

TRACER What's New in 2.8.0



Process Calibration



Fitting Mix Factor – OC / UC

TRACTO					Calibra	tion				
Data										
Name:					Precon	ditions for the TF	RACER	Calib	ration include:	
	Data with 50% OC/U	с			1. An a 2. A Do	nalytic PSF or a P se vs. Density tal	SF from	n the ained	archive by exposing a	nd evaluating a PEC corrected density varying
					3. Resis	i, obtainable fron it contrast value.	n GenlS	ys.		
Description:										
					~					
PEC parame	ter used to process t	he calibration pa	attern							
🔘 Use analy	tical PSF									
	Beta [nm]:	8318	È Eta:	1.29	▲ ▼					
Gar	nma [nm]:	0	Nu:	0.00	▲ ▼					
Use PSF f	from archive									
	2D-PSF: Substrat	te_InP_Thicknes	s_700000_Energy	_100_LayersRes	sist_PMMA 200	nm_Z-Position_0	.05_Elec	ctron	s_1000000_Alp	ha_0_Beta_0_Eta_0_Gamma1_0_1 Archive
			•		•					
Optimal co	ontrast [%]:	50	/	50	: Uniform cle	aring [%]				
Calibrated n	nodel									
Resist	×	Resist con	trast:	3.50	Thickness [nm	1:	200	0	D0 [uC/cm^2	2]: 400.00 From CC
Use addit	tional mid range fit t	erm								
Fit mix fa	ictor									
	Α	В	с	D	E	F	, í	^	Add Dose	
1	Target CD [nm]	200	200	200	200	200	200	15	Add Dataset	
2	Density [%]	50.000	33.300	25.000	16.000	9.000	0.000	1 č	Remove	
3	Dose [uC/cm^2]	Mea. CD [nm]	Mea. CD [nm]	Mea. CD [nm]	Mea. CD [nm]	Mea. CD [nm]	Mea	12	Remove	
4	1050	0	325.1	283.5	254.6	234.7	220.7	F	Import	
5	980	0	301.7	2/1.5	251.8	230.9	216.8		Emer	
6	910	550.1	265.1	200.9	240.0	228.9	210.9		Export	

- In process calibration, the additional fit option is added for optimization:
 - mix factor for optimal contrast and uniform clearing composition in PEC. The mix factor fit shows its advantage when the calibration has difficulty in matching both isolated and dense patterns.



Improved Visualization of Calibration Results



- The results of the calibration are summarized in an condensed table.
 - The details help users understand the influence of parameters in calibration by changing them one at a time.
 - Lateral bias, blur and dose latitude are listed for corresponding coverage density.



Visualization of Process Window



• Details of the process calibration result can be visualized:

- Dose/blur process window is calculated for each pattern density.
- The process window has the CD range to be ±10% of the expected CD including bias.

Beta equivalent [nm]: 8318 Eta equivalent: 1.293 Additional mid range [nm]: - Mid range weight: -

Base dose [uC/cm^2]:	612.98	Optimize 🗸		Cov. [%]	Lateral Bias [nm]	Applied Bias [nm]	Blur Latitude [%]	Dose Latitude [%]
Process blur [nm]:	25 🛉	Optimize 🗸		1	0	13	100	73
Constant bias [nm]:	13 🚔	Fixed 🗸		9	4	16	100	66
				16	7	20	100	55
Optimal contrast [%] / Uniform clearing [%]	50 - 50 -		Refit	25	12	24	100	46
Overdose:	1.00			33	17	29	100	40
				50	28	41	100	31
Fit RMS deviation [nm]:	5.29			97	63	75	100	17
O Detailed Result Table								
						< Back	Finish	Cancel



Calibration Base Dose, Blur and Bias Name: Dose Blur Latitude vs Bias Dose - CD Process Window Show Legend ---- Target 200, Density 50, Blue ✓ Target 200, Density 50, Dose Target 200, Density 33, Blur Target 200, Density 33, Dose 1.0 Dose Lat. [-], rel. Blur Lat. [-] Target 200, Density 25, Blur Target 200, Density 25, Dose 0.8 ✓ Target 200, Density 16, Blur ✓ Target 200, Density 16, Dose 0.6 ✓ Target 200, Density 9, Blur ✓ Target 200, Density 9, Dose ✓ Target 200, Density 0, Blur 0.4 ✓ Target 200, Density 0, Dose ✓ Target 200, Density 100, Blur <u>e</u> 0.2 -~ Target 200, Density 100, Dose 0% WP @ 14.5 @ Dose 612.98 • 100% WP @ 77.5 @ Dose 613.14 0.0 -50 50 100 Bias to be applied [nm] Plot Settings

Beta equivalent [nm]: 8318 Eta equivalent: 1	1.293 Additional m	nid range [nm]:	 Mid range wei 	ght: -				
Base dose [uC/cm^2]:	612.98	Optimize 🗸		Cov. [%]	Lateral Bias [nm]	Applied Bias [nm]	Blur Latitude [%]	Dose Latitude [%]
Process blur [nm]:	25 🚔	Optimize 🗸		1	0	13	100	73
Constant bias [nm]:	13 🚔	Fixed ∨		9	4	16	100	66
				16	7	20	100	55
Optimal contrast [%] / Uniform clearing [%]	50 - 50 -		Refit	25	12	24	100	46
Overdose	1.00			33	17	29	100	40
Overdose.	1.00 -			50	28	41	100	31
Fit RMS deviation [nm]:	5.29			97	63	75	100	17
() Detailed Result Table								
						< Back	Finish	Cancel

Dose/Blur Latitude vs Bias

- Details of the process calibration result can be visualized:
 - Relative dose/blur latitude vs applied bias is calculated from the process window.
 - The goal of the calibration is to find optimized process work points for iso and dense structures. They are merged into one proximity effect correction (PEC) by adjusting the optimal contrast/uniform clearing dose range.



w Dose Blur Latitude vs Bias					
CD Plot	ncl. Bias	✓ Nominal	Dose		
%					
6		Base Dose			
6					
6	-		7	2	
	-	/			× -
	1		/		1
70	300 - E - - - - - - - - - - - - - - - - - -	x	x x x x x x x x	× × × × × ×	*
Min 193.366 Max 346.112	200	600 Nominal	800 I Dose [uC/cm^2]		F 00
Eta equivalent: 1.293 Additio	al mid range [nm]: - Mid range wei	ght: -			
612.98	■ Optimize ∨	Cov. [%] Lateral Bias	[nm] Applied Bias [nm]	Blur Latitude [%]	Dose Latitude [9
25	▲ Optimize ∨	1	0 13	3 100	
13	▲ Fixed ✓	9	4 16	5 100	
rm clearing [%] 50 📥 50	* Refit	25	12 24	100	
		33	17 29	9 100	
		50	28 41	I 100	
1.00		97	63 75	5 100	
Eta equivalent: 1.293 Additio 612.98 25 13 rm clearing [%] 50 + 50	al mid range [nm]: - Mid range wei Optimize Optimize Fixed Refit	ght: - Cov. [%] Lateral Bias 1 9 16 25 33 50 97 97	Image: Figure 3 Applied Bias [nm] 0 13 4 16 7 20 12 24 17 29 28 41 63 75	Blur Latitude [%]	D

Enhanced Plot Control

- The plot range is controlable:
 - The x axis and y axis can be set via "Plot Settings".
 - The zoom via mouse works in all plot views.



User Interface



Improved Interface for Adding Material

When a new material is added in

enhanced for convenience.

Material Archive, the user interface is

Old version

Edit Material Material Name	C5H8O1	×		 The stoichiom simplified as s 	etry composition is nown in the example.
Mass Density [g/cm^3] Excitation Energy [eV] Stoichiometry	0.95	Resist	Tracer 2.8	 The excitation be either calcu entered manu 	energy of the material can Ilated automatically or ally.
Element: C	V Count: 5	Add Co Edit Material	C5H8O1	×	
Element: H	✓ Count: 8	Mass Density [g/o	Materials can be copied by changes: m^3] 0.950000	ging the name	
Element: 0	OK Cancel	Stoichiometry	C5H8O [eV] Automatic O Manual 65.	558060	
			OK Cancel		



Custom Tag

TRACER					- 0	×
<u>F</u> ile <u>E</u> dit <u>V</u> iew <u>H</u> elp						
Image: Save Save Save Save			2D-PSF No. 1 - archiv	ved since 08 Nov 201	3 at 13:22:34	×
Navigator	2D-PSF Archive		Tag	project		
 3D-PSF Archive 2D-PSF Archive Material Archive Project 	Order by: Tag F LPSF Analytic Calibration Tag Substrate Za Si Za Si	SiO2 100 nm SiO2 100 nm Cr 80 nm Cr 80 nm	Substrate Layers Resists Beam Energy [keV] Z-Position Electrons Alpha [um]	Si PMMA 100 nm 50 0.045000 2000000 0.000000]]]]] Beta [um]	0.000000
	30GaAs31GaAs32GaAs33GaAs34GaAs35GaAs36Si37Si38GaAs39GaAs40InP41project51		Eta Gamma1 [um] Nue1 Simulator Comment ## PSF ARCHIVED of mcTrace electron	0.000000 0.000000 0.000000 0.000000 mcTrace 1.0.0 on 2013-Nov-08 13:22 simulation (internal)	Gamma2 [um] Gamma2 [um] Nue2	0.000000
	Add to Proje	ect Edit	# Data Manageme RadialMode: MeshRZNumber AllocSizeRZ: 24	ent exp R: 222 Z: 11 442 1 OK	Cancel	>

• A customer tag can be added for each 2D PSF. Thus user can easier recognize the desired PSF in the 2D-PSF Archive.



Save Default for Monte Carlo Simulation

onte Carlo Sir	nulation		_		>
imulation					
Stack Descrip	otion				
Туре	Material	Thickness [nm]	Save [y/n]		
Resist	PMMA	200	Yes		
Layer	Si	700000	No		
Insert Ro Parameters - Simulation Beam Ene	w Delete Row I	mport Ex	port		
Number	of Electrons [e-]		1000000]
Vertical G	rid [nm]]
			В	eam	
		Sa Sa	ave Trajecto	ries to File	
Intermedia	te Results				
Update In	terval [s]		60]
Sim	ulate Save Setup	Save As Defaul		ancol	

• In Monte Carlo simulation dialog, the "Save As Default" button is added to save the simulation parameters: beam parameters and update Intervals



License Management



License Management

Properties	×
General Simulation Archives	
Number of Threads 8	
Hand License back when idle for (mins): 10	
Recent Projects File menu keeps up to 5 r project path entries	
Show last view on startup	
Show Gaussian values as a pop-up for 2D fit nodes	
OK Cancel	

- License hand back
 - License idle timeout can be activated via File->Properties dialog.
 - When Tracer is not used for the assigned time, the license is released with a warning dialog.
 - The user can re-take the license to save the project, or close the program.

License Server	
The License is unavai	lable.
Yes - to attempt to a	cquire a license
No - to save project	and quit TRACER.
	Yes No



Thank You!

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