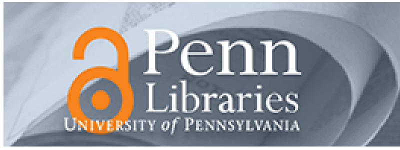

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Performance Check 1 on Elionix E-beam writer

Jisoo Kang
jisoo@seas.upenn.edu

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Keywords
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On-site Inspection (Graduate Student Fellow Program)

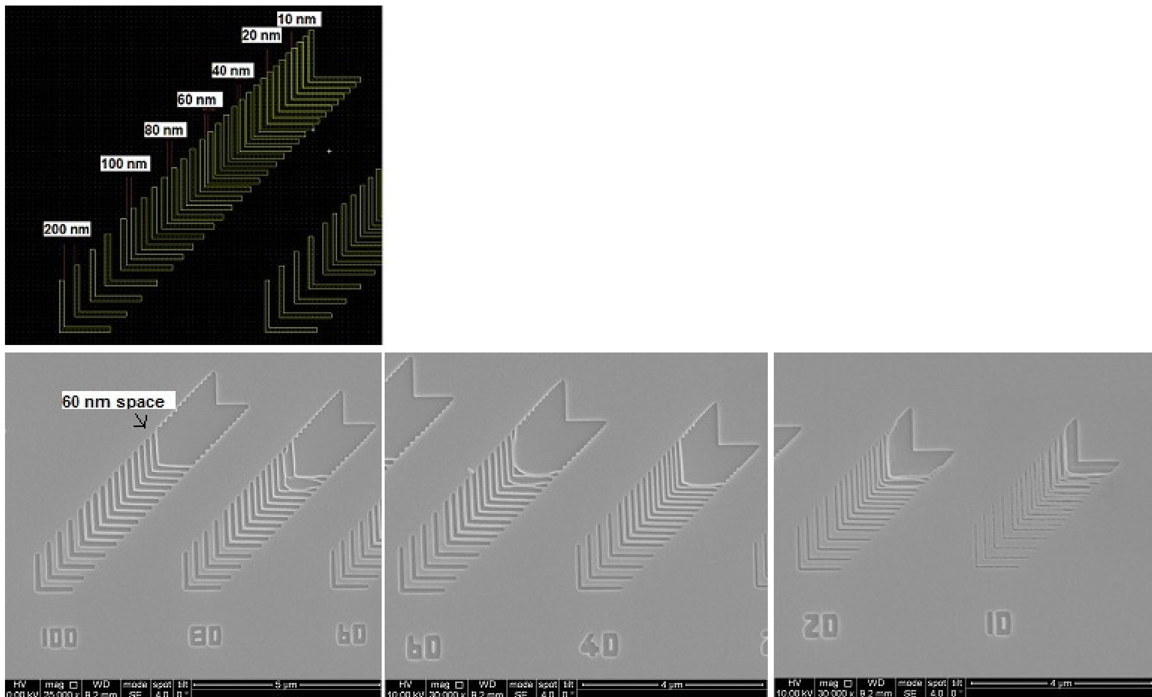
Beam Current = 100 pA

Prepared by Jisoo Kang (9/20/2014)

- A4 495 PMMA film
- Thickness: 160-170 nm (using F40)
- Spin coat: 3000 rpm, 60 sec
- Bake: 180 °C, 5 min, on a hot plate
- Develop: Methyl Isobutyl Ketone (MIBK): IPA = 1:3, 60 sec
- Rinse: IPA

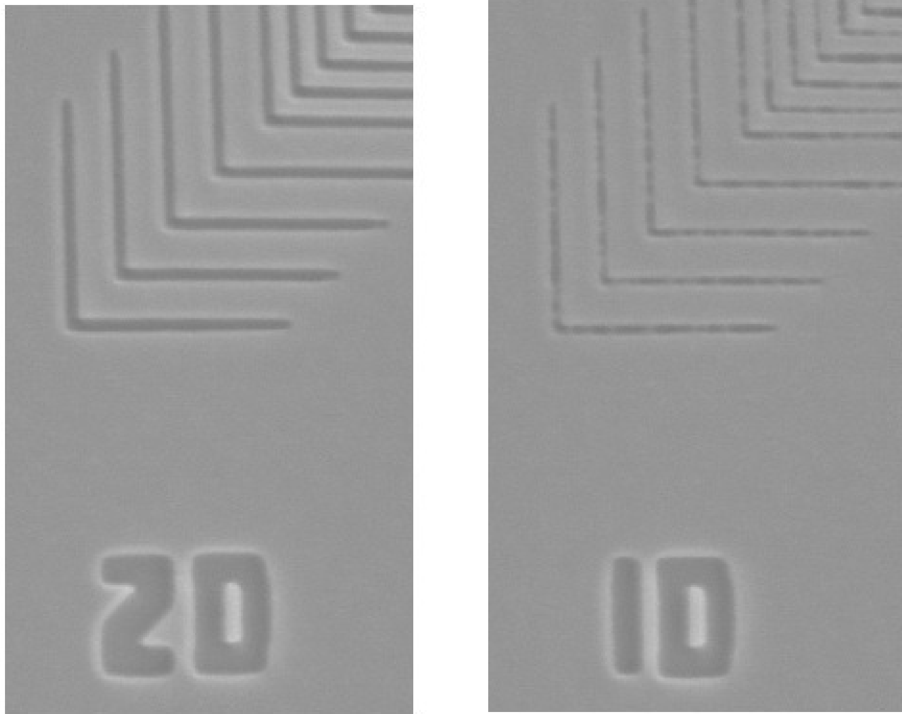
- Acceleration voltage: 50 kV
- Resist Sensitivity assumed: 500 µC/cm2
- Field size: 60000 dot x 60000 dot
- Area: 75 µm x 75 µm
- Dose Time: 0.07813 µsec/dot

Line and Space



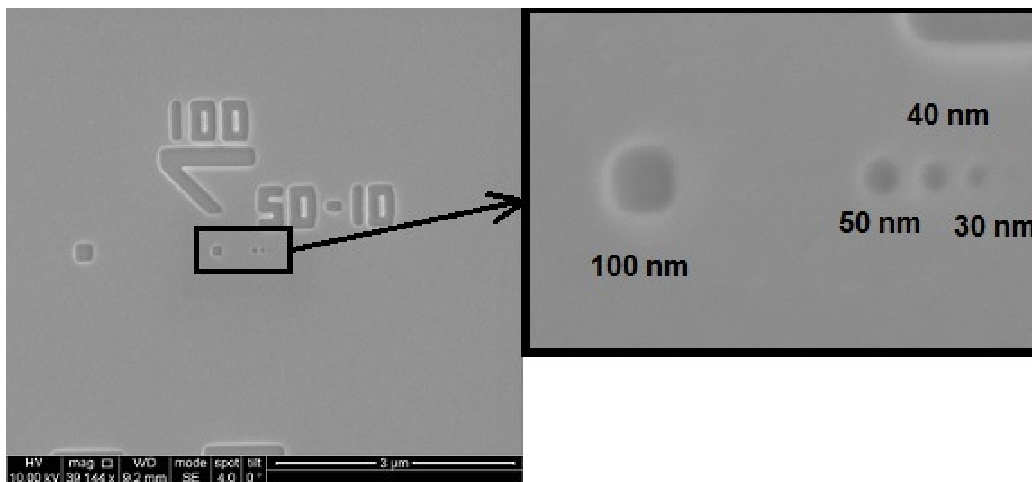
SEM images of e-beam lithography of line and space on 495 PMMA on Si wafer
Line width: 100, 80, 60, 40, 20, and 10 nm
Space: 200, 100, 80, 60, 40, 20, and 10 nm

* Proximity effect was found at the space of less than 40-60 nm.



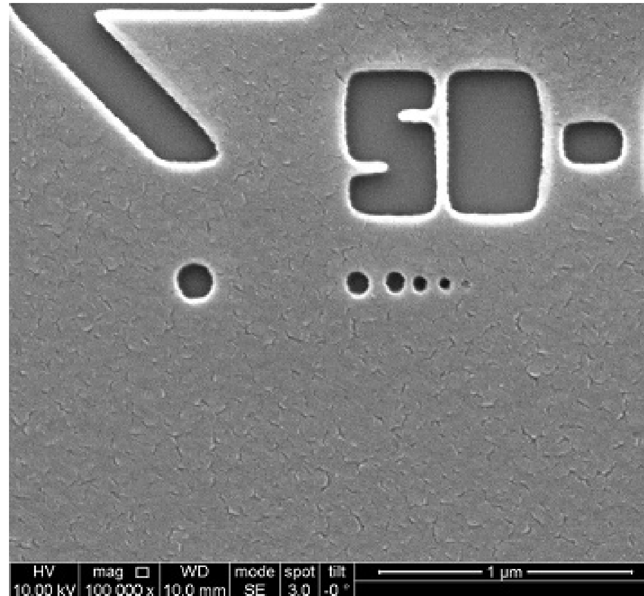
SEM images of e-beam lithography of 10 and 20 nm line.
The space is 200 nm. Exposure for 10 nm line is still small.

Dots

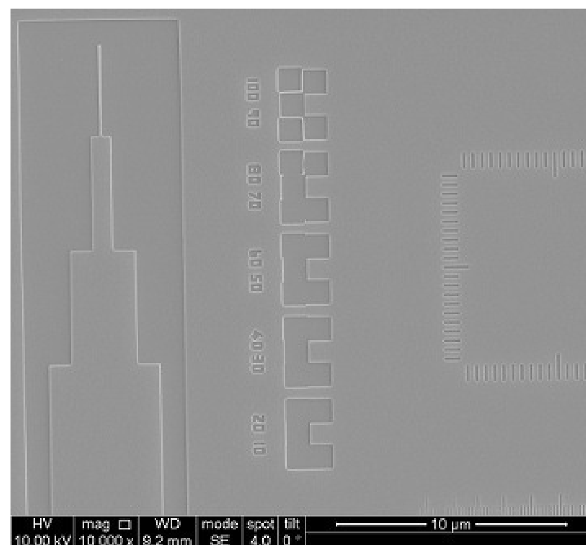


SEM images of e-beam lithography of Dots on 495 PMMA on Si wafer
The dot sizes of more than 30 nm were confirmed.

- The beam current of more than 100 pA shows the following result. As can be seen in the SEM image, the 20 nm dot is confirmed. The 10 nm dot is partially formed, but the exposure is still small.



Blocks



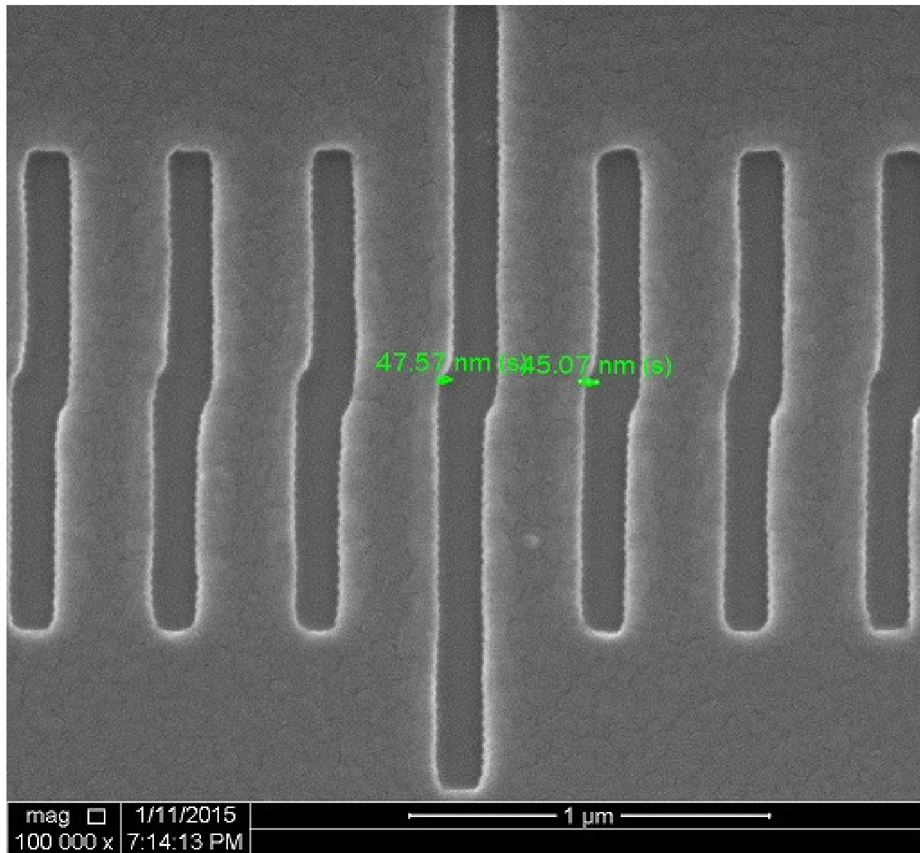
SEM image of e-bema lithography of 1 µm x 1 µm blocks

The proximity effect was found at the space of less than 80 nm.

Stitching Error

Prepared by Jisoo Kang (1/12/2015)

- Beam current = 100 pA
- The condition is shown above. (Field size = 75 µm x 75 µm)
- The stitching error is ~48 nm.



Beam Current = 50 pA

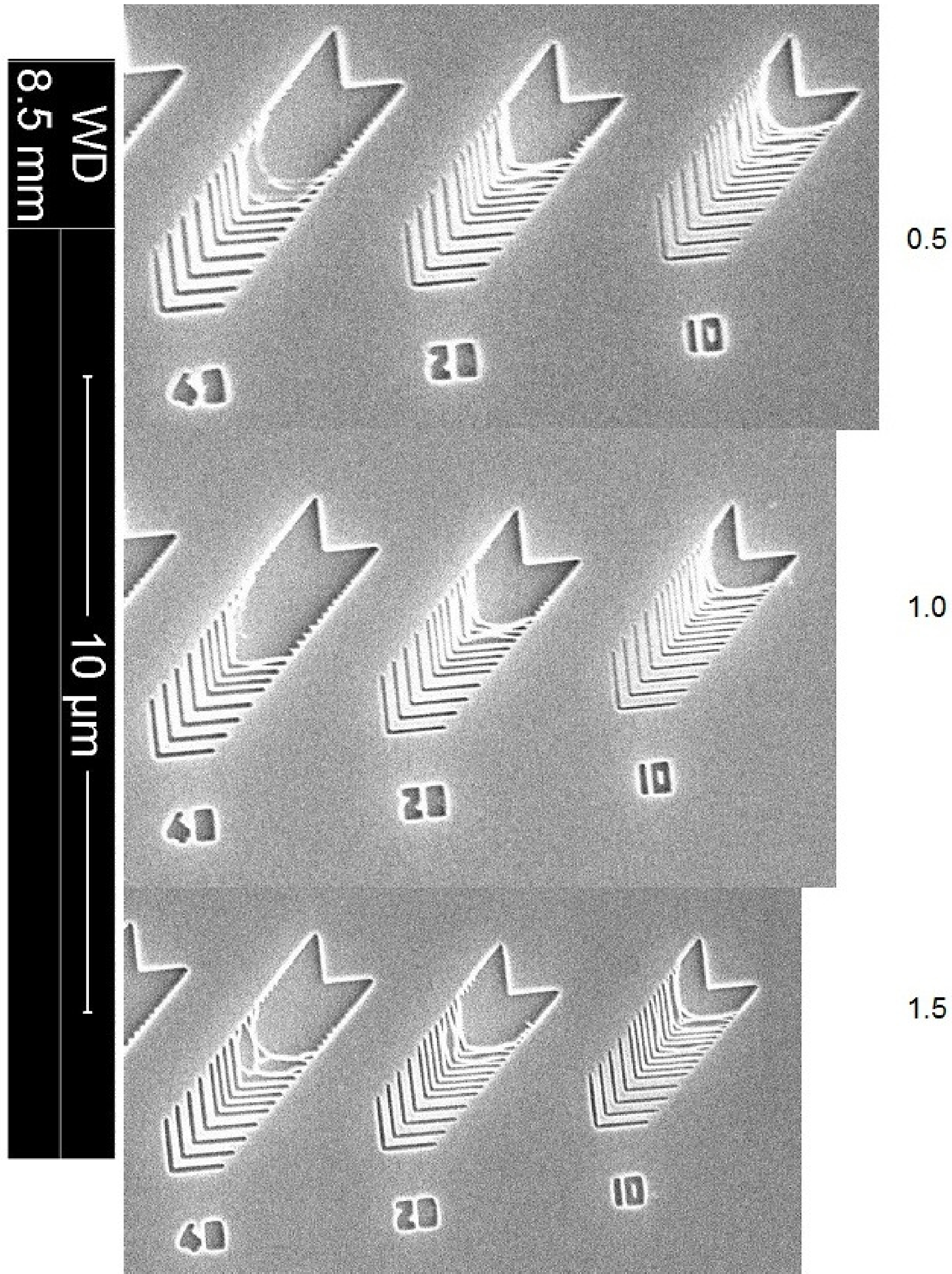
Prepared by Jisoo Kang (10/20/2014)

- A4 495 PMMA diluted by anisole
- Thickness: ~60 nm (using F40)
    - **Note:** A 160 nm thick 495 PMMA film did not work at 50 pA beam current and 500 µC/cm2.
- Spin coat: 3000 rpm, 60 sec
- Bake: 180 °C, 5 min, on a hot plate
- Develop: Methyl Isobutyl Ketone (MIBK): IPA = 1:3, 60 sec
- Rinse: IPA

- Acceleration voltage: 50 kV
- Resist Sensitivity assumed: 500 µC/cm2
- Field size: 60000 dot x 60000 dot
- Area: 75 µm x 75 µm
- Dose Time: 0.1563 µsec/dot

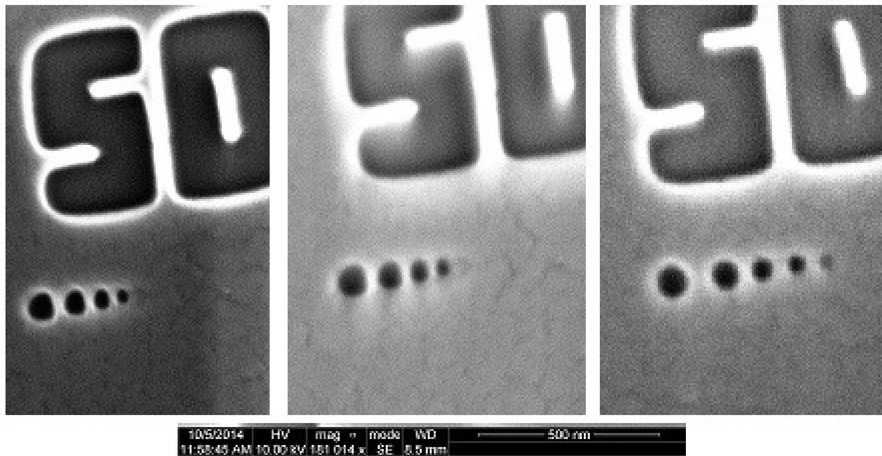
Line and Space

- SEM images of e-beam dosage dependence of lines ans spaces on 495 PMMA on Si wafer.
    - Line: 40, 20, 10 nm
    - Space: 200, 100, 80, 60, 40, 20, and 10 nm
        - Dose slope: 0.5 (50%), 1.0 (100%), and 1.5 (150%).



Dots

- SEM images of e-beam dosage dependence of dots on 495 PMMA on Si wafer.
    - Diameter setpoint: 50, 40, 30, 20, and 10 nm
    - Dose slope: 0.5 (50%), 1.0 (100%), and 1.5 (150%).



0.5 1.0 1.5

Beam Current = 20 pA

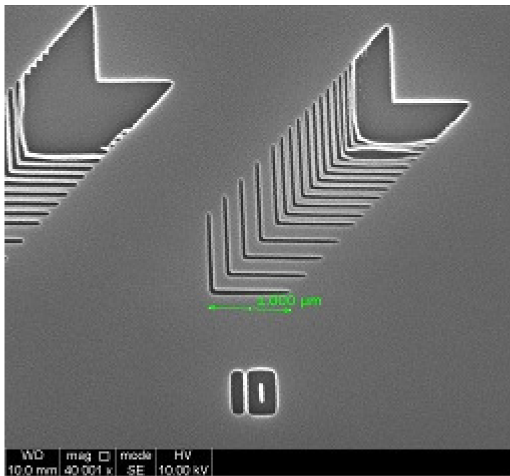
Prepared by Jisoo Kang (11/17/2014)

- A4 495 PMMA diluted by anisole
- Thickness: ~60 nm (using F40)
  - Note: A 160 nm thick 495 PMMA film did not work at 50 pA beam current and 500 μC/cm2.
- Spin coat: 3000 rpm, 60 sec
- Bake: 180 °C, 5 min, on a hot plate
- Develop: Methyl Isobutyl Ketone (MIBK): IPA = 1:3, 60 sec
- Rinse: IPA

- Acceleration voltage: 50 kV
- Resist Sensitivity assumed: 500 μC/cm2
- Field size: 60000 dot x 60000 dot
- Area: 75 μm x 75 μm
- Dose Time: 0.3906 μsec/dot

Line and Space

- SEM images of e-beam dosage dependence of lines ans spaces on 495 PMMA on Si wafer.
  - Line: 10 nm
  - Space: 200, 100, 80, 60, 40, 20, and 10 nm
  - Dose slope: 0.5 (50%), 1.0 (100%), and 1.5 (150%).



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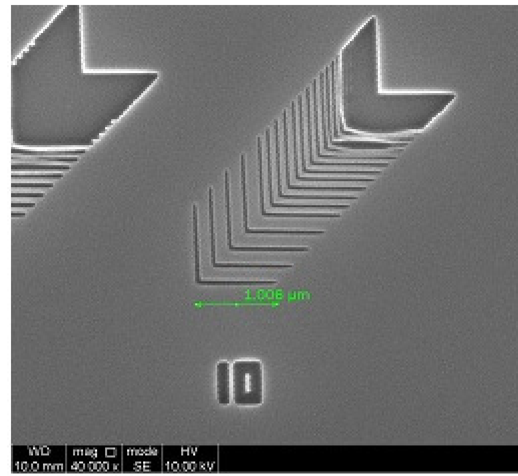

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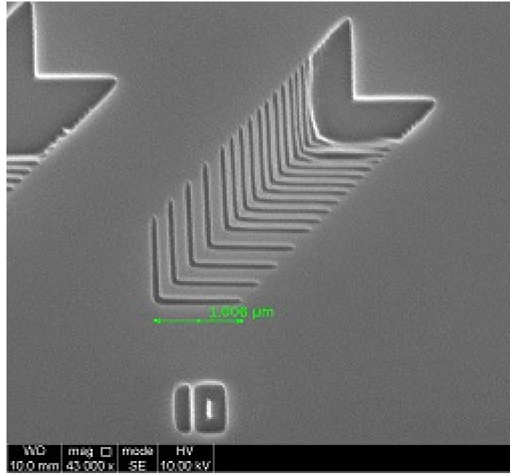


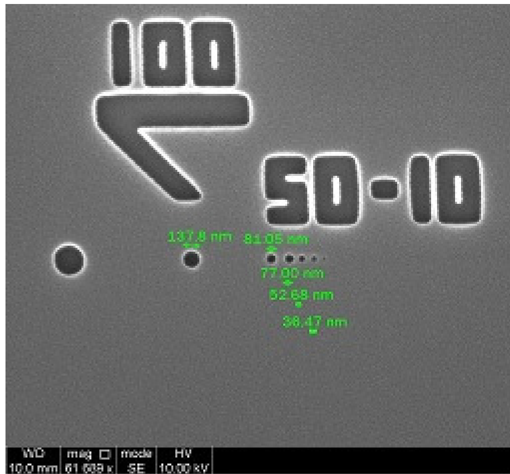
1.5

Dots

- SEM images of e-beam dosage dependence of dots on 495 PMMA on Si wafer.
  - Diameter setpoints: 50, 40, 30, 20, and 10 nm
  - Dose slope: 0.5 (50%), 1.0 (100%), and 1.5 (150%).

Actual dot size (nm)

Dose slope (%)	Diameter setting (nm)			
	20	30	40	50
0.5	36.47	52.68	77.00	81.05
1.0	41.77	49.37	64.56	79.84
1.5	50.10	59.37	78.12	96.03



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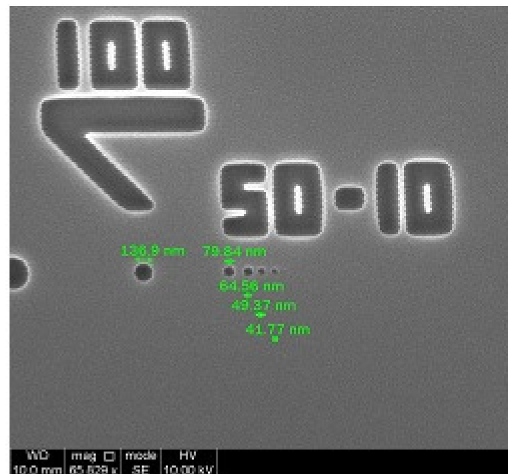

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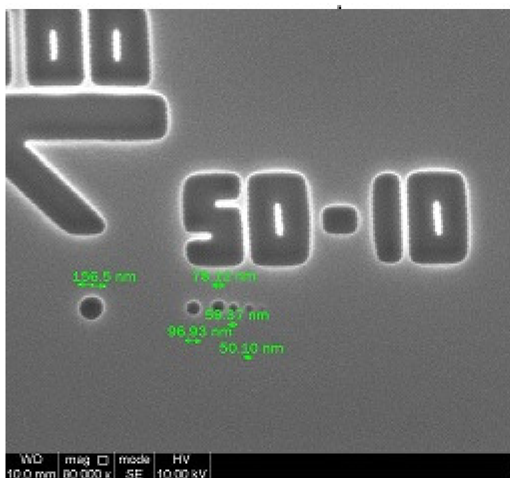

1.5