

LAB

What's new v5.10

Simplified CAR Model

- CAR resist modelling requires a Post Exposure Bake (PEB) process simulation. The complete parameter set in older LAB versions are kept in the Full model.
- The new simple CAR model removes PEB temperature dependence and reduces the PEB parameters to only three:
 - Acid diffusivity
 - PEB amplification
 - Quencher loading
- Simple CAR model facilitates resist calibration while valid for many resists.

Resist Type
 DNQ CAR

CAR Model
 Simple Full

Acid Diffusivity [nm²/s]

PEB Amplification [1/s]

Quencher Loading

Rmin [μm/s] Rmax [μm/s]

Slope Mth

Resist Tone
 Positive Negative

Depth Model
 None Surface inhibition

r0 Inhibition depth [μm]

OK Cancel Help

Rule OPC Optimizer

Critical Shape Error (CSE) is activated for optimization of OPC rules.

- CSE is the average deviation between the simulated contour and target contour. CSE = 0 means no difference between the resulting shape and target.
- CSE for each OPC rule is calculated as well as a total CSE for all applied OPC rules.
- Please refer to the LAB manual for CSE definition in details.

Rule based Process Correction

General | Advanced | Signal Definitions | Label/Comment

Keep Initial Layout

Min Free Edge Size [um] Min Segment Size [um]

Min Corner Size [um] Max Segment Size [um]

Bias Limit [um]

Target Layer

Action	Dependence Param	Scenario	Condition	Optimize	CSE [nm]
Bias	CD	AnySegment	true	<input checked="" type="checkbox"/>	13
Serif	-	Corner	true	<input checked="" type="checkbox"/>	13

Condition

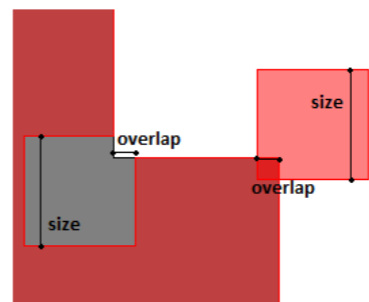
Type of Serif

Min Edge Length [um]

Min Distance [um]

Size [um]

Overlap [um]



To optimize parameter use this syntax: %[lower_bound:step_size:upper_bound](optimizer_result)%
 Specifying a step size is optional. Therefore, you can omit the step size together with one of the colons.
 The optimizer result is presented in the parentheses after the brackets.

Start Optimizer Stop Optimizer Total CSE of active scenarios: 13 nm

Layer Tree Doses C

- Input
- 0(0)
- 6(0)
- 49(0)
- Optimizer Result
- OPC
- Simulated Contour

All Hide Show Cell Information Measu

Mouse position (Layout Origin) [um]: 121.8276,18.7952

OK Cancel Help Preview

Improved Resist Calibration

In Resist Calibration, *Ensure Clearing* adds a condition to ensure a proper resist profile

- Previously the only condition was a CD measurement not considering the resist shape above or below the measurement line
- With this new condition, only clearing parameter sets are considered as solution

Resist Calibration

Settings Label/Comment

FEM 1 <add>

Measurement Height [um] 0.075 CD [um] 0.15
Pitch [um] 0.3

v Defocus v

[um]	[um]	[um]	[um]	
0.35	0.15309	0.12666	0.11255	0.08417
	1	1	1	1
0.3	0.14745	0.12883	0.11551	0.10293
	1	1	1	1
0.25	0.14376	0.1295	0.1189	0.10848
	1	1	1	1
0.2	0.1426	0.13044	0.11951	0.10865
	1	1	1	1
0.15	0.1429	0.12884	0.11753	0.10797
	1	1	1	1
0.1	0.14254	0.12841	0.11641	0.10548
	1	1	1	1

Settings

Projection...

Resist...

Optimizer...

Ensure Clearing

Calibration

Run

Result View...

Save Material...

Verification

Verification

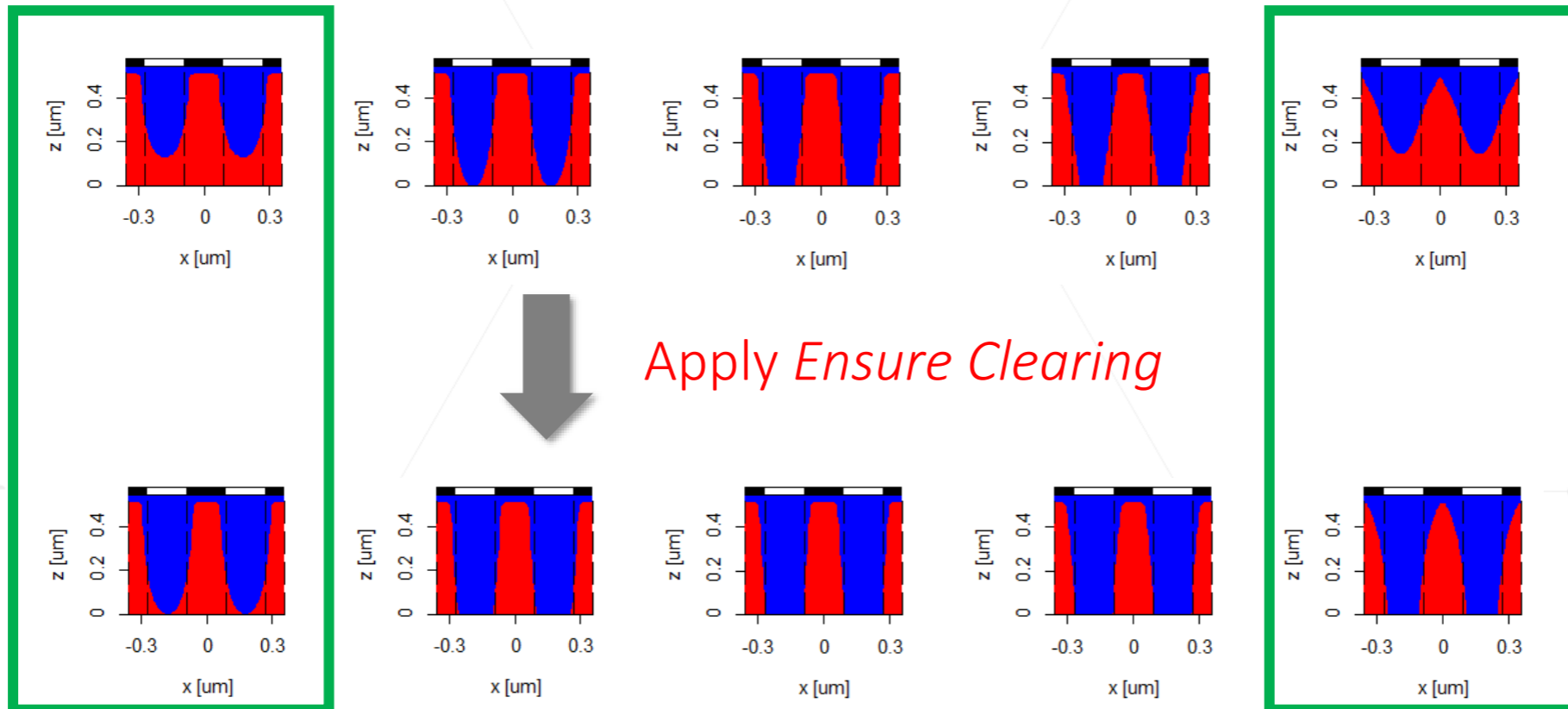
View...

Create Empty Import Data ... Export Data ... Reset Delete

Example of resist clearing in calibration

- The condition “ensure clearing” is fulfilled, if the resist contour touches the substrate surface in at least on position within the simulation region.

Simulated resist Profile in calibration



Topography Stack 3D View

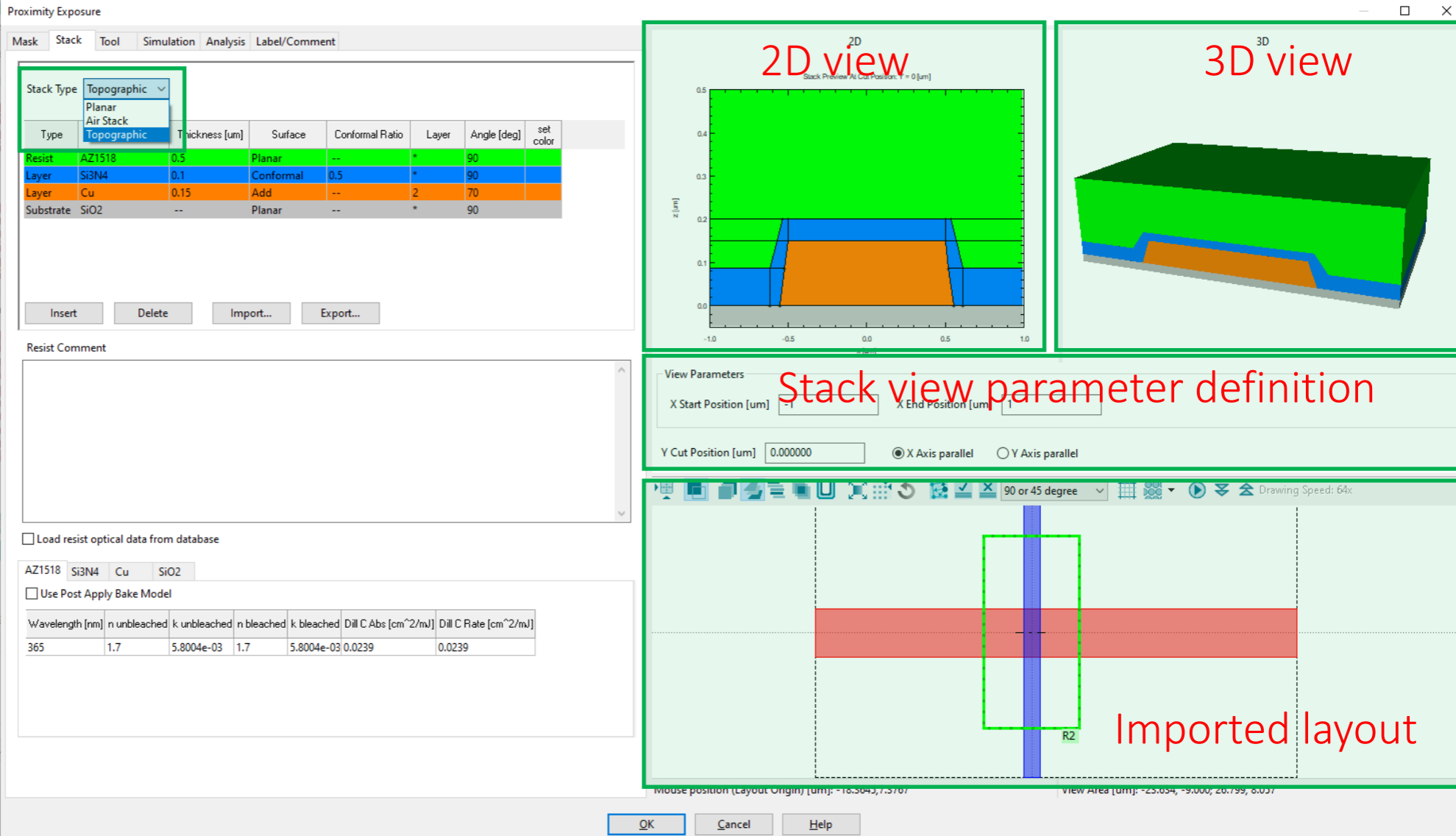
3D view of topography stack

- The stack 3D view is available after importing the layout.

topo_layout

Proximity

- Selection of Stack Type „Topographic“ opens the viewer.



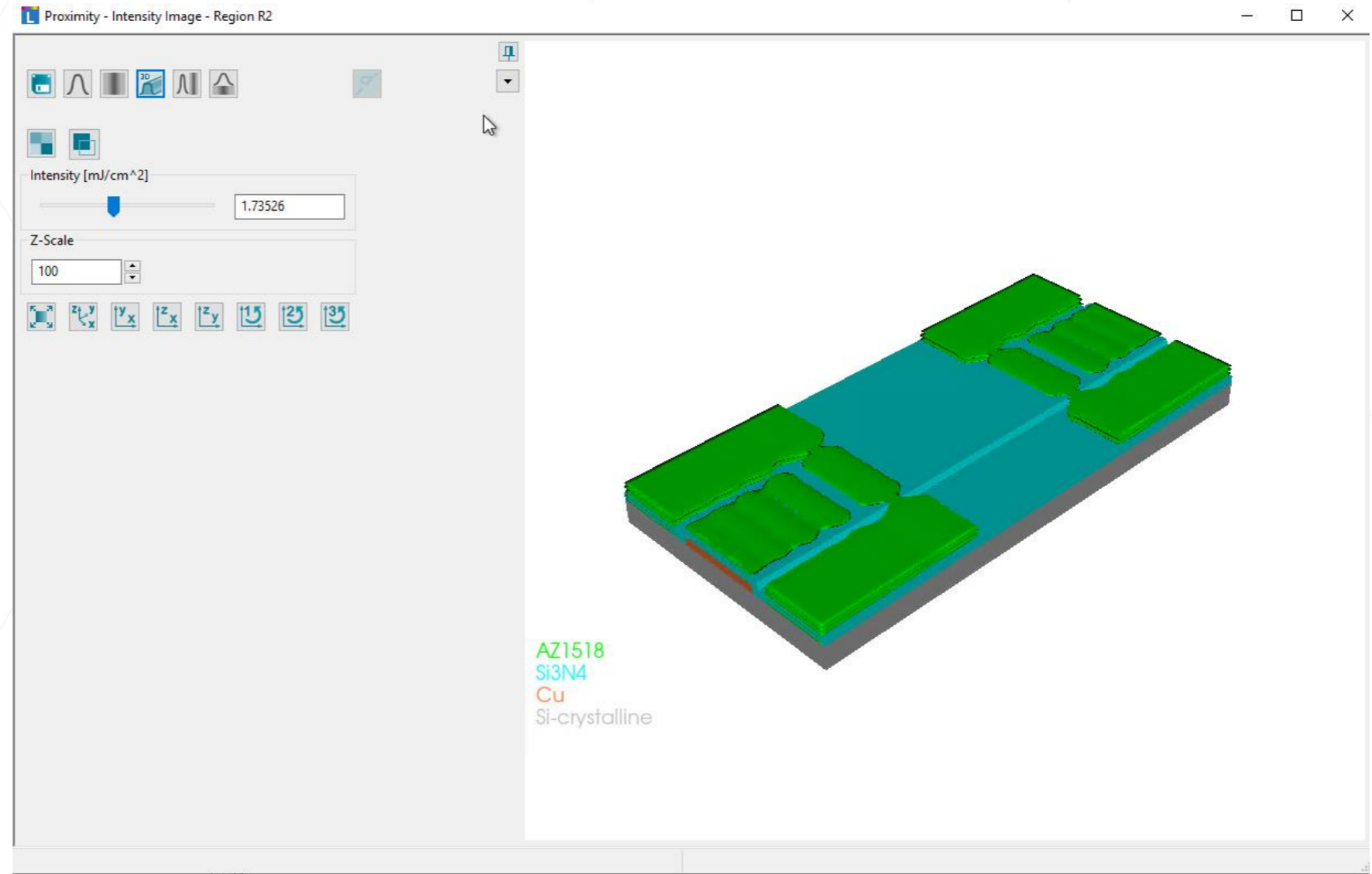
The screenshot displays the Proximity Exposure software interface. The main window is titled "Proximity Exposure" and contains several panels:

- Stack Configuration Table:**

Type	Material	Thickness [um]	Surface	Conformal Ratio	Layer	Angle [deg]	set color
Resist	AZ1518	0.5	Planar	--	*	90	
Layer	Si3N4	0.1	Conformal	0.5	*	90	
Layer	Cu	0.15	Add	--	2	70	
Substrate	SiO2	--	Planar	--	*	90	
- 2D view:** A cross-sectional plot showing the stack profile with a z-axis from 0.0 to 0.5 um and an x-axis from -1.0 to 1.0 um.
- 3D view:** A 3D perspective view of the stack structure.
- Stack view parameter definition:**
 - X Start Position [um]: -1
 - X End Position [um]: 1
 - Y Cut Position [um]: 0.000000
 - Options: X Axis parallel, Y Axis parallel
- Imported layout:** A 2D layout view showing a red rectangular feature and a blue vertical line labeled "R2".

3D view of topography result

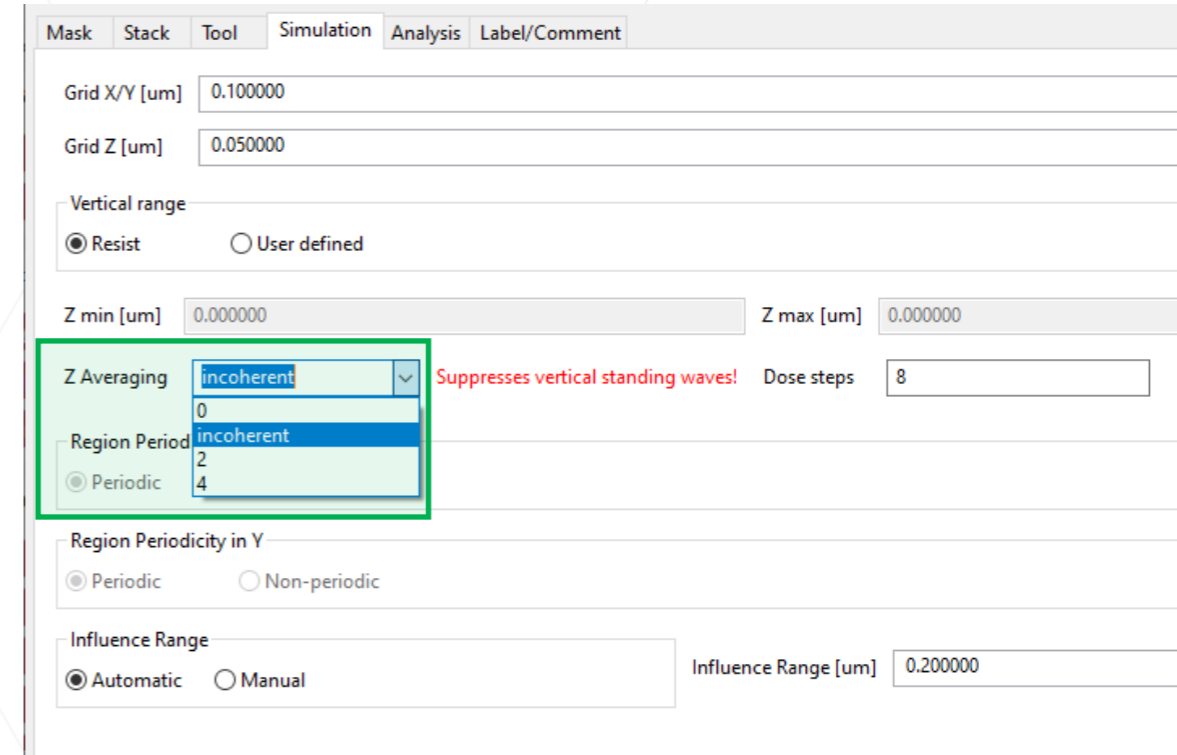
- 3D images of both bulk intensity and resist profile are available



Thick Resist Simulation

Incoherent Z Averaging

- Thick resist simulation has a heavy demands on memory and simulation time.
- This requires a relative large Grid Z value, which can cause sampling errors in cases with standing wave effects.
- Incoherent Z averaging is introduced to suppress the standing wave effect while keeping high accuracy in intensity simulation.



Mask Stack Tool Simulation Analysis Label/Comment

Grid X/Y [um] 0.100000

Grid Z [um] 0.050000

Vertical range
 Resist User defined

Z min [um] 0.000000 Z max [um] 0.000000

Z Averaging **incoherent** Suppresses vertical standing waves! Dose steps 8

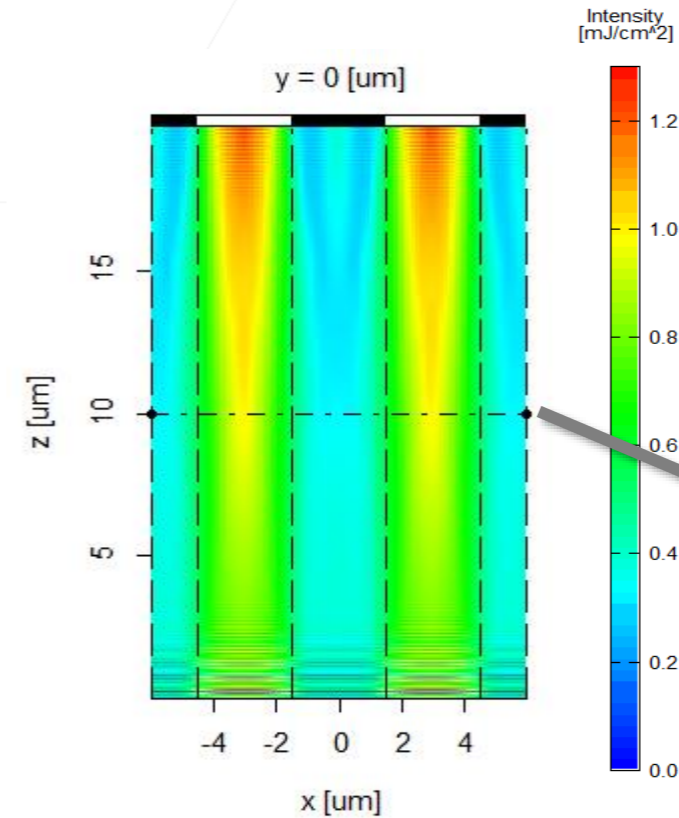
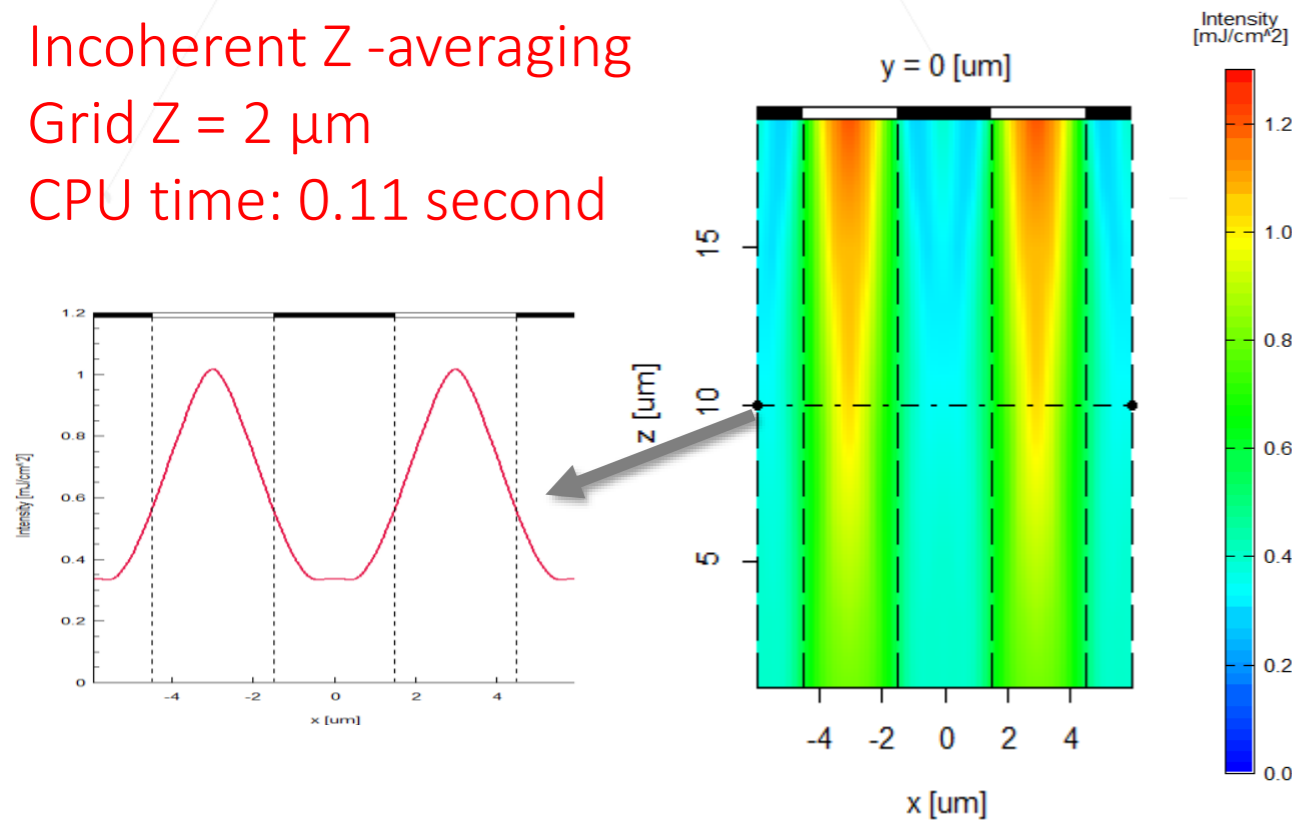
Region Periodicity in Y
 Periodic Non-periodic

Influence Range
 Automatic Manual Influence Range [um] 0.200000

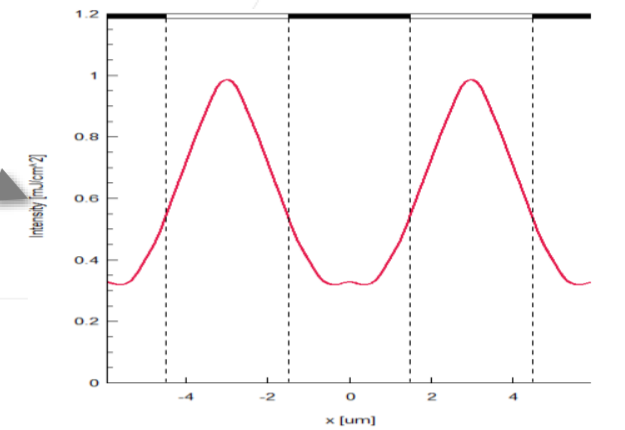
Simulation example for SU8 with 20 μm thickness

- Incoherent Z-averaging has comparable simulation result with no Z-averaging, with intensity deviation within 3.3%.
- Incoherent Z-averaging significantly reduces simulation time.

Incoherent Z -averaging
Grid Z = 2 μm
CPU time: 0.11 second



No Z-averaging
Grid Z = 0.01 μm
CPU time: 29.42 second



Thank You!

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