Goal:

This report documents the contrast curves for the PMMA A2 electron beam lithography resist from MicroChem. Spin curves can be found in previous work and is available at http://repository.upenn.edu/scn_protocols/34/. The aim is to provide an approximate clearing and base dose for the PMMA A2 standard process at the Singh Center for Nanotechnology.

Materials:

- MicroChem PMMA A2
- 3” Si wafers
- 3 clean beakers
    - One large enough to develop a 3” wafer
    - Two 80mL beakers
- Developer: DI water, Isopropyl Alcohol (IPA)

Equipment:

- ReynoldsTech Spinner
- Torrey Pines Scientific Hotplate
- Filmetrics F40
- Elionix ELS-7500EX Electron Beam Lithography (EBL) Tool
- Timer

Protocol:

Spin Coat and Soft Bake

1. Mount wafer and ensure that it is centered on the ReynoldsTech Spinner
2. Spin wafer at a fixed RPM for 60 seconds.
3. Bake wafer at 180 °C for 90 seconds and allow wafer to cool after removal.

Exposure

1. Generate an array of 60 micron by 60 micron square in a dose matrix on a 100 micron pitch.
2. Using the Elionix ELS-7500EX EBL tool, expose the pattern using 100pA with a 30 micron objective lens aperture (OLA, a.k.a. final aperture).

Developer Preparation: 3:1 IPA:DI Water Co-solvent Developer

1. Pour 60mL of DI Water into the first clean 80mL beaker.
2. Pour 20mL of IPA into the second clean beaker.
3. Pour the contents of the DI water into the beaker containing the IPA. Alternate pouring from one beaker to another to guarantee thorough mixing.
4. When finished, pour the dilution into to larger beaker.

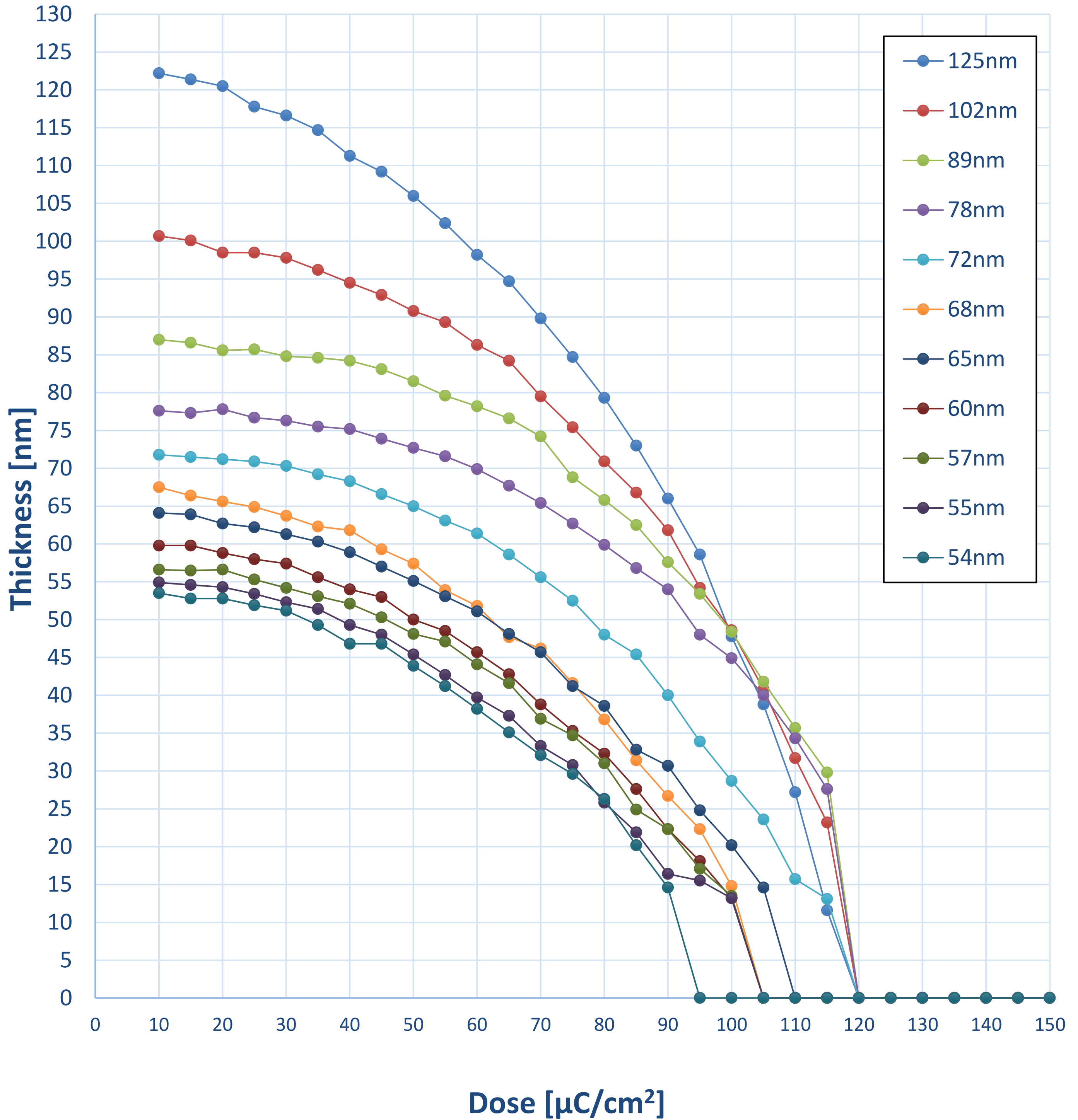
Development at ~20°C

1. Set timer to 60 seconds.
2. Drop exposed wafer into bath of 3:1 IPA:DI water co-solvent developer making sure the wafer is completely submerged, and start the timer. Do not agitate.
3. After 60 seconds, remove the wafer from the bath and place on a TexWipe.
4. Blow dry the wafer with N_2.

Measurement

1. Allow the Filmetrics F40 light to warm up for at least 5 minutes.
2. Click *Baseline…* to calibrate the tool using the SiO_2 and Si standards.
3. Mount wafer and select the *PMMA on Si* recipe.
4. Measure the resist thickness at the center of each square.

Results:



Pads were exposed to 155 µC/cm^2.

Dose [mC/cm^2]	**Resist Thickness**										
	125nm	102nm	89nm	78nm	72nm	68nm	65nm	60nm	57nm	55nm	54nm
10	122.2	100.7	87	77.6	71.8	67.5	64.1	59.8	56.6	54.9	53.5
15	121.4	100.1	86.6	77.3	71.5	66.4	63.9	59.8	56.5	54.6	52.8
20	120.5	98.5	85.6	77.8	71.2	65.6	62.7	58.8	56.6	54.3	52.8
25	117.8	98.5	85.7	76.7	70.9	64.9	62.2	58	55.3	53.4	51.9
30	116.6	97.8	84.8	76.3	70.3	63.7	61.3	57.4	54.2	52.3	51.2
35	114.7	96.2	84.6	75.5	69.2	62.3	60.3	55.6	53.1	51.4	49.3
40	111.3	94.5	84.2	75.2	68.3	61.8	58.9	54	52.1	49.3	46.8
45	109.2	92.9	83.1	73.9	66.6	59.3	57	53	50.3	48	46.8
50	106	90.8	81.5	72.7	65	57.4	55.1	50	48.1	45.4	43.9
55	102.4	89.3	79.6	71.6	63.1	53.9	53.1	48.5	47.1	42.7	41.2
60	98.2	86.3	78.2	69.9	61.4	51.8	51.1	45.7	44.1	39.7	38.2
65	94.7	84.2	76.6	67.7	58.6	47.7	48.1	42.8	41.6	37.3	35.1
70	89.8	79.5	74.2	65.4	55.6	46.2	45.7	38.8	36.9	33.3	32.1
75	84.7	75.4	68.8	62.7	52.5	41.6	41.2	35.3	34.7	30.8	29.6
80	79.3	70.9	65.8	59.9	48	36.8	38.6	32.3	31	25.8	26.3
85	73	66.8	62.5	56.8	45.4	31.4	32.8	27.6	24.9	21.9	20.2
90	66	61.8	57.6	54	40	26.7	30.7	22.3	22.3	16.4	14.6
95	58.6	54.2	53.4	48	33.9	22.3	24.8	18.1	17.1	15.5	0
100	47.8	48.6	48.4	44.9	28.7	14.8	20.2	13.2	13.5	13.2	0
105	38.8	40.8	41.8	40	23.6	0	14.6	0	0	0	0
110	27.2	31.7	35.7	34.3	15.7	0	0	0	0	0	0
115	11.6	23.2	29.8	27.6	13.1	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0