

Nabity System

UPDATES:

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- [Walk-through](#)

As of 10/19/16 (though truly from 2013-2014 during MoS2 work):

Chip Spinning:

1. spin 4% 495 @ 3000 rpm, 1000 ramp, 60 s (resist will be ~150 nm thick)
 - bake @ 170 °C for 15 min
2. spin 2% 950 @ 3000 rpm, 1000 ramp, 60 s (resist will be ~50 nm thick)
 - bake @ 170 °C for 15 min

(develop in 1:3 MIBK:IPA - see below - & lift-off in 1:1 methylene chloride:acetone)

E-beam Writing on the Nabity

1. Measure the current in pA for all apertures you are going to use (typically, 10 μm ap \Rightarrow 30-40 pA & 60 μm ap \Rightarrow ~1000+ pA)
 2. Parameters common to all run files (including alignment):
 - a. gun @ 20 kV
 - b. 900 magnification
 - c. general params:
 - - - Non-stop writing mode yes
 - Disable automated stage control no
 - Disable digital SEM control no
 - Disable x-y focus mode yes
 - Enable global rotation correction no
1. alignment windows:
 - counts of 15
 - center-to-center spacing 50 nm
 - line spacing of 50 nm
2. pattern writing of fine features:
 - 10 μm aperture (set in Supra system, not Nabity system)
 - continuous write
 - center-to-center spacing 5 nm
 - line spacing of 5 nm
 - 300 $\mu\text{C}/\text{cm}^2$ area dose
3. pattern writing of large features:
 - 60 μm aperture (set in Supra system, not Nabity system)
 - continuous write
 - center-to-center spacing 30 nm
 - line spacing of 30 nm
 - 500 $\mu\text{C}/\text{cm}^2$ area dose

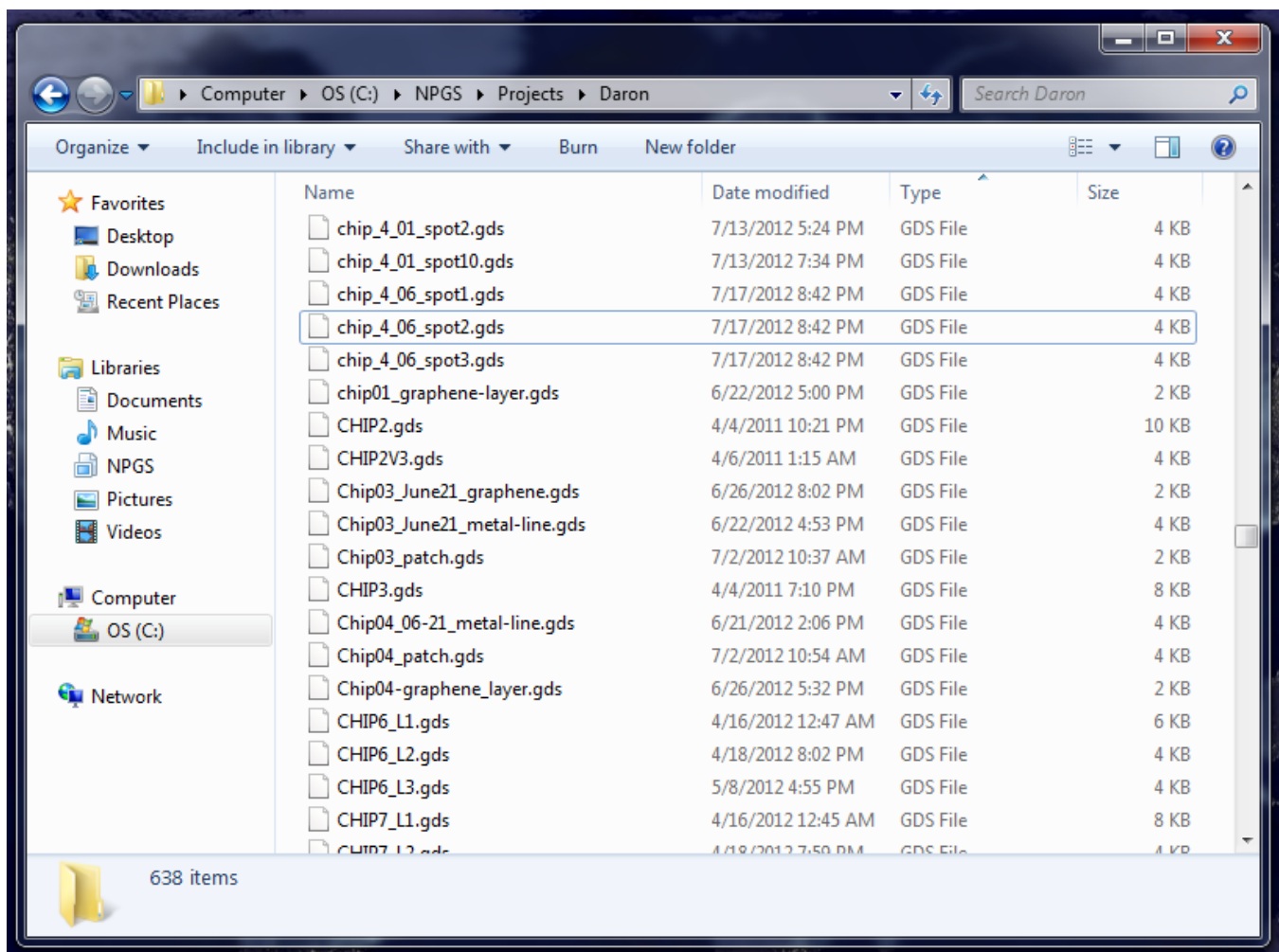
*see screenshots below

Development

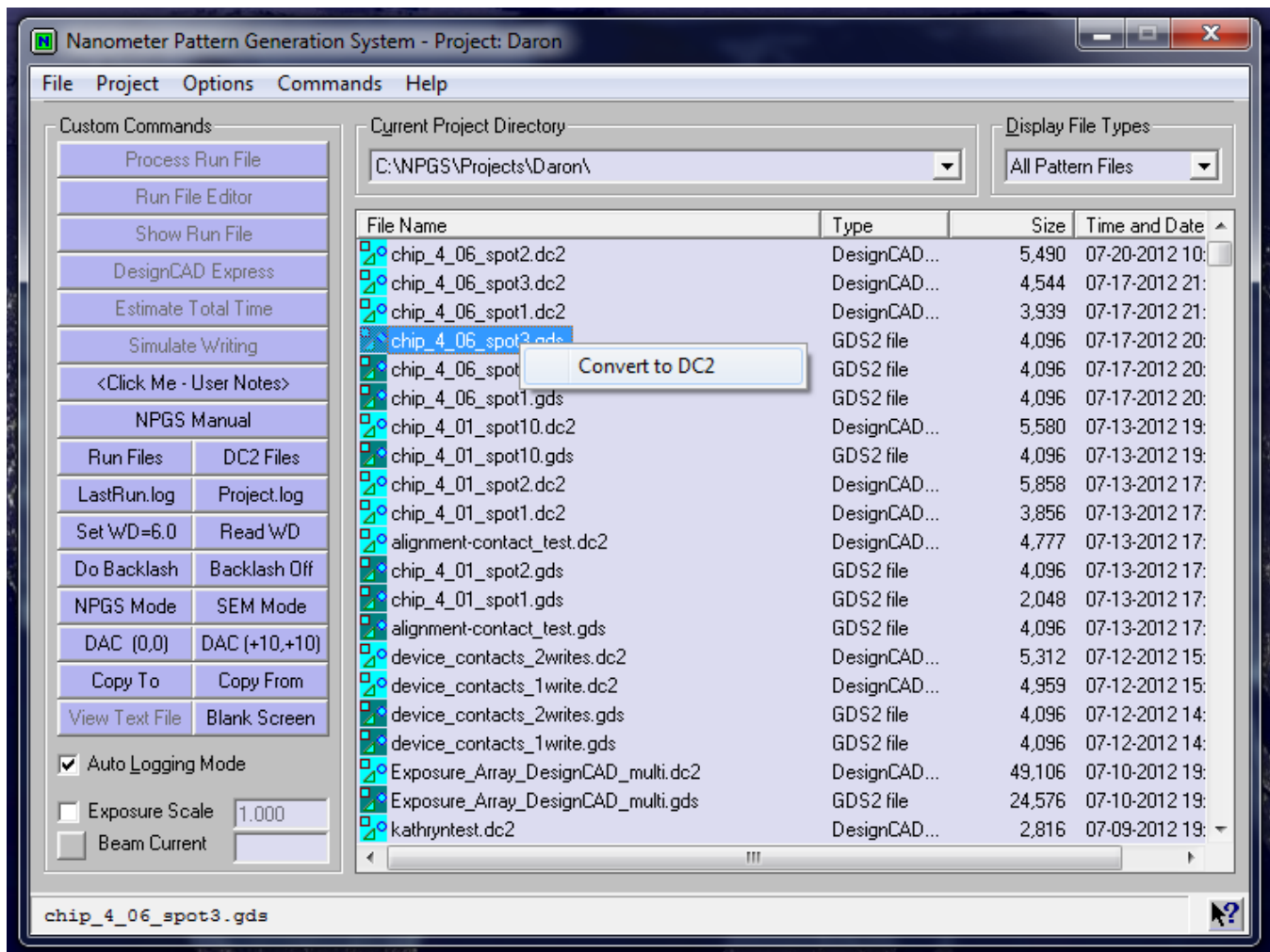
- 45 sec in 1:3 MIBK:IPA (shake chip back-and-forth in soln) & quench in IPA; N2 dry

Walk-through

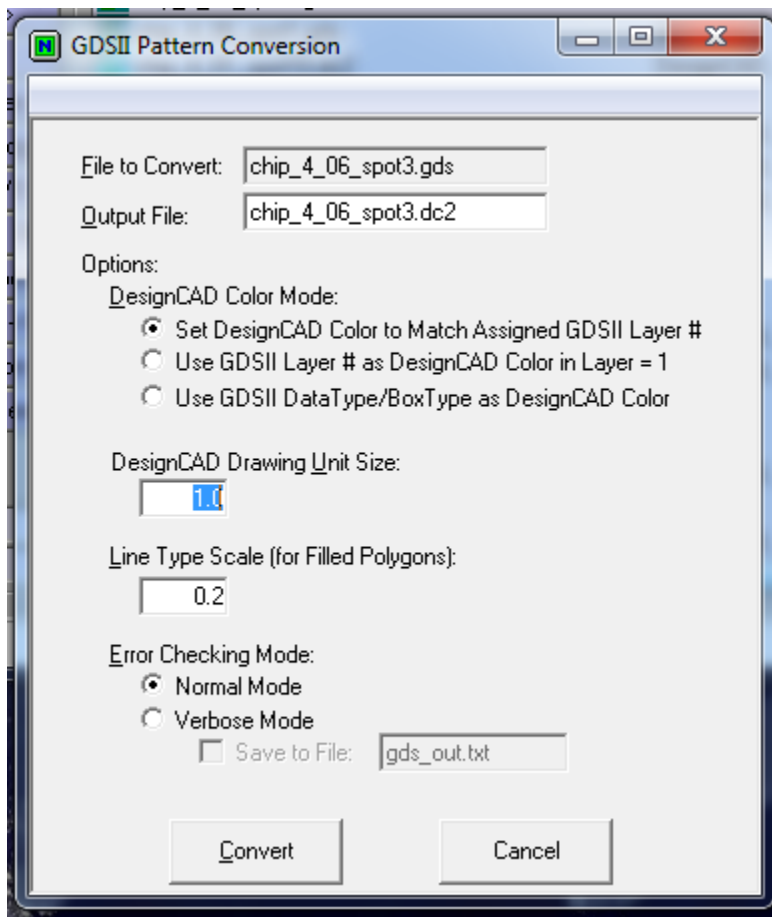
step 1 - copy gds file into this directory:



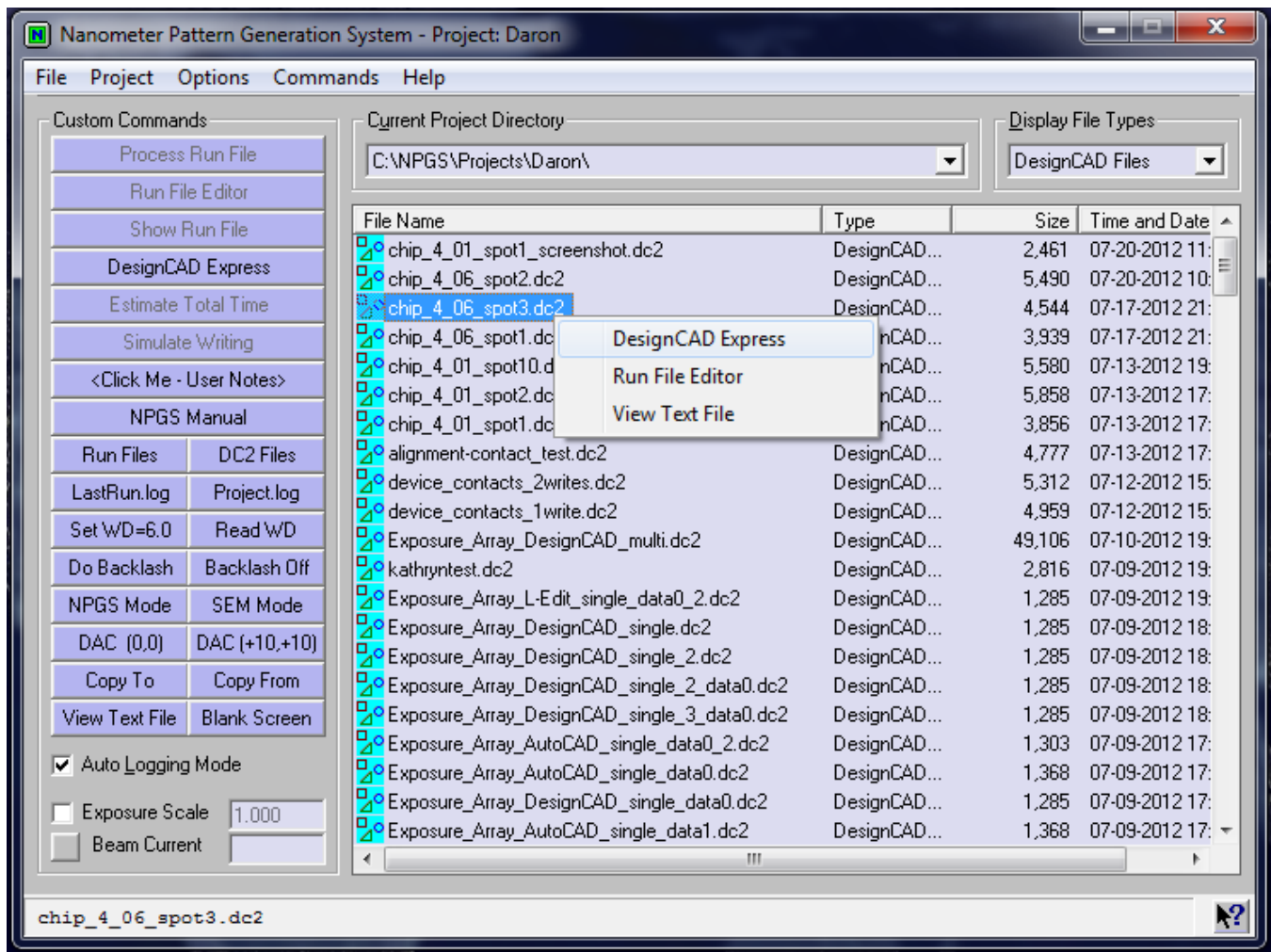
step 2 - right click to convert gds to dc2:



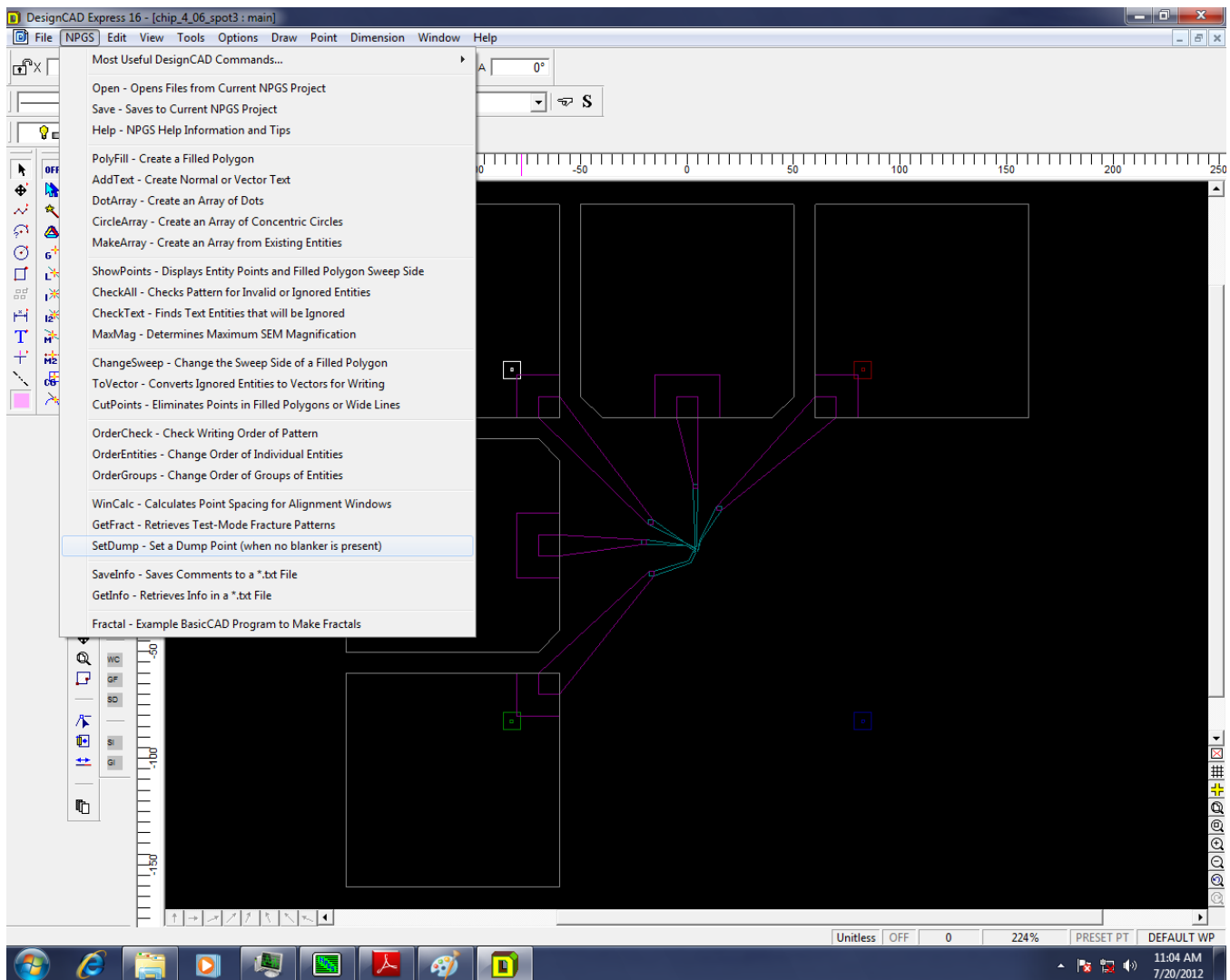
step 2.1 - change drawing unit size to 1 and press convert:



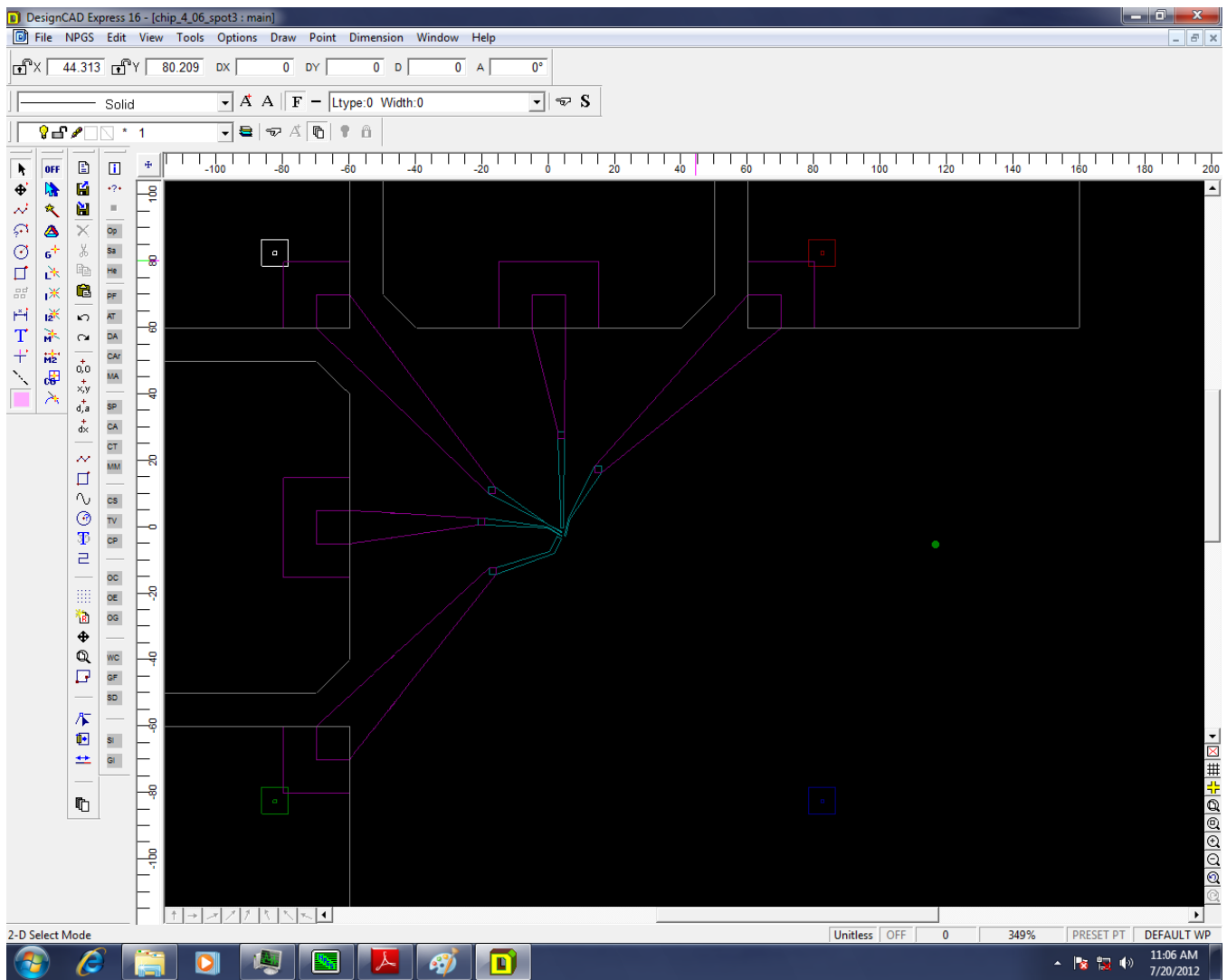
step 3 - right click on new dc2 file and select DesignCAD Express:



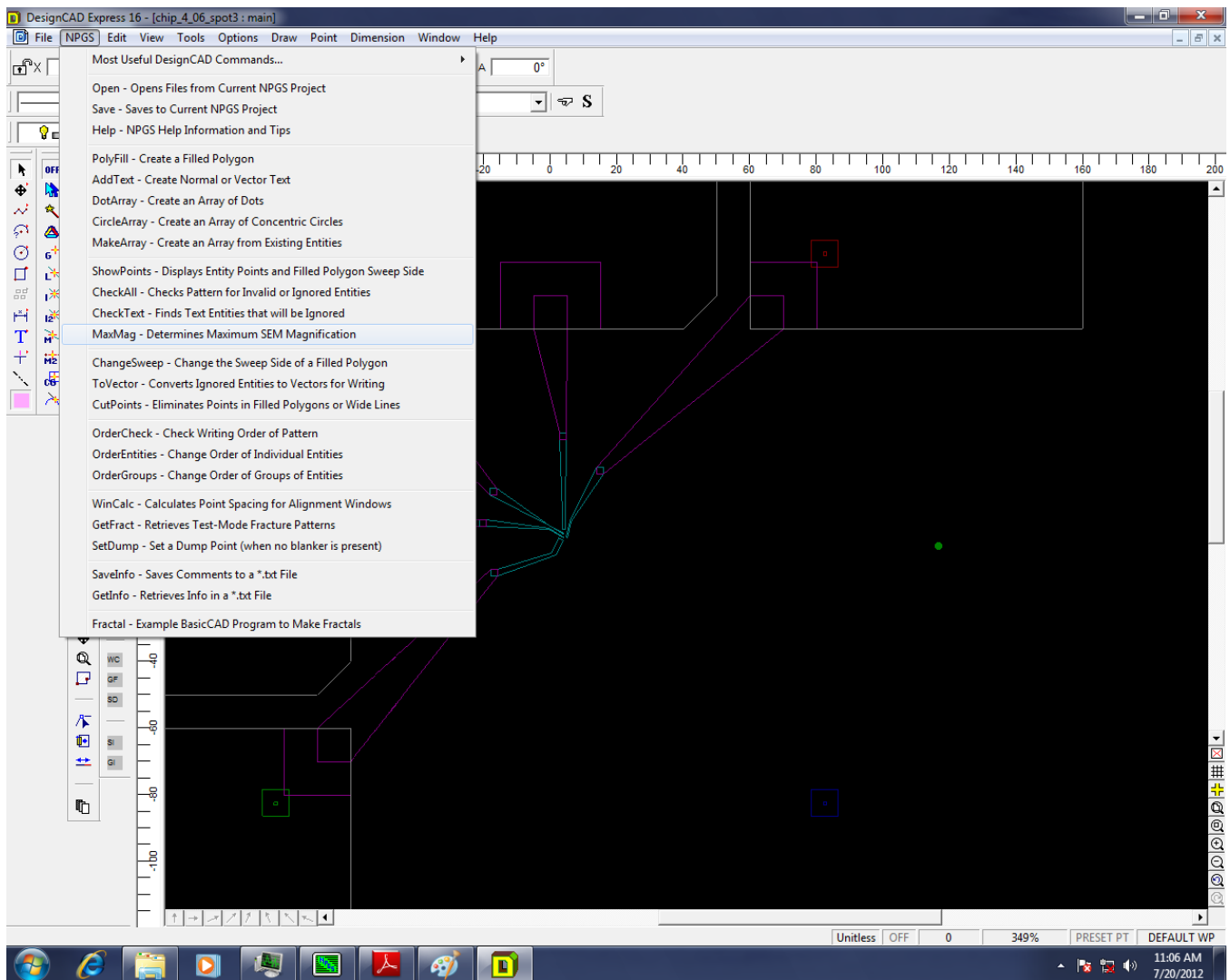
step 3.1 - click NPGS - setdump



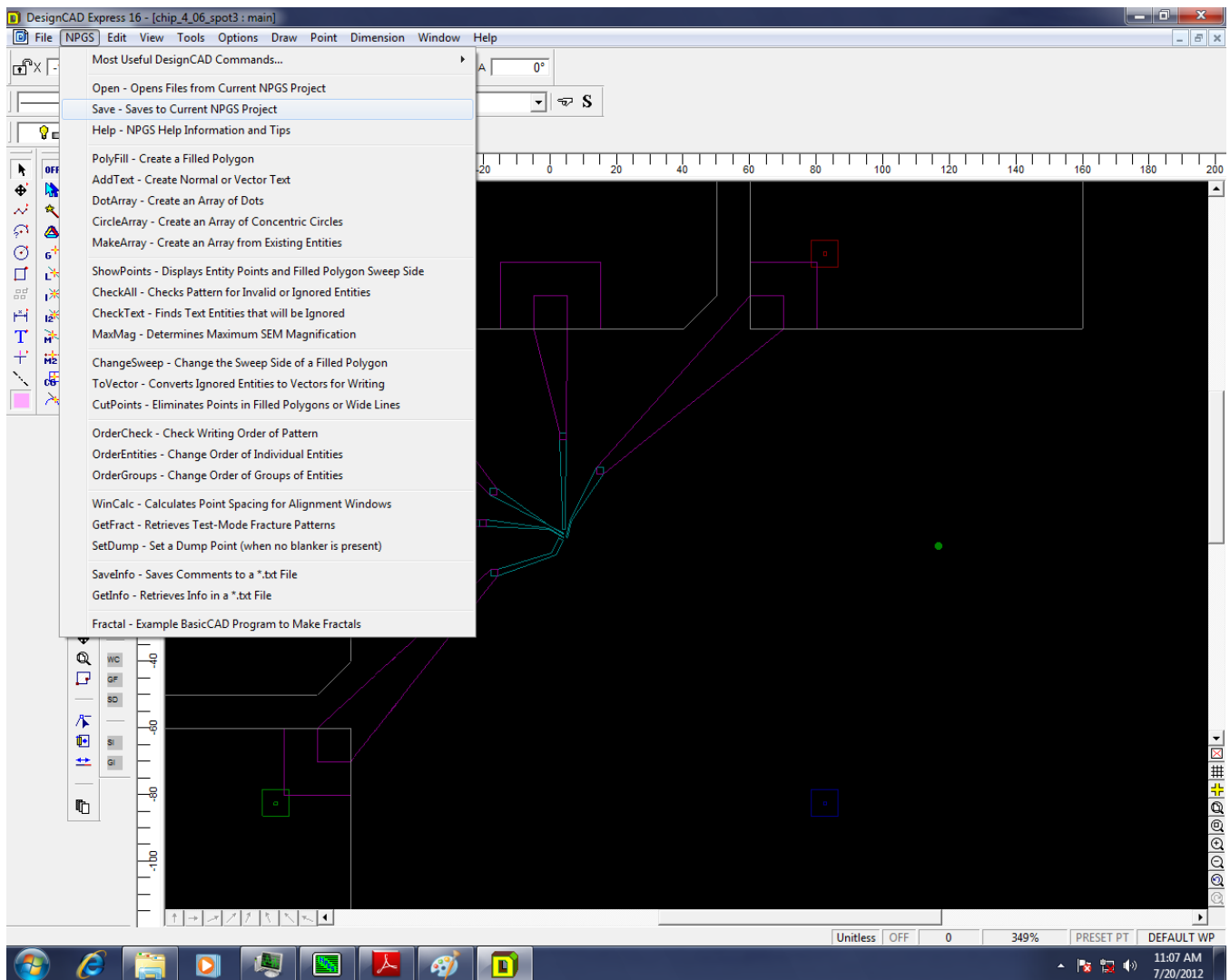
step 3.1.1 - the dump point is green:



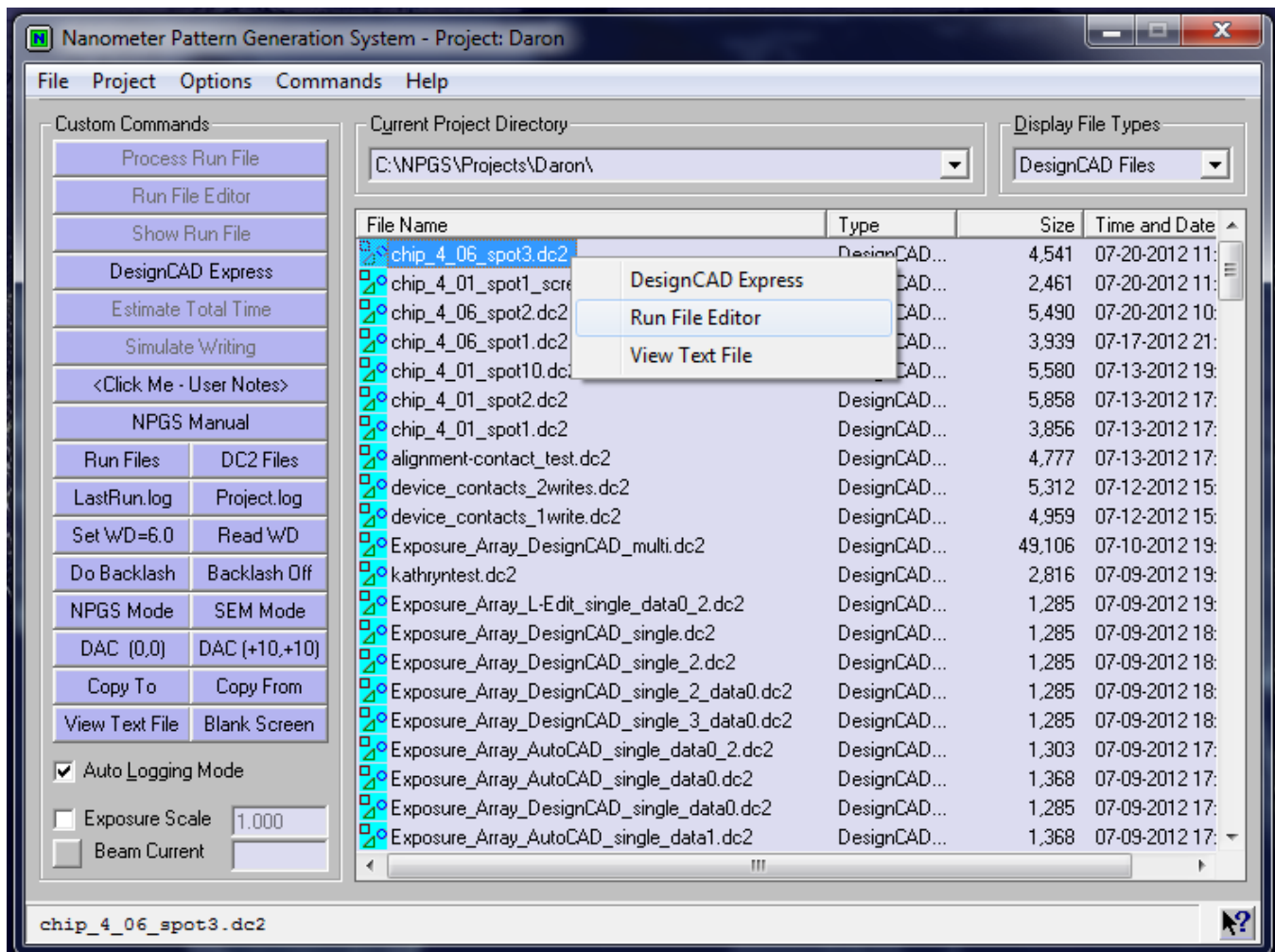
step 3.2 - click NPGS - MaxMag:



step 3.3 - click NPGS - save - exit when done - then re-open to double check dump existence:



step 4 - right click on dc2 - choose run file editor:



step 4.1 - for fine contacts process 2 entities - set params as shown - pattern name is name of dc2 file:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries		Highlighted Entity Data	
Number of entities to process	2	Non-Stop Writing Mode	Yes
Allow Advanced Modes	Yes	Disable Automated Stage Control	No
1. Entity Type	Alignment	Disable Digital SEM Control	No
Alignment Mode	Manual	Disable X-Y-Focus Mode	Yes
Pattern Name	chip_4_06_spot3	Disable Automated Beam Reading	Yes
Number of times to repeat pattern	1	Time Between Readings	(Minutes) 20.0
XY Move to Pattern Center	(μm , μm) 0,0	Check Beam Reading Before	1
2. Entity Type	Pattern	Enable Global Rotation Correction	No
Pattern Name	chip_4_06_spot3	Offset for Stage Rotation Adjustment	1,0
Number of times to repeat pattern	1	Offset for Stage Matrix	(Optional)
XY Move to Pattern Center	(μm , μm) 0,0		

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

Up to 5000 Entities can be created using the Run File Editor. You can now save changes.

step 4.2 - 1st entity is alignment - set params as shown - insert measured beam current in pA:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries

Number of entities to process 2

Allow Advanced Modes Yes

1. Entity Type Alignment

Alignment Mode Manual

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

2. Entity Type Pattern

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

Highlighted Entity Data

Layer 1 Window

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 50.86

Line Spacing (nm) 50.86

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Dwell: Color 1 ☐ Counts 15

Layer 2 Window

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 50.86

Line Spacing (nm) 50.86

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Dwell: Color 1 ☒ Counts 15

Layer 3 Window

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 50.86

Line Spacing (nm) 50.86

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

Layer 1: Measured Beam Current limits: 1.0 < X < 10000000.0

You can now save changes.

step 4.2.1 - skip all non alignment layers:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries		Highlighted Entity Data	
Number of entities to process	2	Dwell: Color 1	Counts 15
Allow Advanced Modes	Yes	Layer 4	Window
1. Entity Type	Alignment	Origin Offset (x,y)	(μm , μm) 0,0
Alignment Mode	Manual	Magnification	900
Pattern Name	chip_4_06_spot3	Center-to-Center Distance	(nm) 50.86
Number of times to repeat pattern	1	Line Spacing	(nm) 50.86
XY Move to Pattern Center	(μm , μm) 0,0	Configuration Parameter	1
2. Entity Type	Pattern	Measured Beam Current	(pA) 10.0
Pattern Name	chip_4_06_spot3	Dwell: Color 1	Counts 15
Number of times to repeat pattern	1	Layer 6	Skip
XY Move to Pattern Center	(μm , μm) 0,0	Origin Offset (x,y)	(μm , μm) 0,0
		Magnification	900
		Center-to-Center Distance	(nm) 50.86
		Line Spacing	(nm) 50.86
		Configuration Parameter	1
		Measured Beam Current	(pA) 10.0
		Dwell: Color 1	Counts 15
		Layer 7	Skip
		Origin Offset (x,y)	(μm , μm) 0,0
		Magnification	900
		Center-to-Center Distance	(nm) 50.86

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

Layer 6: Select the appropriate setting for each layer in the pattern. You can now save changes.

step 4.3 - 2nd entity for fine contacts - skip all alignment layers - change line to area dose:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries

Number of entities to process 2

Allow Advanced Modes Yes

1. Entity Type Alignment

Alignment Mode Manual

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

2. Entity Type Pattern

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

Highlighted Entity Data

Layer 4 Skip

Origin Offset (x,y) (μm,μm) 0,0

Magnification 1000

Center-to-Center Distance (nm) 18.31

Line Spacing (nm) 50.35

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 ■ (μsec) 238.04

Line Dose (nC/cm) 1.30

Layer 6 Continuous

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 5.09

Line Spacing (nm) 5.09

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 ■ (μsec) 66.12

Line Dose (nC/cm) 1.29997

Layer 7 Area

Line

Point

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

Layer 6: Area Dose limits: 0.00001 < X < 100000000.00 You can now save changes.

step 4.3.1 - enter params as shown - same for each layer! - skip contact pad layer - remember to update measured current

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries

Number of entities to process 2

Allow Advanced Modes Yes

1. Entity Type Alignment

Alignment Mode Manual

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

2. Entity Type Pattern

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

Highlighted Entity Data

Layer 6 Continuous

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 5.09

Line Spacing (nm) 5.09

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 (μsec) 7.761

Area Dose (μC/cm²) 300.00

Layer 7 Continuous

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 5.09

Line Spacing (nm) 5.09

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 (μsec) 7.761

Area Dose (μC/cm²) 300.00

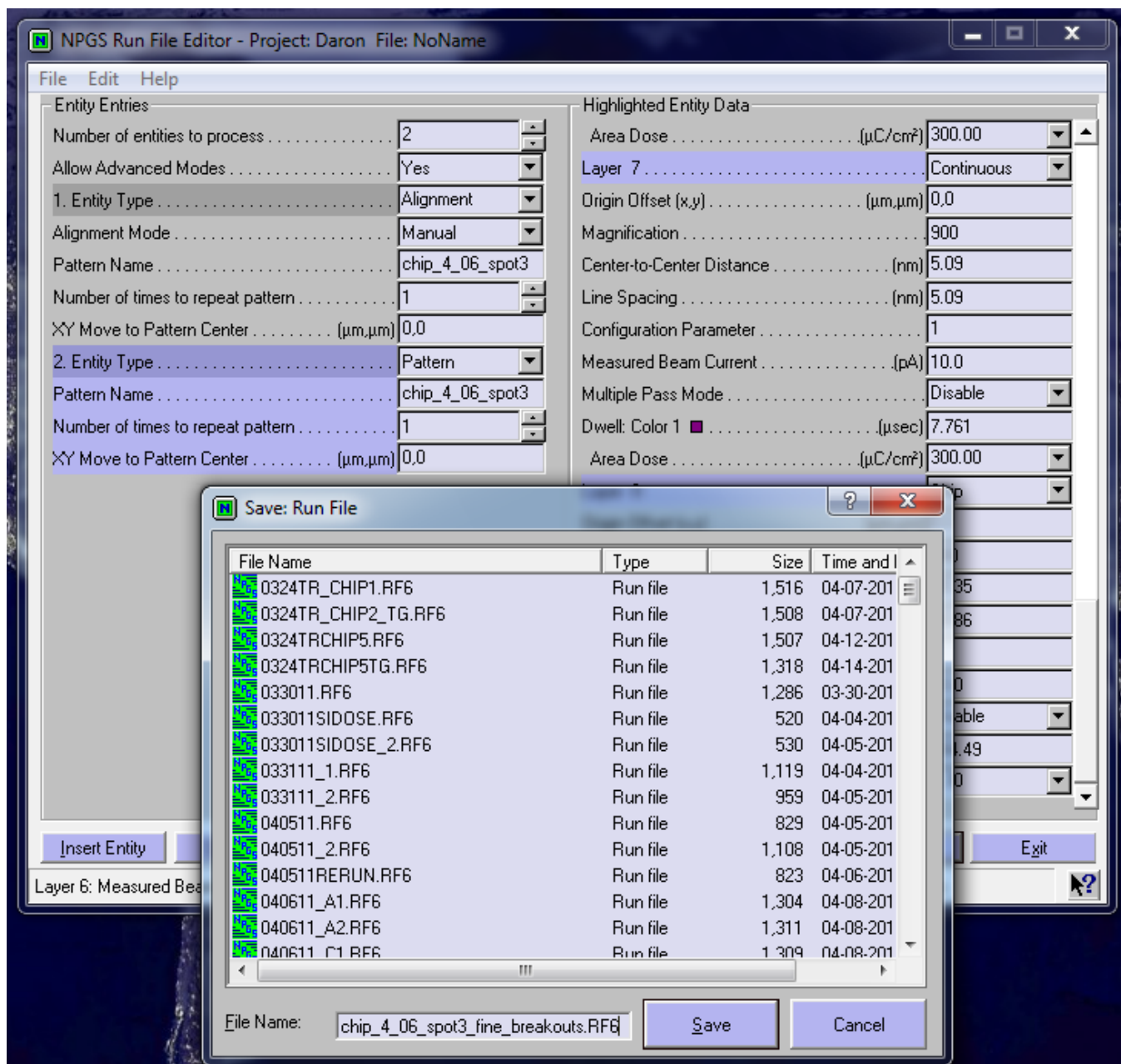
Layer 8 Skip

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

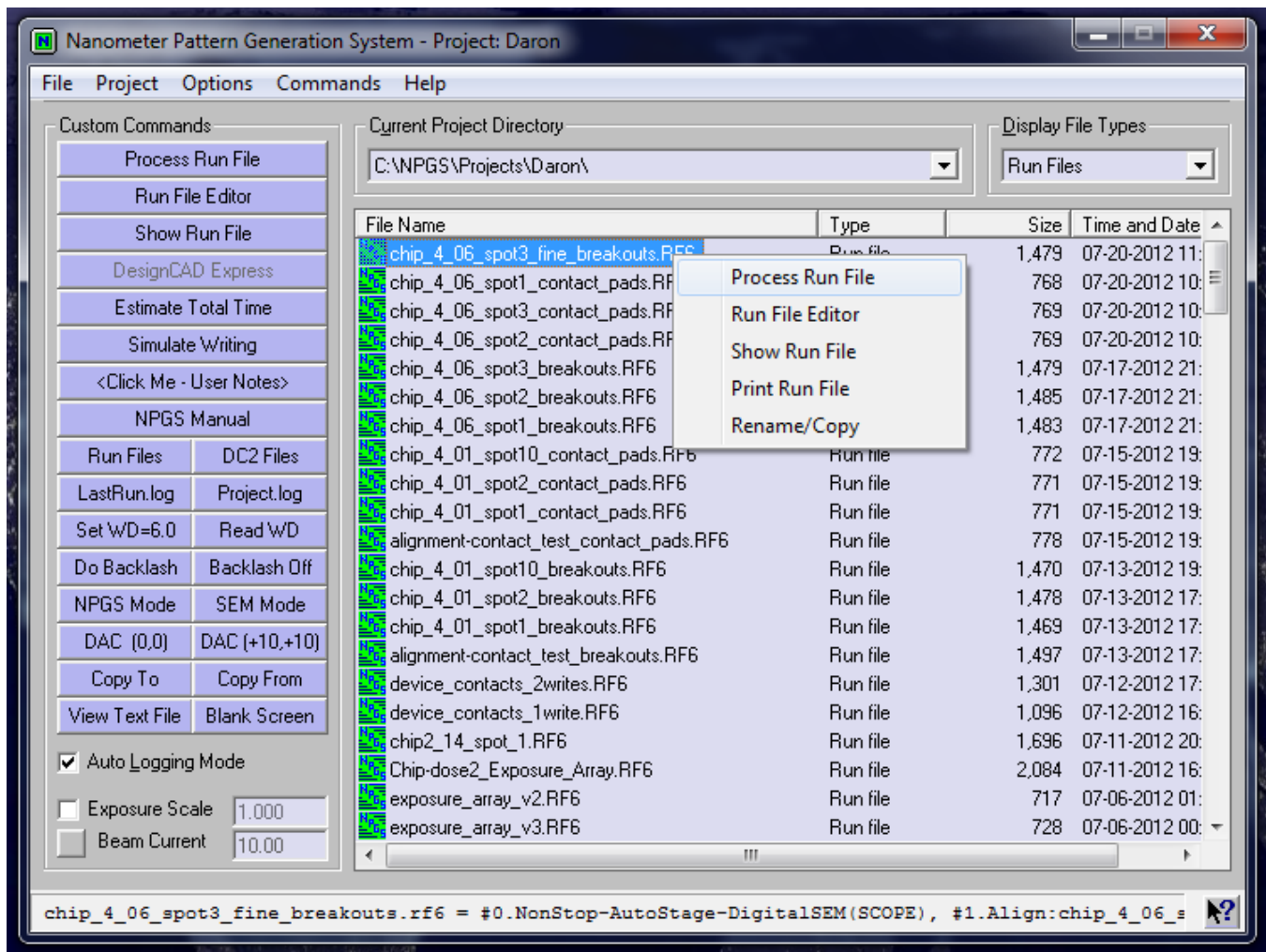
Layer 6: Measured Beam Current limits: 1.0 < X < 10000000.0

You can now save changes.

step 4.4 - save run file - extension RF6 - and exit:



step 5 - find run file - right click - process run file:



step 5.1 - click continue - the writing will start!

Log File Editor - Project Daron File: Pg_Log_Pre.sys

File Help

<Pre-Writing Log File>

Sample Information...

Sample #1	Sample/Wafer ID
none	Secondary ID
Si3N4	Substrate
950k PMMA	Resist (Top Layer)
150-200nm	Resist Thickness
Not Used	Resist (Bottom Layer)
Not Used	Resist Thickness

Microscope Settings...

20kV	Accelerating Voltage (kV)
7	Gun Bias
2.2	Filament Current (A)
60	Emission Current (pA)

Save & Continue Continue Cancel Exposure

Sample/Wafer ID No Changes

step 6 - set up contact pad exposure - use these params:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries		Highlighted Entity Data	
Number of entities to process	1	Non-Stop Writing Mode	Yes
Allow Advanced Modes	Yes	Disable Automated Stage Control	No
1. Entity Type	Pattern	Disable Digital SEM Control	No
Pattern Name	chip_4_06_spot3	Disable X-Y-Focus Mode	Yes
Number of times to repeat pattern	1	Disable Automated Beam Reading	Yes
XY Move to Pattern Center (μm,μm)	0,0	Time Between Readings (Minutes)	20.0
		Check Beam Reading Before	1
		Enable Global Rotation Correction	No
		Offset for Stage Rotation Adjustment	1.0
		Offset for Stage Matrix (Optional)	

The SEM driver is defined in Pg_Cmd.sys. You can now save changes.

step 6.1 - skip all but contact pad layer - enter params - remember to update measured current - proceed as before:

NPGS Run File Editor - Project: Daron File: NoName

File Edit Help

Entity Entries

Number of entities to process 1

Allow Advanced Modes Yes

1. Entity Type Pattern

Pattern Name chip_4_06_spot3

Number of times to repeat pattern 1

XY Move to Pattern Center (μm,μm) 0,0

Highlighted Entity Data

Line Dose (nC/cm) 1.30

Layer 7 Skip

Origin Offset (x,y) (μm,μm) 0,0

Magnification 1000

Center-to-Center Distance (nm) 32.04

Line Spacing (nm) 50.35

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 ■ (μsec) 416.56

Line Dose (nC/cm) 1.30

Layer 8 Continuous

Origin Offset (x,y) (μm,μm) 0,0

Magnification 900

Center-to-Center Distance (nm) 30.52

Line Spacing (nm) 30.52

Configuration Parameter 1

Measured Beam Current (pA) 10.0

Multiple Pass Mode Disable

Dwell: Color 1 ■ (μsec) 465.661

Area Dose (μC/cm²) 500.00

Insert Entity Cut Entity Copy Entity Paste Entity Set Doses Print Save Exit

Layer 8: Measured Beam Current limits: 1.0 < X < 10000000.0

You can now save changes.