UPDATE ON EUV OUTGASSING
IMEC

I. POLLENTIER

Status of resist outgassing qualification for NXE3100

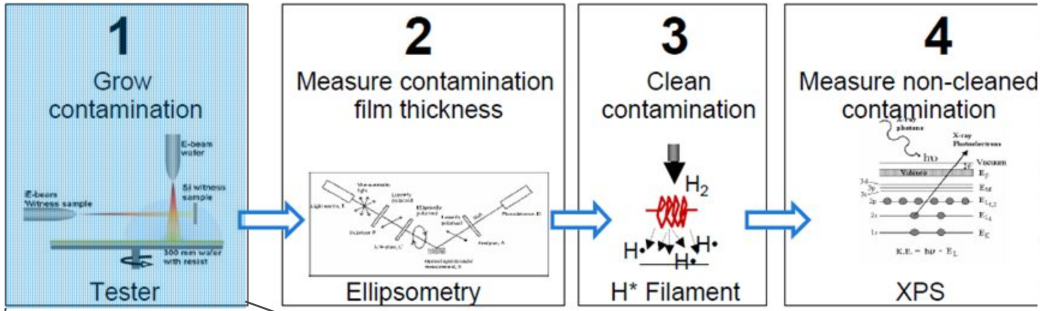
Investigation of outgassing and contamination in multilayer schemes

STATUS ON RESIST OUTGAS QUALIFICATION FOR NXE3100

I. POLLENTIER, AND R. LOKASANI

OUTGASSING QUALIFICATION FOR NXE3100 STATUS MARCH'11

[N. Harned (ASML), IEUVI Resist TWG meeting, Nov'2010]



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	b	Specification ellipsometer
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	e	Reproducibilty of contamination growth exposure
	f	Contamination grown from background (total thickness)
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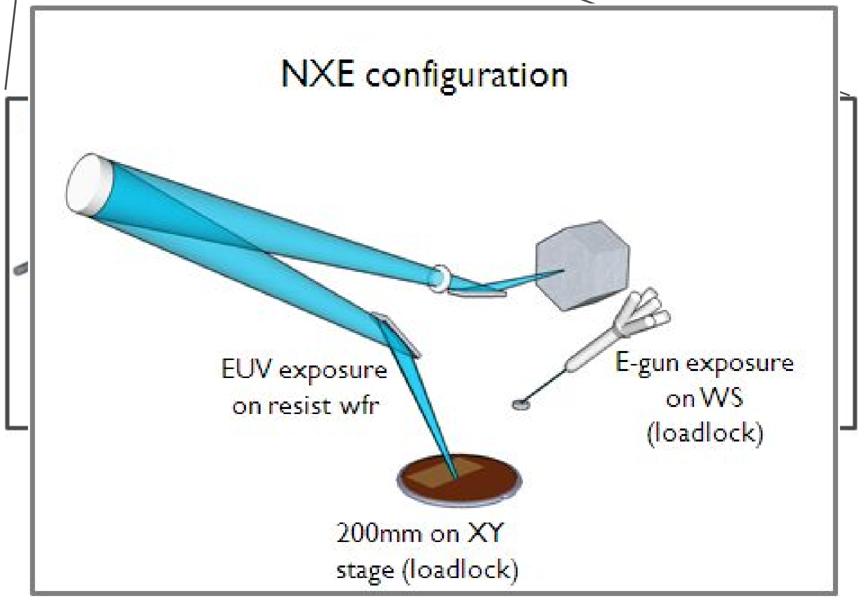
5 Calibration	a	Check outgassing limited contamination growth (bleeding tests)
	b	Calibration exposures (4 resists preferred)



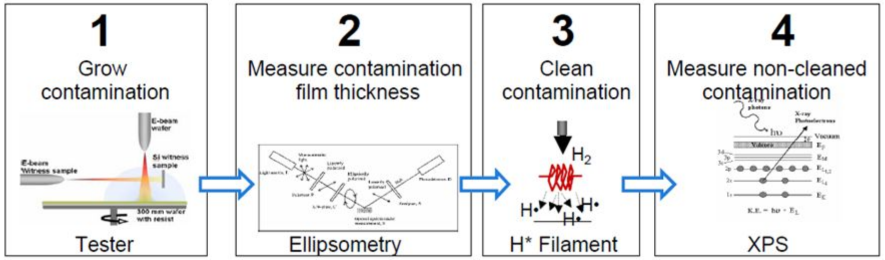
Essential hardware modifications done on imec outgassing tool (vacuum improvement + e-gun)

ASML first guidelines available

System used for ADT qualifications

Work on datapackages started only in early May

OUTGASSING QUALIFICATION FOR NXE3100



1 Grow contamination – Tester

2 Measure contamination film thickness – Ellipsometry

3 Clean contamination – H* Filament

4 Measure non-cleaned contamination – XPS

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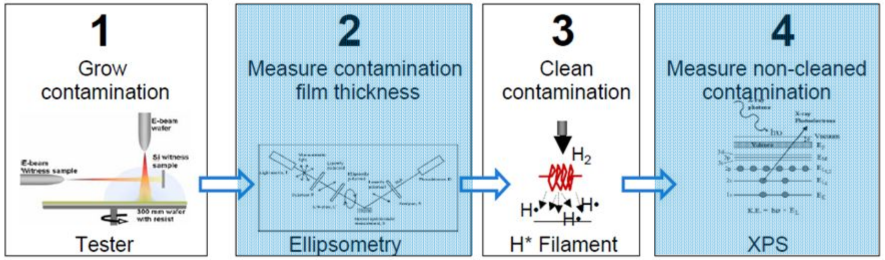
Where are we ?

OUTGASSING QUALIFICATION FOR NXE3100



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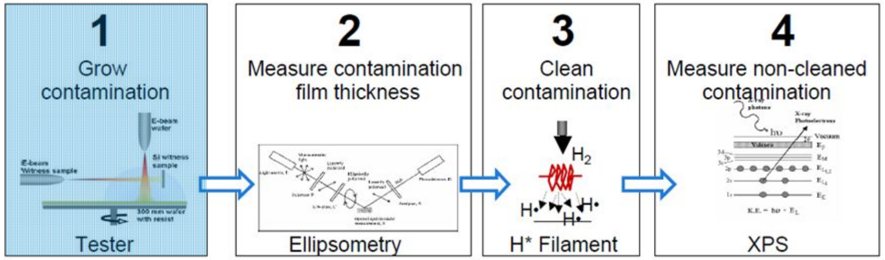
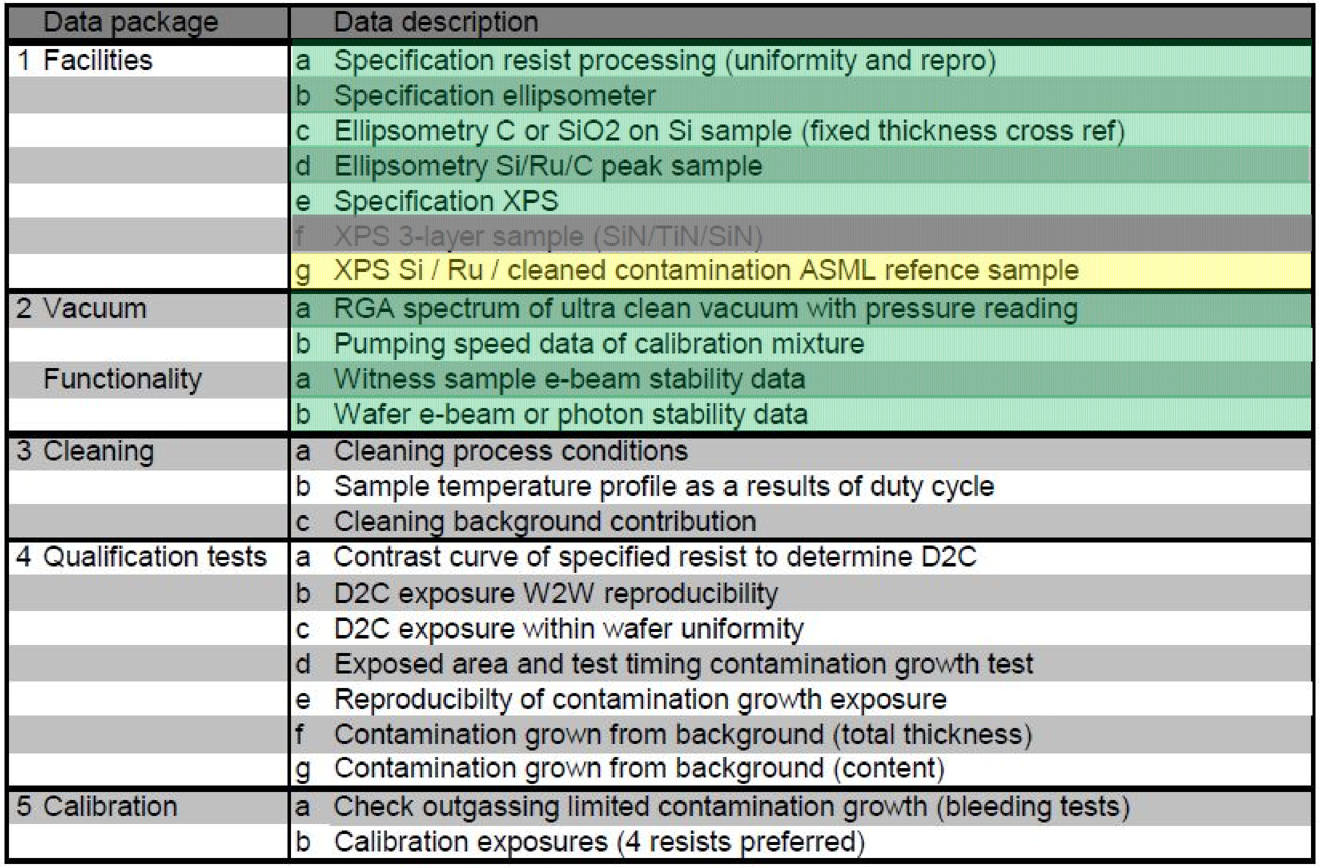
KLA-T UV1280


Thermofisher Theta300

1" WS are measured by 200mm tools by pocket wafers

OUTGASSING QUALIFICATION FOR NXE3100





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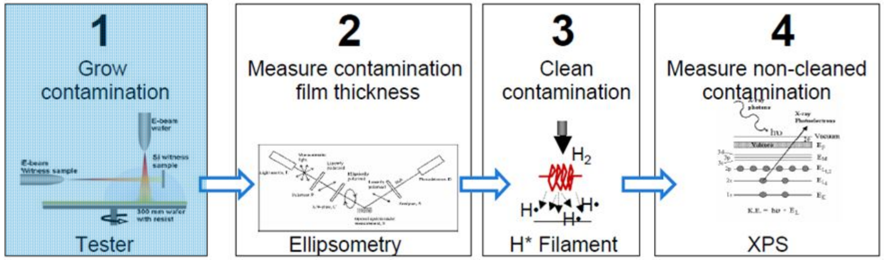

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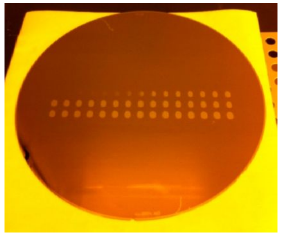
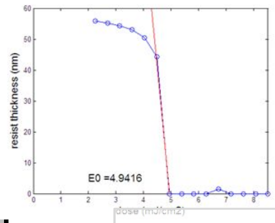
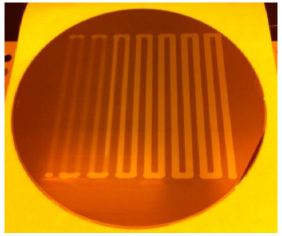
Dose-to-clear done in 2 ways :

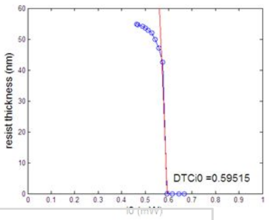
Incr. time @ const int.





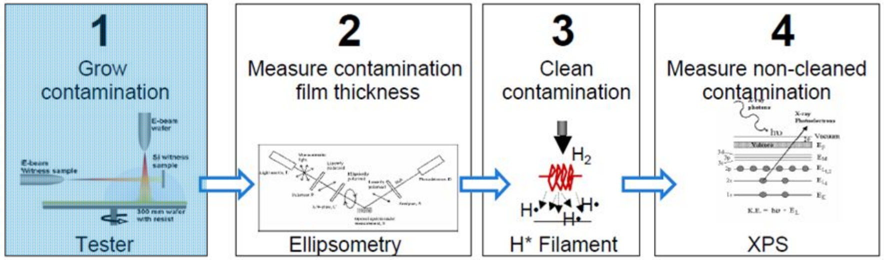
Incr. int. @ const speed

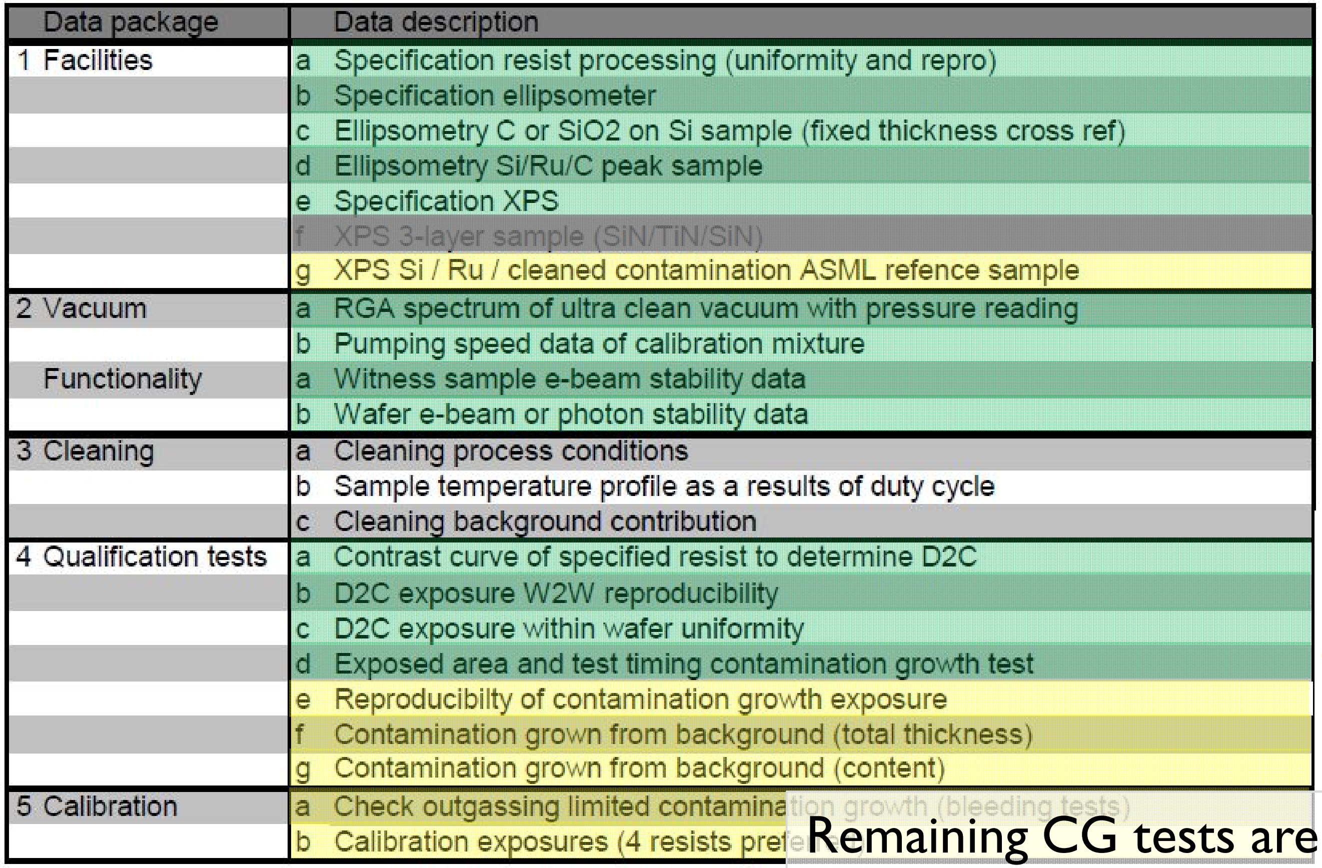




$$i0 = 0.11 \cdot E0$$

OUTGASSING QUALIFICATION FOR NXE3100





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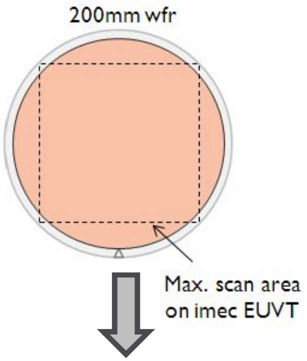
ASML spec on wafer exposure area :
>90% of 200mm wfr (>270cm2)
during 1hr

Exposure at E0

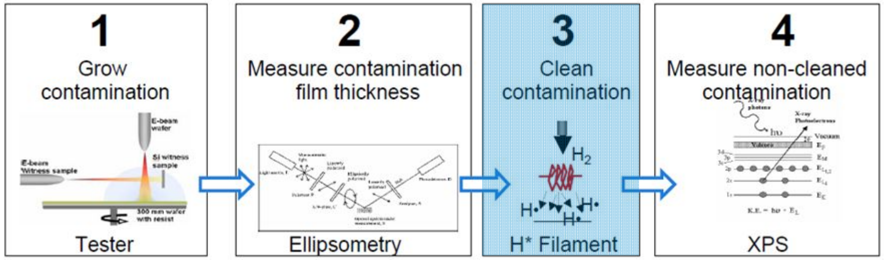


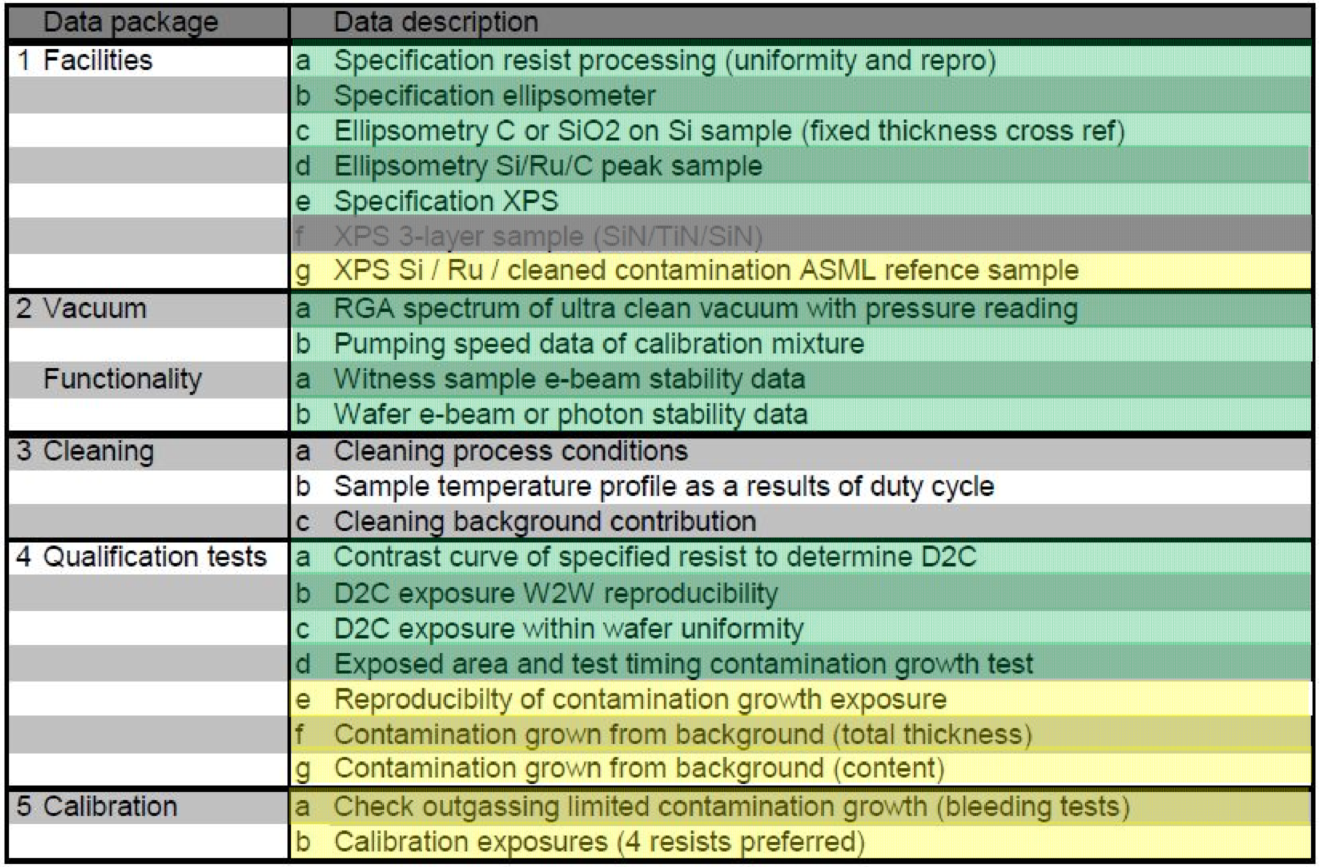
2 wafers will be exposed, each with area ~200cm2 during ½ hr (total ~400cm2 in 1hr)

Delay between wafers is estimated to be <45min, but during this time the power intensity can be adjusted.

Remaining CG tests are prepared and ongoing but need verification with WS precleaning

OUTGASSING QUALIFICATION FOR NXE3100





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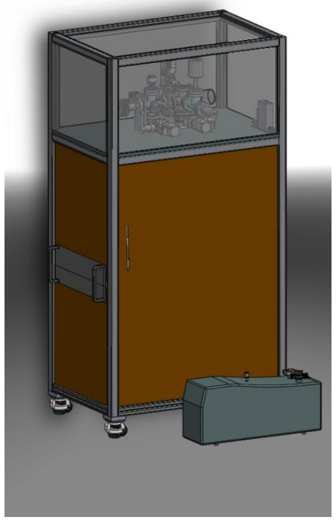
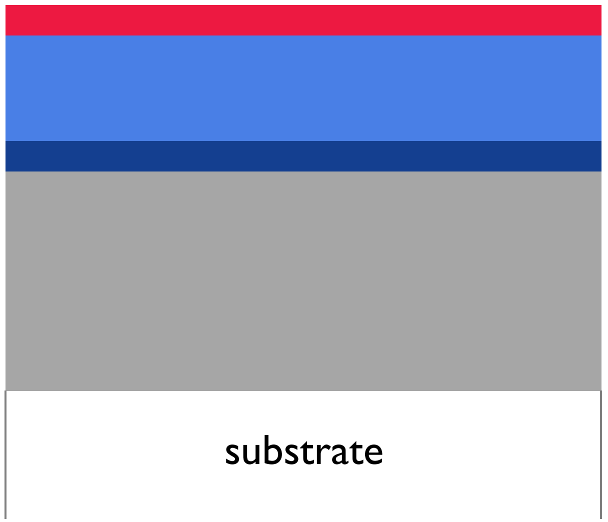


WS H-cleaner currently developed by EUV Technology will be shipped in December'11

EUV OUTGASSING AND CONTAMINATION IN MULTILAYER MATERIAL SCHEMES (EUVL POSTER)

I. POLLENTIER, V. TRUFFERT, R. LOKASANI, AND R. GRONHEID

EUV MATERIAL STACK



Topcoat

EUV resist

Underlayer

Spin-on Layer(s) (SoL) for patterning, e.g. SOG/SOC

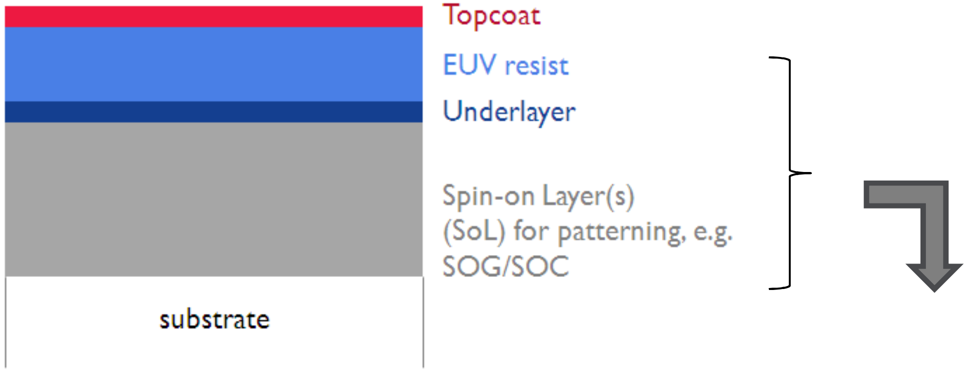
[e.g. H.-W. Kim (Samsung), SPIE2011]

EUV stack can be a complex stack of organic (outgassing) materials.

So far the resist is the main material to be qualified (ASML WS test), and this without presence of other layers.

In this work some layer combinations are characterized by WS test.
However emphasis was put on RGA since this enables additional understanding on mechanisms !

IMPACT OF LAYERS BELOW RESIST

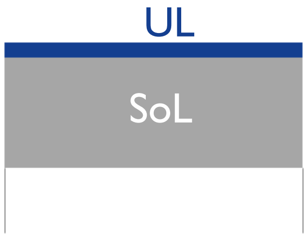


Case 1

How much outgassing contamination can be expected from SoL when it is covered with resist ?

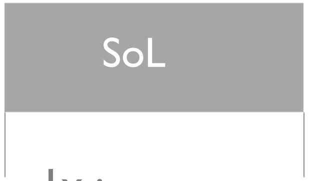
Is resist outgassing changed by underlying material ?

Case 2



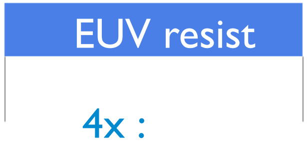
How efficient is an UL for suppression of outgassing & contamination of underlying SoL ?

experimental



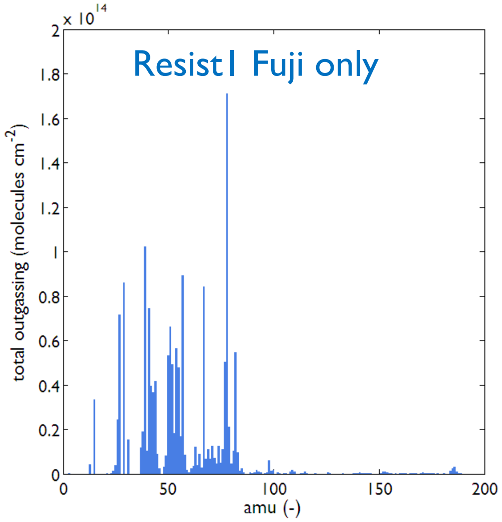
1x :
SOG (Nissan)

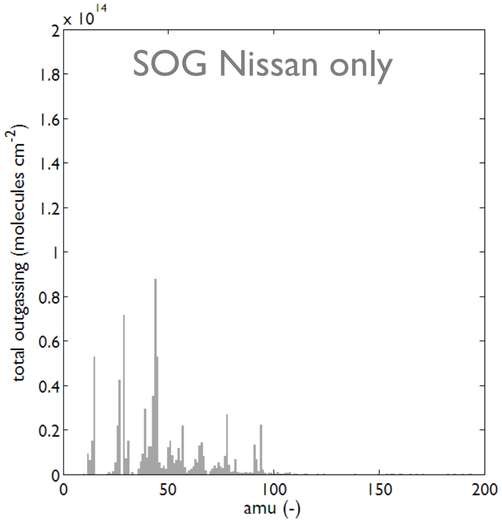
1x :
Brewer AL412



4x :
3 model resists FujiFilm
+ SEVR140

IMPACT OF LAYERS BELOW RESIST


Resist1 Fuji only

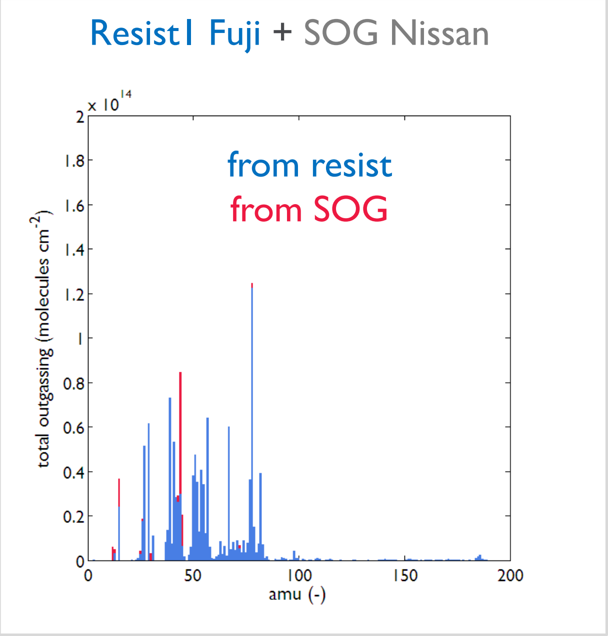

SOG Nissan only

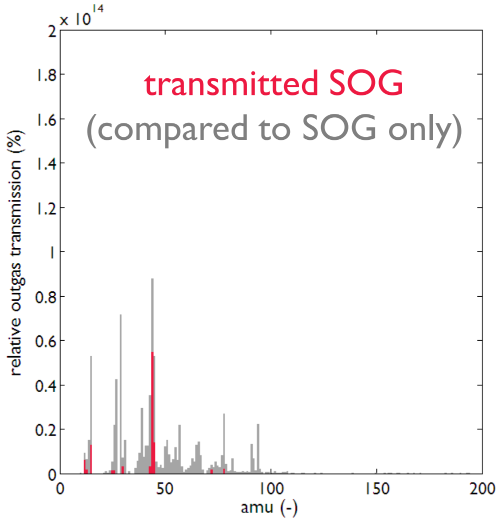

Resist1 (60nm)

SOG Nissan (60nm)

Resist outgassing amount is (slightly) changed

A small amount of SOG related outgassing is observed


Resist1 Fuji + SOG Nissan


transmitted SOG (compared to SOG only)

IMPACT OF LAYERS BELOW RESIST

Resist	T_g (°C)	MW	Block. Ratio	Resist outgassing change	Transmissed SoL outgassing
FF Resist1	high	high	low	-28%	13%
FF Resist2	low	low	high	-18%	33%
FF Resist3	medium	low	low	-29%	27%
SEVR140	-	-	-	12%	17%
	resist chemistry			*RGA outgassing*	

The transmitted SoL outgassing is related to the resist chemistry, but in line with PAG related outgassing !

IMPACT OF LAYERS BELOW RESIST

WS cont. thickness*
SOG **:** 0.05

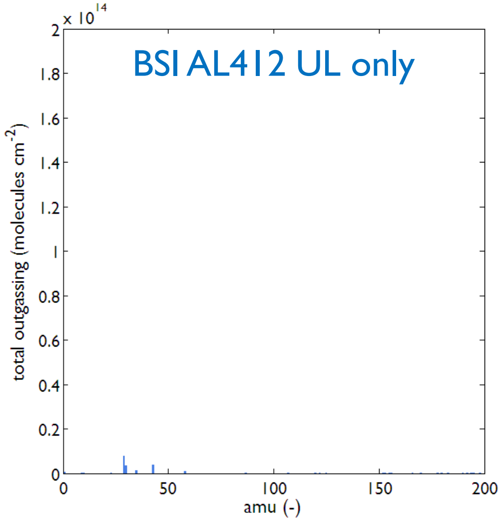
* Using initial e-gun method (1 wafer at higher dose)

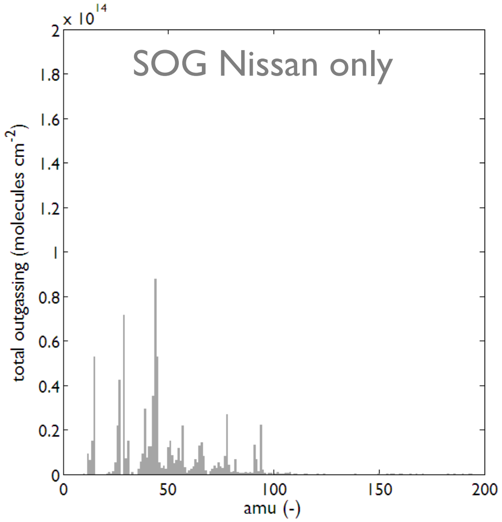
Resist	**T_g (˚C)**	**MW**	**Block. Ratio**	**Resist outgassing change**	**SoL transmission**	**WS cont. thickness resist * (nm)**	**WS cont. thickness stack ***
FF Resist1	high	high	low	-28%	13%	0.40	-
FF Resist2	low	low	high	-18%	33%	1.38	-
FF Resist3	medium	low	low	-29%	27%	0.83	0.84
SEVR140	-	-	-	12%	17%	0.75	0.85
	resist chemistry			*RGA outgassing*		*WS contamination*	

WS contamination can be slightly changed by underlying SoL stack, but it is believed that this is not because of SoL related outgassing but only by change in resist related outgassing

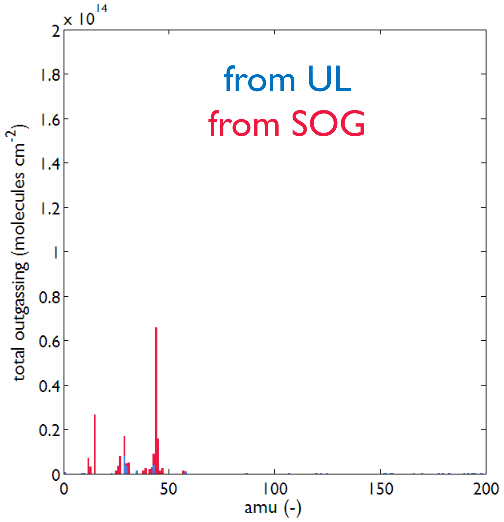
IMPACT OF LAYERS BELOW RESIST

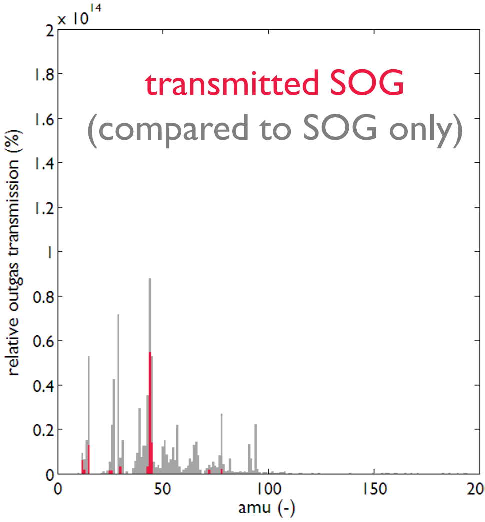
Only minor fraction (~20%) and low AMU part of SOG outgassing is measured in stack





BSI AL412 UL + SOG Nissan





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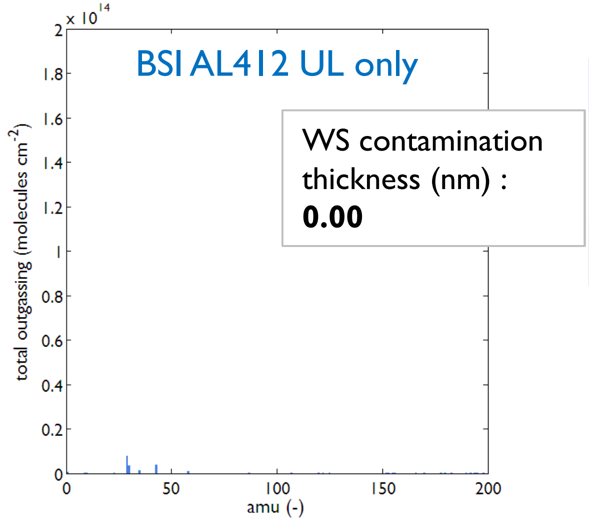
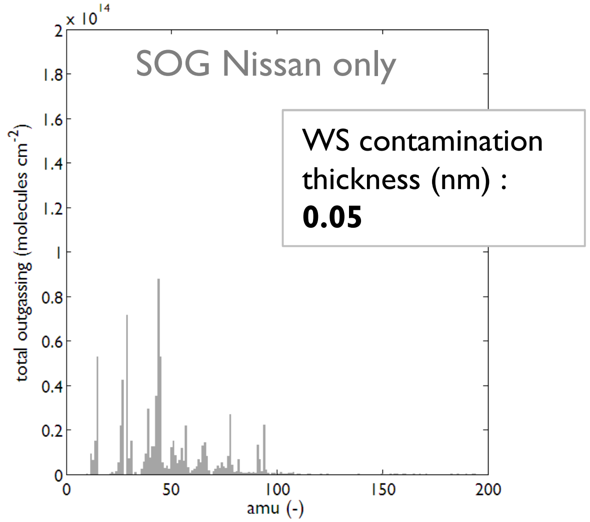

BSI AL412 UL only

WS contamination thickness (nm) : **0.00**


BSI AL412 (12nm)

SOG Nissan (60nm)

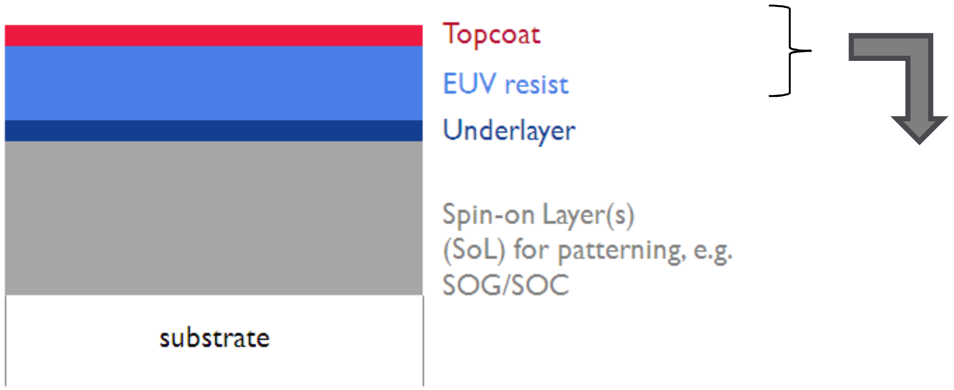

SOG Nissan only

WS contamination thickness (nm) : **0.05**

Contamination of UL and SoL is very low, so minor risk is expected from combined stack.

* Using initial e-gun method (1 wafer at higher dose)

IMPACT OF LAYERS ABOVE RESIST



Topcoat

EUV resist

Underlayer

Spin-on Layer(s)
(SoL) for patterning, e.g.
SOG/SOC

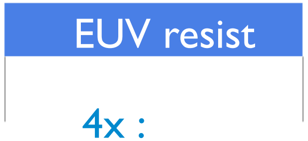
substrate

How efficient is a topcoat for suppression of outgassing & contamination of underlying resist ?
Is a topcoat resulting in contamination ?

Topcoat

EUV resist

experimental



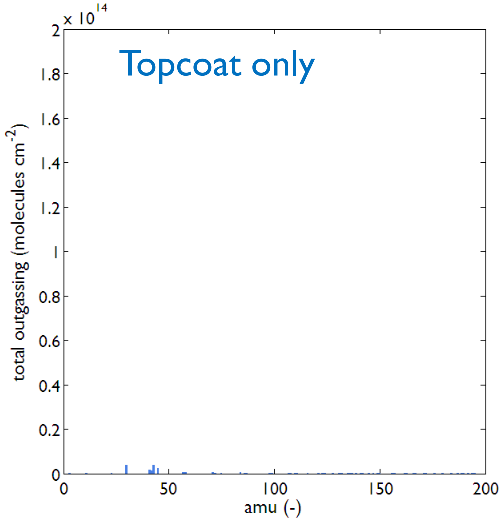
EUV resist

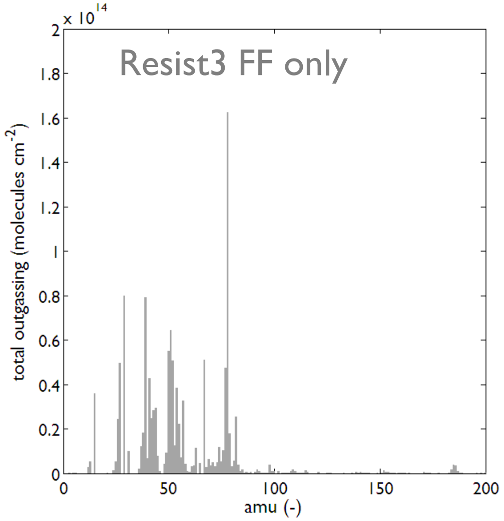
4x :
3 model resists FujiFilm
+ SEVR140

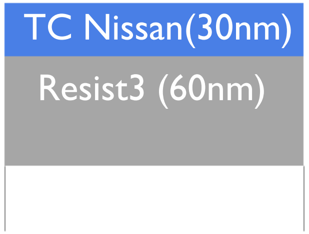
Topcoat

2x :
Nissan

IMPACT OF LAYERS ABOVE RESIST


Topcoat only


Resist3 FF only

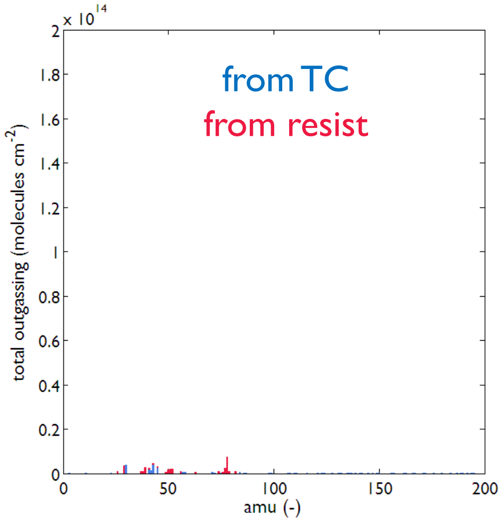

TC Nissan(30nm)

Resist3 (60nm)

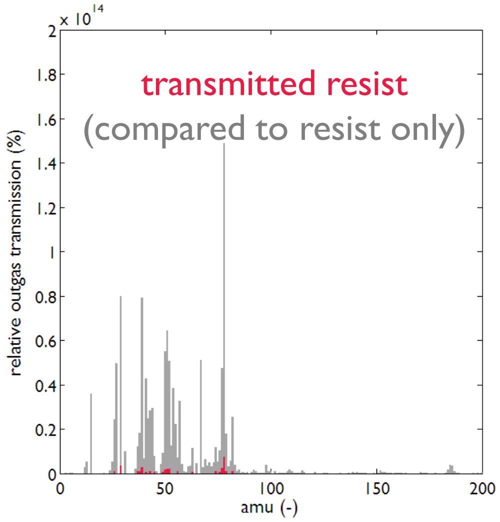
Only very minor fraction and low AMU part of resist outgassing is measured in stack

contamination ?

Topcoat (Nissan) + Resist3 FF

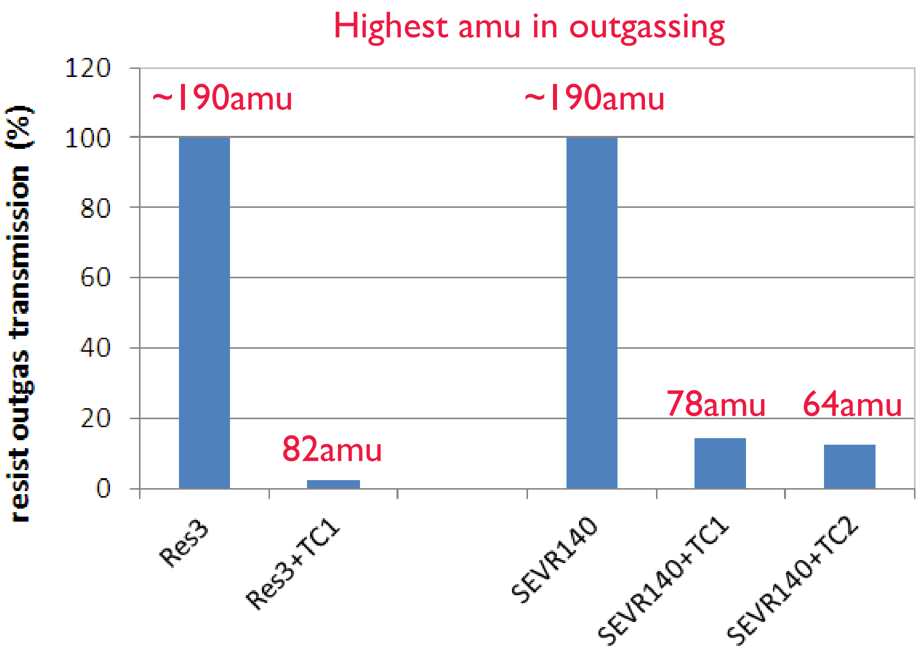

from TC

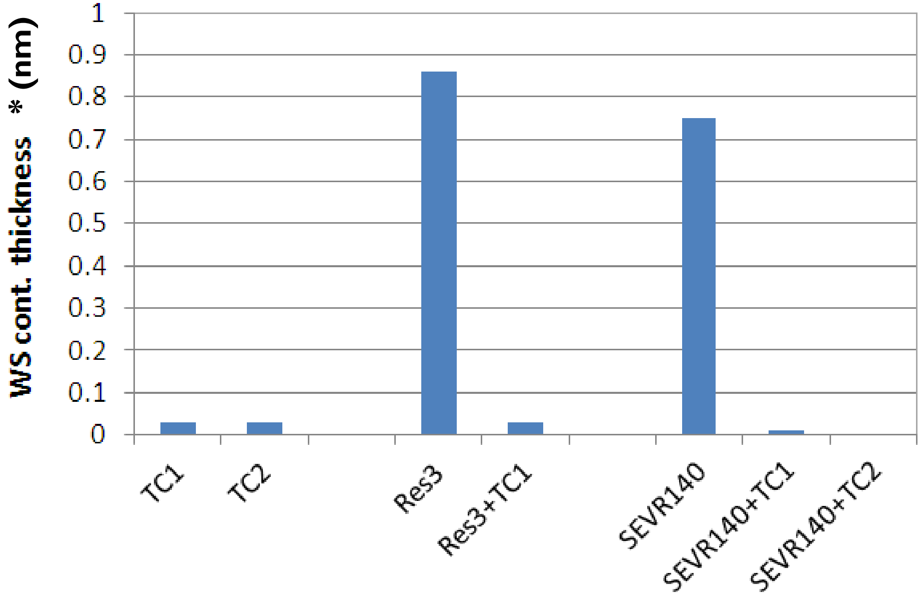
from resist


transmitted resist

(compared to resist only)

IMPACT OF LAYERS ABOVE RESIST TOPCOAT

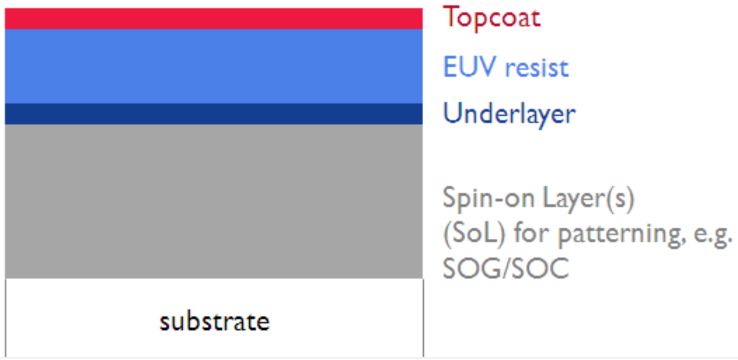




Investigated TC's are very effective in reducing both outgassing and contamination !!!

* Using initial e-gun method (1 wafer at higher dose)

SUMMARY


Topcoat
EUV resist
Underlayer
Spin-on Layer(s)
(SoL) for patterning, e.g.
SOG/SOC
substrate

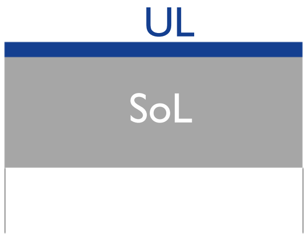
This investigation confirms that resist is the main contributor to outgassing and contamination.

However the resist related outgassing and contamination can be slightly changed by the presence of an underlying layer.

In general, top layers are good high-amu filters for outgassing of underlying layers.

Low outgas top-coats can be very effective in reducing the resist related contamination.


EUV resist
SoL


UL
SoL


Topcoat
EUV resist

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