



Scios Drift Suppression mode

Module 9

Drift Suppression mode

- Drift Suppression (DS) = Automated charge compensation
- Standard feature in the UI; in patterning control area
- Accurate and fast milling of non-conductive material
- E-beam is used to compensate for the positive charge
- Max. ion beam current can be compensated
- New e-beam alignment for DS on Scios2

NOTE: for Scios1 max ion BC that can be compensated is 15nA

The screenshot displays the 'Patterning Control' software interface. At the top, it shows the current job '15 - CCS 1' and a progress bar for 'CCS line progress'. Below this, the 'Property' section is set to 'Selective Mill'. The 'Basic Properties' table lists: Application (Si), X Size (60.00 µm), Y Size (15.00 µm), Z Size (3.00 µm), Scan Direction (Bottom To Top), Dwell Time (1.000 µs), Beam (Ion), and Time (00:20:08). The 'Advanced Properties' table lists: Position X (8.43 µm), Position Y (18.28 µm), Rotation (180.0 °), Gas Type (none), Overlap X (50 %), Overlap Y (50 %), and Pitch X (91.00 nm). The 'Gas Injection' table is as follows:

Gas	Insert	Heat	Flow
C dep	<input type="checkbox"/>	Warm	Closed
IEE	<input type="checkbox"/>	Warm	Closed
Pt dep	<input type="checkbox"/>	Warm	Closed
SCE	<input type="checkbox"/>	Warm	Closed

At the bottom, the 'DS' (Drift Suppression) mode is selected, with a status of 'On' and 'Automatic'. The 'E-Beam Compensation' is set to '100 %', 'High Voltage' is '1.00 kv', and 'Beam Diameter' is '72.5 µm'.

Drift Suppression mode: easy control

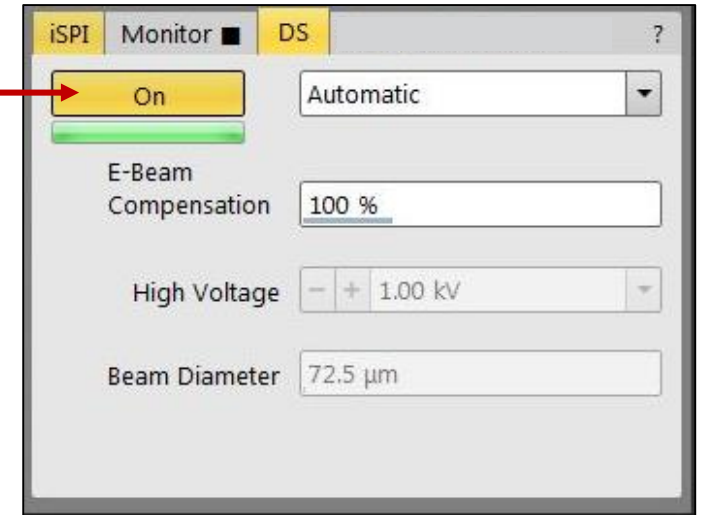
- Drift Suppression (DS) in patterning control area: Switch ON DS:

Automatic:

- e-beam is set to OptiTilt mode
- e-beam is blanked and set to spot mode

NOTE: The position of the green cross can be moved in the e-beam quad.

- e-beam compensation = 100%;
e-beam current $I_{b(e)} \sim 3I_{b(ion)}$
using 1kV for e-beam compensation
- Beam Diameter = Defocus of beam
- Beam diameter/defocus is automatically calculated according to pattern size.



Custom settings : can be used to fine tune the auto settings.

NOTE: # both beams switch on/unblank simultaneously when the patterning/ion beam imaging starts ;

this to avoid charging the sample either by e-beam or i-beam

ETD (or ICE) can be used for imaging; they will collect SE's generated by the i-beam and the e-beam.

So the higher the currents the more the image quality will be affected.

Drift Suppression; User interface

- DS = On
- E-beam in spot mode (green cross) with correct BC to compensate the 30nA FIB and defocused
- Updated FIB image at 30nA + DS mode (e-beam 1kV + 90nA)

Patterning Control

When Finished: No Action

Total time: 00:00:00

Overall progress: [Progress Bar]

Current progress: [Progress Bar]

Properties: Selective Mill

Gas Injection

Gas	Insert	Heat	Flow
C dep	<input type="checkbox"/>	Warm	Closed
IEE	<input type="checkbox"/>	Warm	Closed
Pt dep	<input type="checkbox"/>	Warm	Closed

iSPI Monitor DS

On Automatic

E-Beam Compensation: 100 %

High Voltage: - + 1.00 kV

Beam Diameter: 175 μm

Top-Left Image Metadata: HV 2.00 kV, curr 0.20 nA, det ETD, mode SE, WD 7.0 mm, HFW 254 μm, mag 500 x, PW 331 nm, 50 μm scale bar, Thermo Scientific Scios

Top-Right Image Metadata: HV 30.00 kV, curr 30 nA, det ETD, mode SE, mag 306 x, HFW 414 μm, WD 19.0 mm, tilt 52.0°, 100 μm scale bar, Thermo Scientific Scios

Bottom-Left Image Metadata: 4/25/2018 10:43:27 AM, HFW 156 mm, det Nav-Cam, Thermo Scientific Scios

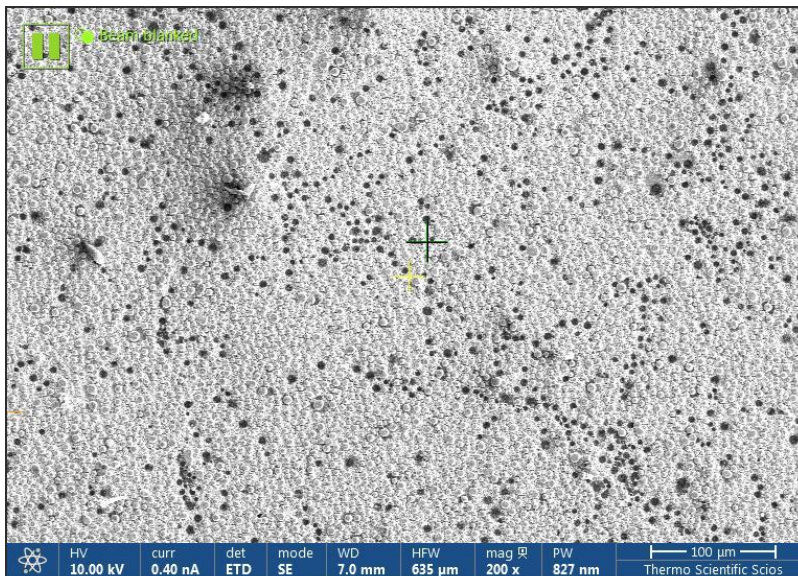
Bottom-Right Image Metadata: 4/26/2018 12:01:02 PM, det CCD, x: 11.4807 mm, y: 26.8776 mm, tilt 52.0°, Thermo Scientific Scios

Drift Suppression; new alignment procedure

4kV to 200V

1pA – 13nA

- Max e-beam current that is aligned is 13nA.
- That's the reason that for Scios1 the max ion BC that could be compensated without any problem was 15nA
- The higher e-beam currents for low kV (<3kV) need to be aligned separately.
- A selection can be made to be aligned.



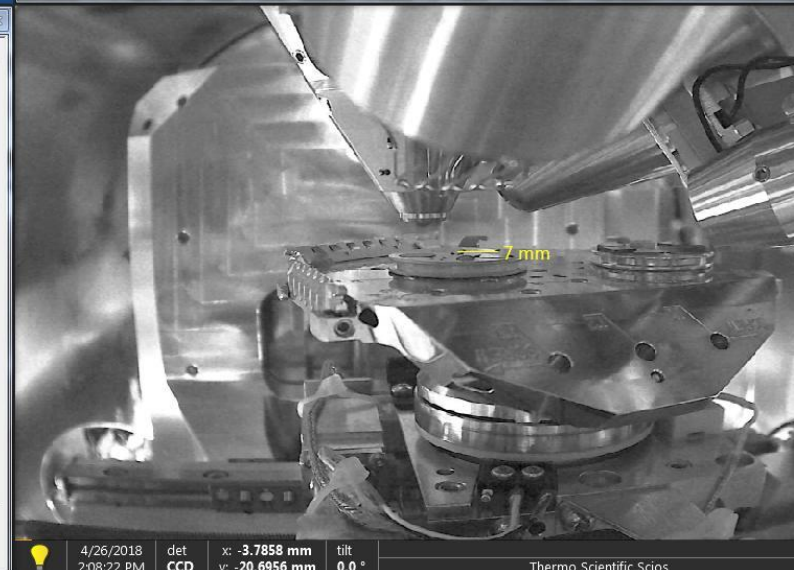
Results	Description	Result	Time
<input checked="" type="checkbox"/>	0 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 5 nA	Manual	1/8/2018 2:24 PM
<input checked="" type="checkbox"/>	1 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 7 nA	Manual	1/8/2018 2:24 PM
<input checked="" type="checkbox"/>	2 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 15 nA	Manual	1/8/2018 2:24 PM
<input checked="" type="checkbox"/>	3 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 30 nA	Manual	1/8/2018 2:25 PM
<input checked="" type="checkbox"/>	4 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 50 nA	Manual	1/8/2018 2:25 PM
<input checked="" type="checkbox"/>	5 EBeamHV: 0.5 kV, IBeamHV: 30 kV, IBeamCurrent: 65 nA	Manual	1/8/2018 2:26 PM
<input checked="" type="checkbox"/>	6 EBeamHV: 0.5 kV, IBeamHV: 16 kV, IBeamCurrent: 7.5 nA	Manual	1/8/2018 2:26 PM
<input checked="" type="checkbox"/>	7 EBeamHV: 0.5 kV, IBeamHV: 16 kV, IBeamCurrent: 15 nA	Manual	1/8/2018 2:26 PM
<input checked="" type="checkbox"/>	8 EBeamHV: 0.5 kV, IBeamHV: 16 kV, IBeamCurrent: 25 nA	Manual	1/8/2018 2:27 PM
<input checked="" type="checkbox"/>	9 EBeamHV: 0.5 kV, IBeamHV: 16 kV, IBeamCurrent: 42 nA	Manual	1/8/2018 2:27 PM
<input checked="" type="checkbox"/>	10 EBeamHV: 0.5 kV, IBeamHV: 8 kV, IBeamCurrent: 3.5 nA	Manual	1/8/2018 2:28 PM
<input checked="" type="checkbox"/>	11 EBeamHV: 0.5 kV, IBeamHV: 8 kV, IBeamCurrent: 7.5 nA	Manual	1/8/2018 2:28 PM
<input checked="" type="checkbox"/>	12 EBeamHV: 0.5 kV, IBeamHV: 8 kV, IBeamCurrent: 12 nA	Manual	1/8/2018 2:29 PM
<input checked="" type="checkbox"/>	13 EBeamHV: 0.5 kV, IBeamHV: 8 kV, IBeamCurrent: 20 nA	Manual	1/8/2018 2:29 PM
<input checked="" type="checkbox"/>	14 EBeamHV: 0.5 kV, IBeamHV: 5 kV, IBeamCurrent: 7.7 nA	Manual	1/8/2018 2:29 PM
<input checked="" type="checkbox"/>	15 EBeamHV: 0.5 kV, IBeamHV: 5 kV, IBeamCurrent: 13 nA	Manual	1/8/2018 2:30 PM
<input checked="" type="checkbox"/>	16 EBeamHV: 0.5 kV, IBeamHV: 2 kV, IBeamCurrent: 7.1 nA	Manual	1/8/2018 2:30 PM
<input checked="" type="checkbox"/>	17 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 5 nA	Reliable	2/28/2018 8:27 AM
<input checked="" type="checkbox"/>	18 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 7 nA	Reliable	2/28/2018 8:30 AM
<input checked="" type="checkbox"/>	19 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 15 nA	Reliable	2/28/2018 8:33 AM
<input checked="" type="checkbox"/>	20 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 30 nA	Reliable	2/28/2018 8:36 AM
<input checked="" type="checkbox"/>	21 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 50 nA	Reliable	2/28/2018 8:39 AM
<input checked="" type="checkbox"/>	22 EBeamHV: 1 kV, IBeamHV: 30 kV, IBeamCurrent: 65 nA	Reliable	2/28/2018 8:42 AM

Drift Suppression

Select conditions to be aligned

Electron Beam HV:	Ion Beam HV:
<input type="checkbox"/> EBeamHV: 0.5 kV	<input checked="" type="checkbox"/> IBeamHV: 30 kV
<input checked="" type="checkbox"/> EBeamHV: 1 kV	<input checked="" type="checkbox"/> IBeamHV: 16 kV
<input type="checkbox"/> EBeamHV: 2 kV	<input checked="" type="checkbox"/> IBeamHV: 8 kV
<input type="checkbox"/> EBeamHV: 3 kV	<input type="checkbox"/> IBeamHV: 5 kV
	<input type="checkbox"/> IBeamHV: 2 kV

Cancel Next



Alignments

E-column: Supervisor Alignments

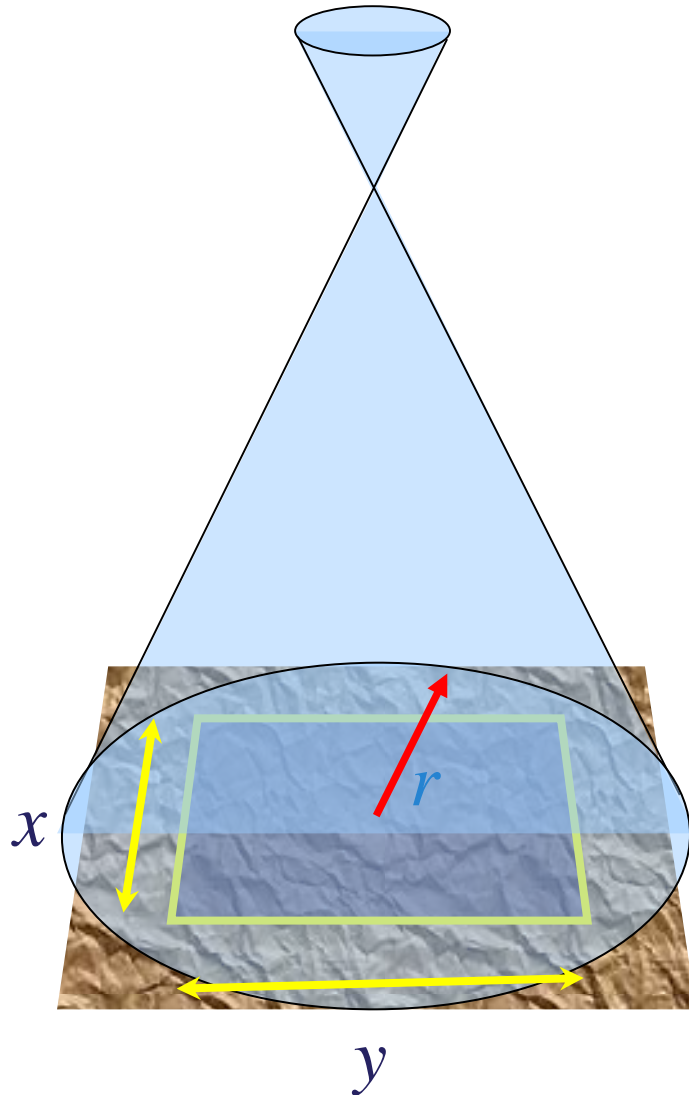
- Sample Alignment
- Aperture Alignment
- Source Tilt and Shift
- Image Shift
- Stigmator Alignment
- Focus Centering
- Low Magnification Lens Alignment
- Drift Suppression
- Switch Electron Beam Off

Run Selection

Finish

Automatic Hide Windows

How does it work?



- E-beam current is calculated and changed automatically: $I_{b(e)} \sim 3I_{b(\text{ion})}$
- Defocused beam according to pattern size