACKNOWLEDGEMENTS

Round Robin team of qualification sites :

- ▶ EIDEC : E. Shiobara, and S. Inoue
- ▶ ASML : C. Verspaget, G. Rispens, and N. Harned
- ▶ NIST : B. Berg, T. Lucatorto, C. Tarrío, and S. Hill
- ▶ Sematech : Yu-Jen Fan

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