HSQ Post Apply Bake Experiment

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7/30/10

HSQ Post Apply Bake Experiment

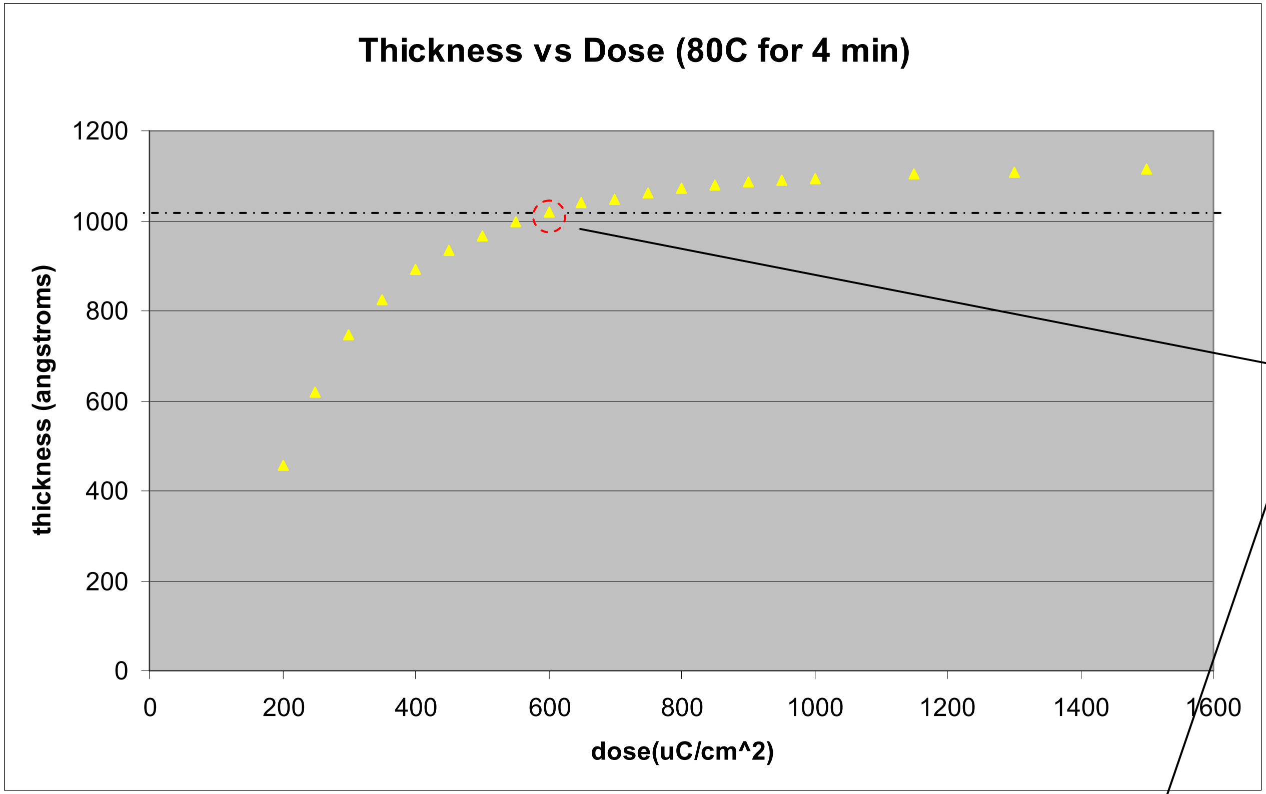
- Purpose
  - To identify, and confirm the effect of different post apply bake conditions for HSQ

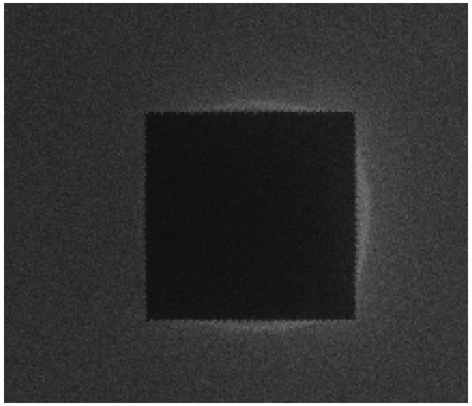
Process Condition

- XR-1541 (HSQ) 6% on a 1” square silicon substrate piece
- Spin conditions = 5000 rpm, 2500 rpm/s, 60 sec
- post apply bake (various conditions)
- average resulting thickness (pre-develop) ~ 116nm
- Develop: MF-319 for 70 seconds, DI water rinse for 60 seconds, nitrogen blow dry

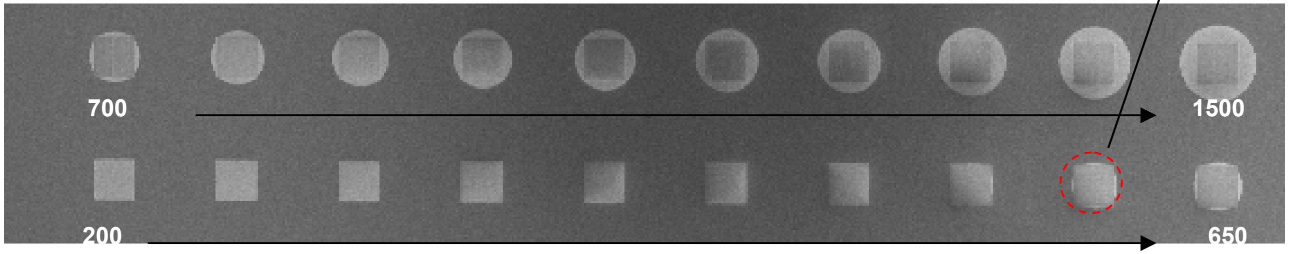
Experiment 1

- 3 post apply bake conditions
  - 80 C 4 min
  - 150 C 2 min
  - 250 C 2 min

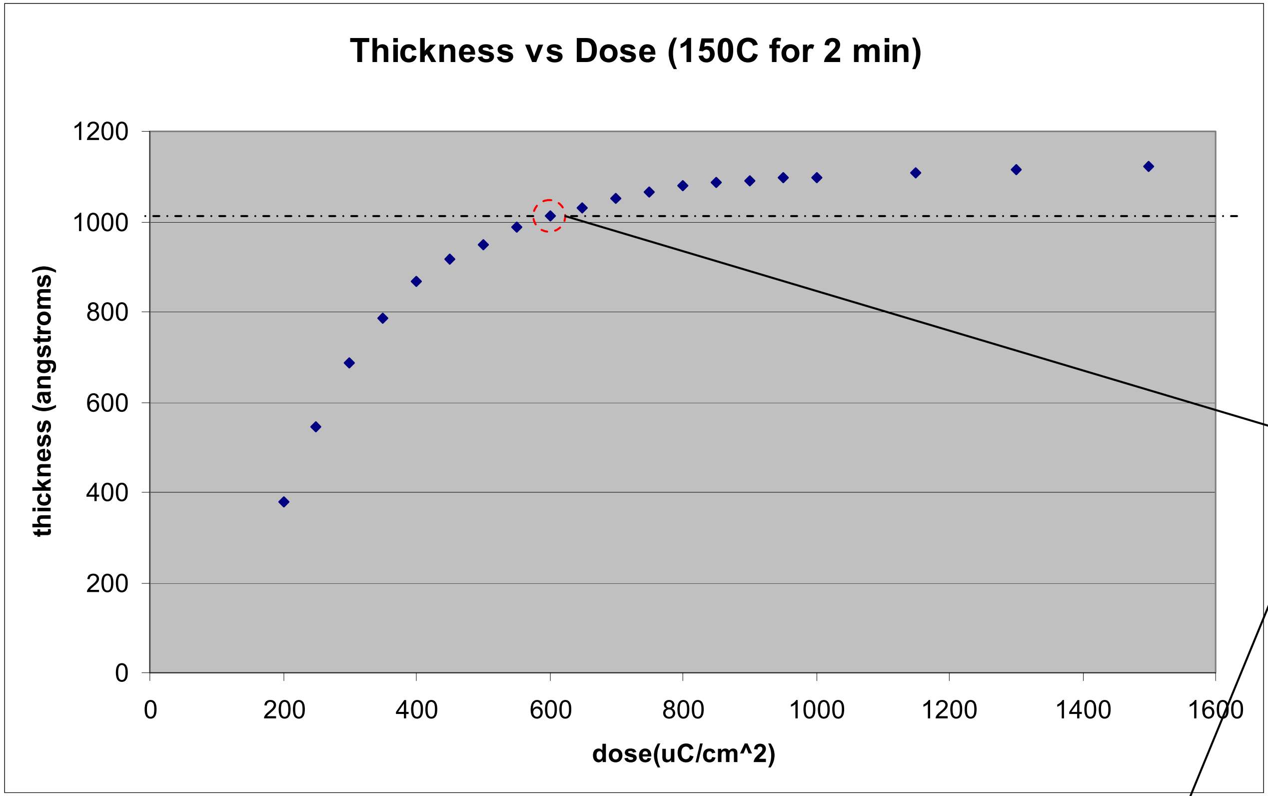


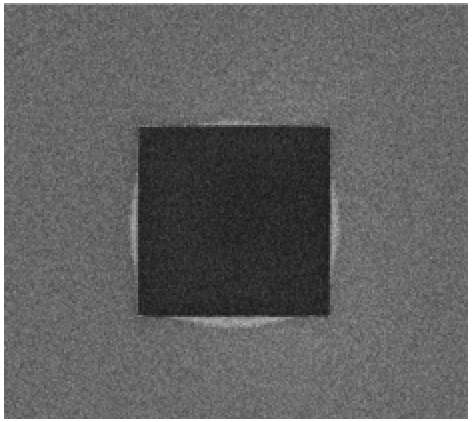


Residues around the square starts to appear at dose of 600uC/cm^2.



Squares of negative resist (HSQ) with different doses. Starting from the bottom left square to the bottom right square, doses are: 200,250,300,350,400,450,500,550,600,650 (uC/cm^2). Starting from the top left square to the top right square, doses are: 700,750,800,850,900,950,1000,1150,1300,1500 (uC/cm^2)





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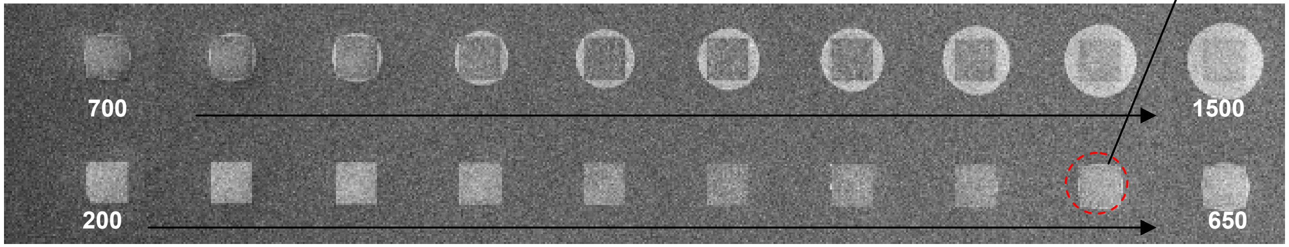

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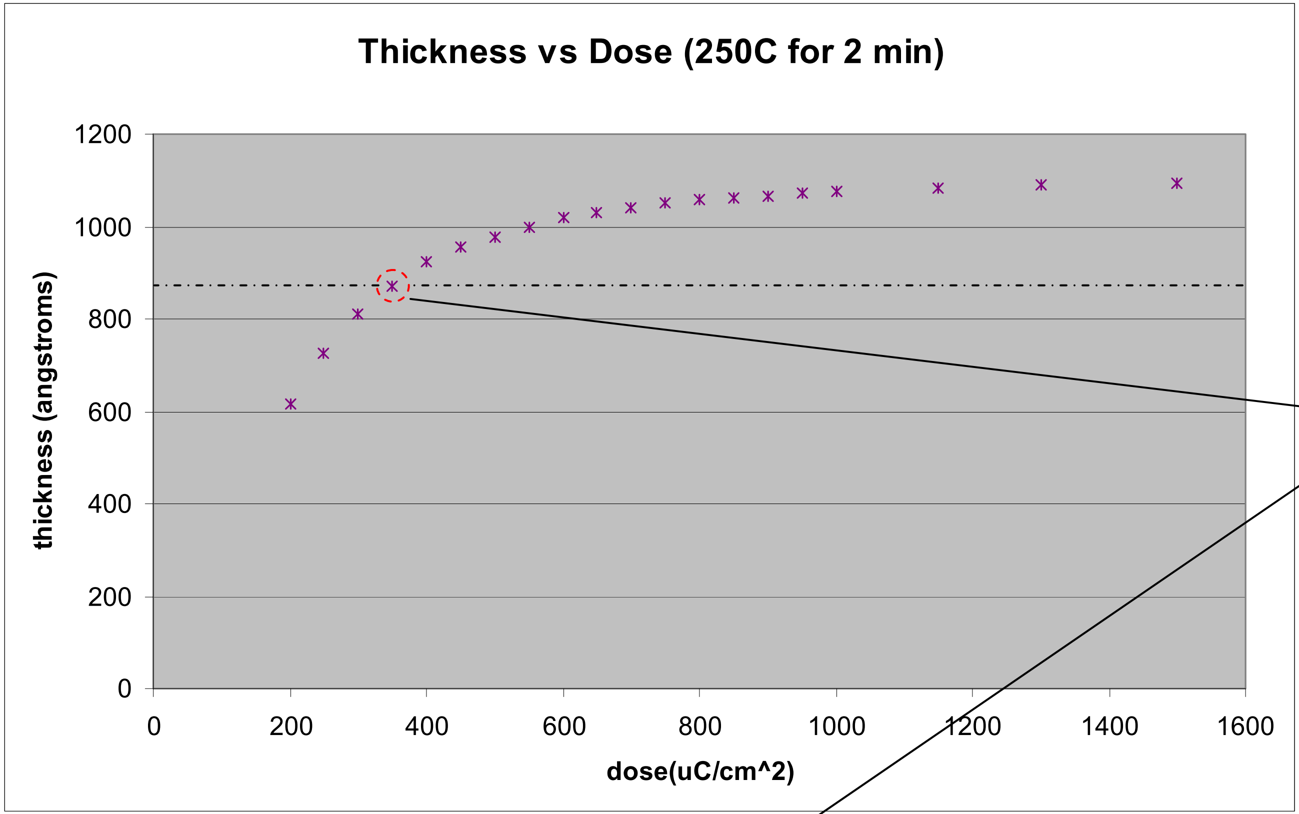
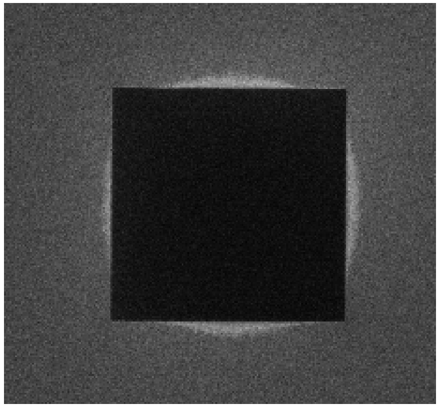
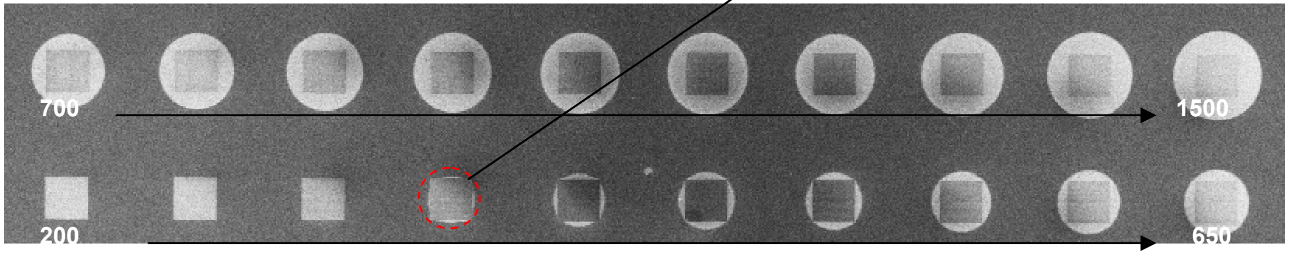




Residues around the square starts to appear at dose of 350uC/cm^2.



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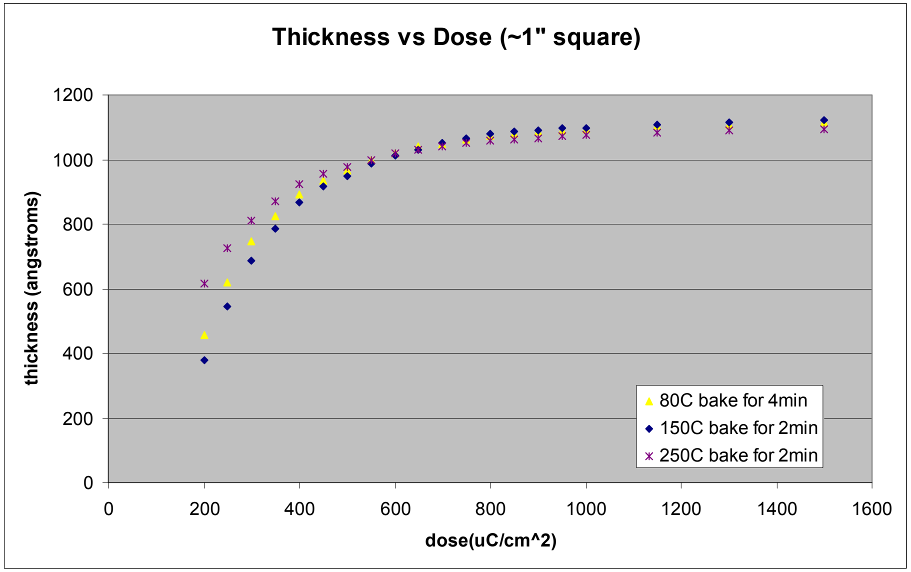
Summary of different bake conditions

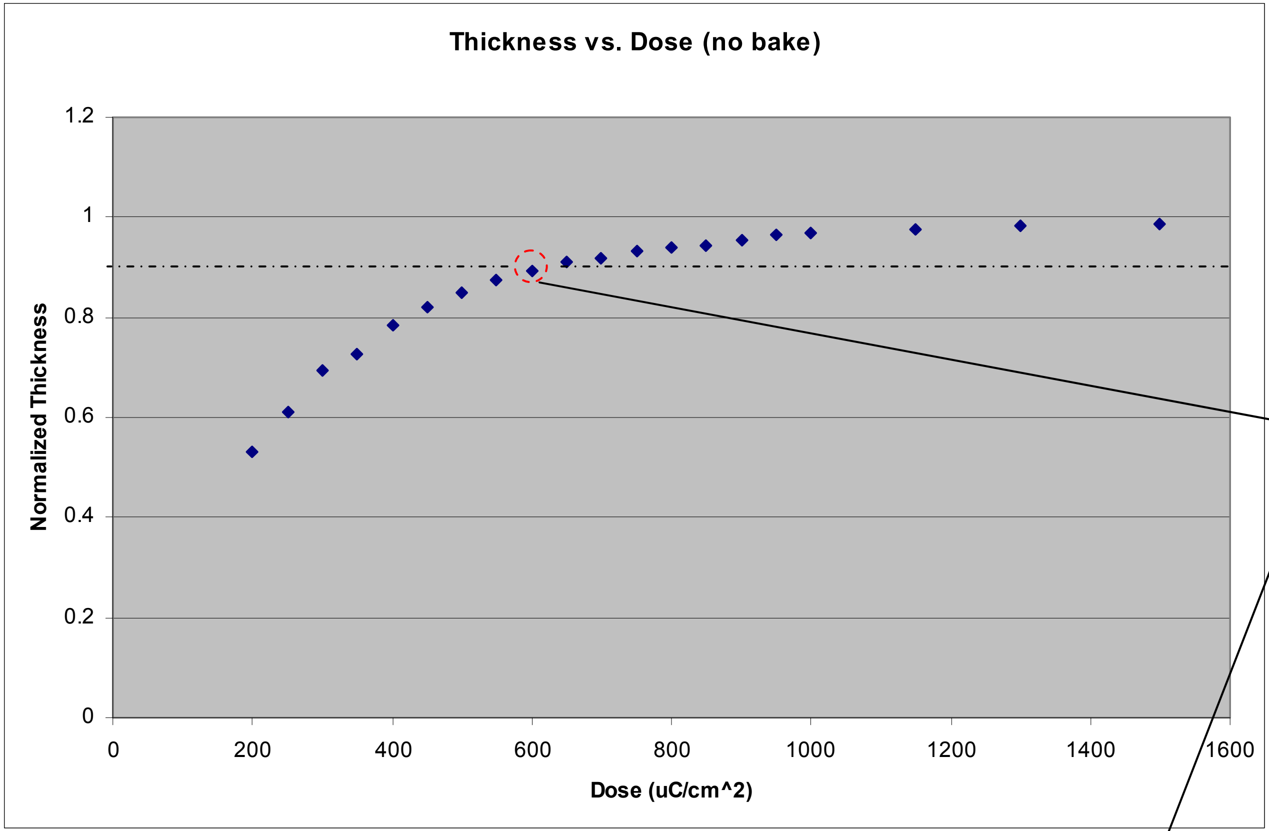


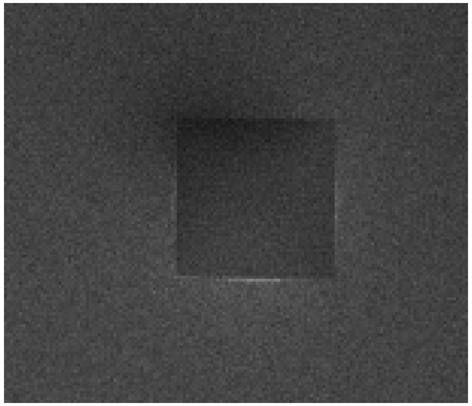
bake	highest dose with no residue (uC/cm2)	thickness (nm)	pre-develop thickness (nm)
80 C 4 min	550	100	116
150 C 2 min	550	99	n/a
250 C 2 min	300	81	n/a

- small difference in thickness vs. dose for the various bake conditions at lower doses (left graph)
- difference in residue around 50 x 50 um feature with different bake conditions (see right table)
- lower bake temperature can achieve a higher post develop resist thickness without residue by using higher dose (see right table)

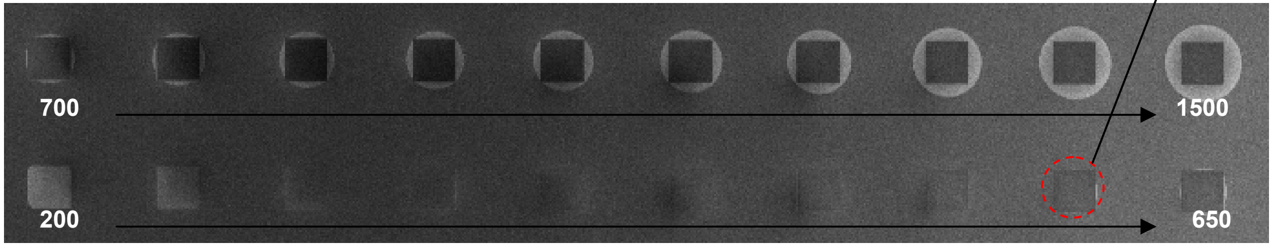
Experiment 2

- Purpose
    - see if experiment 1 is repeatable
    - evaluate no bake





Residues around the square starts to appear at dose of 600uC/cm^2.



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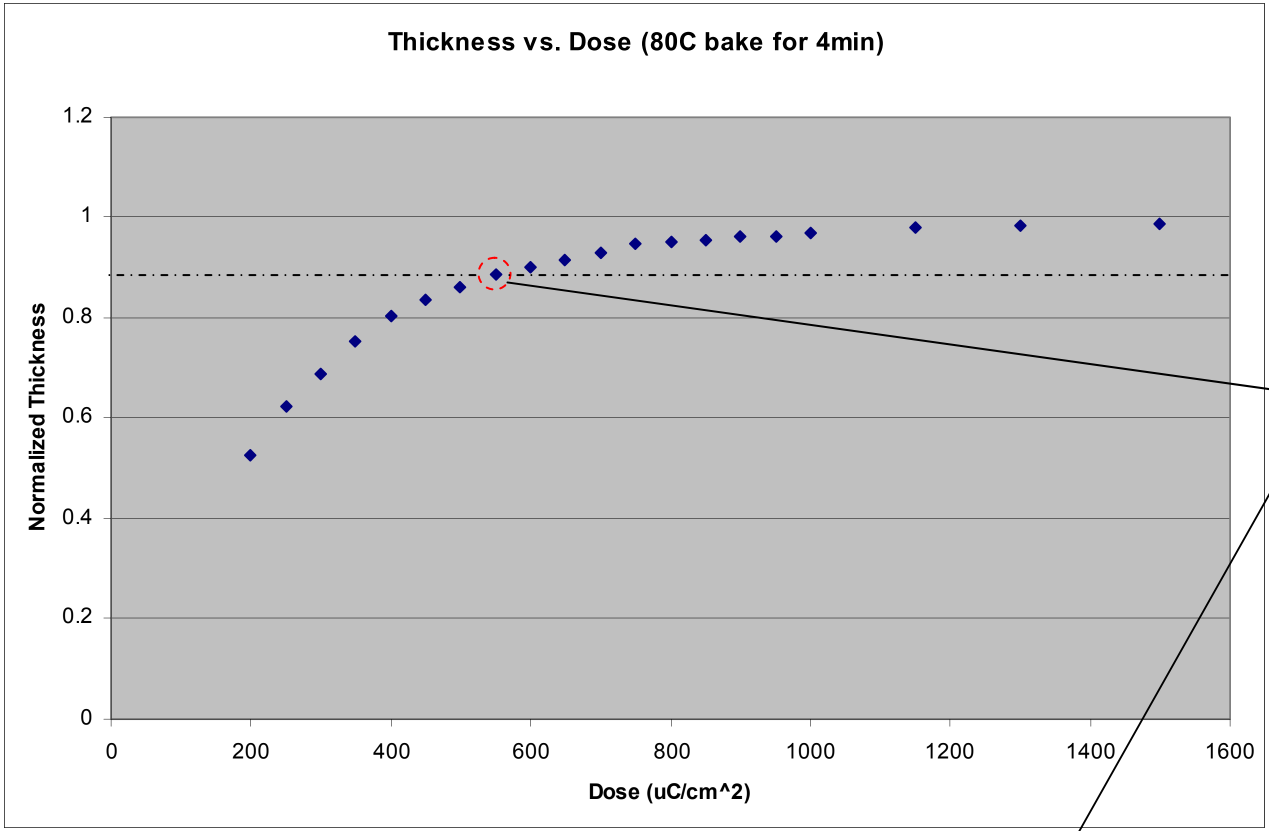
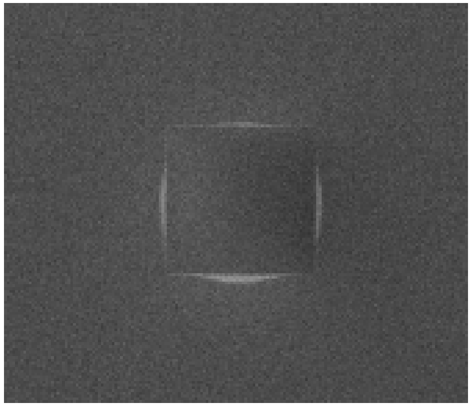
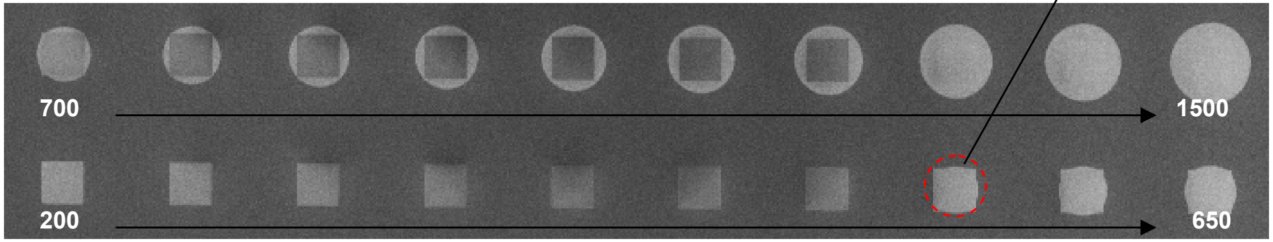
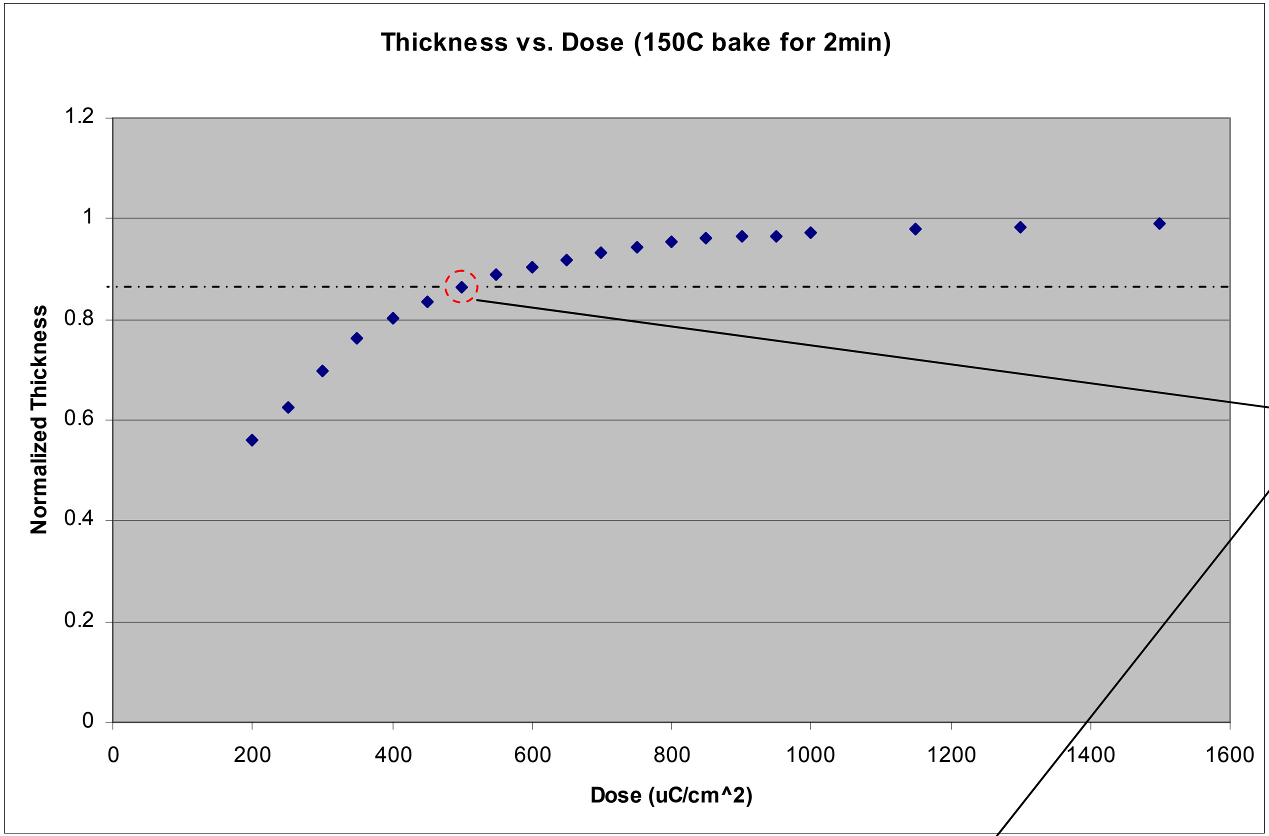


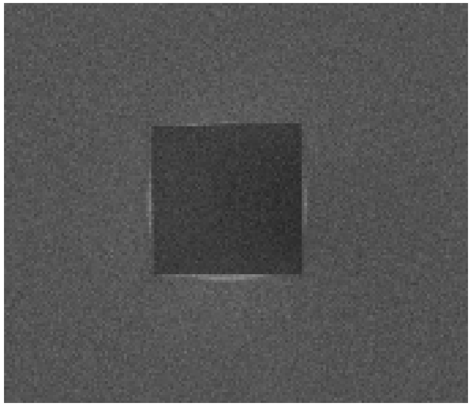


Residues around the square starts to appear at dose of 550uC/cm^2.

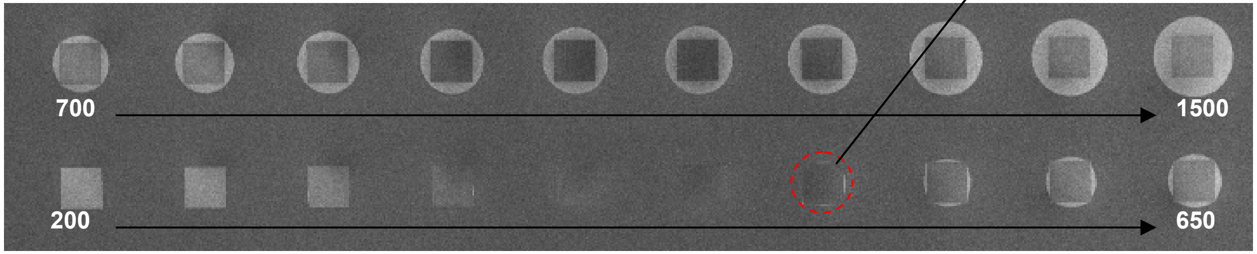


Squares of negative resist (HSQ) with different doses. Starting from the bottom left square to the bottom right square, doses are: 200,250,300,350,400,450,500,550,600,650 (uC/cm^2). Starting from the top left square to the top right square, doses are: 700,750,800,850,900,950,1000,1150,1300,1500 (uC/cm^2)





Residues around the square starts to appear at dose of 500uC/cm^2.



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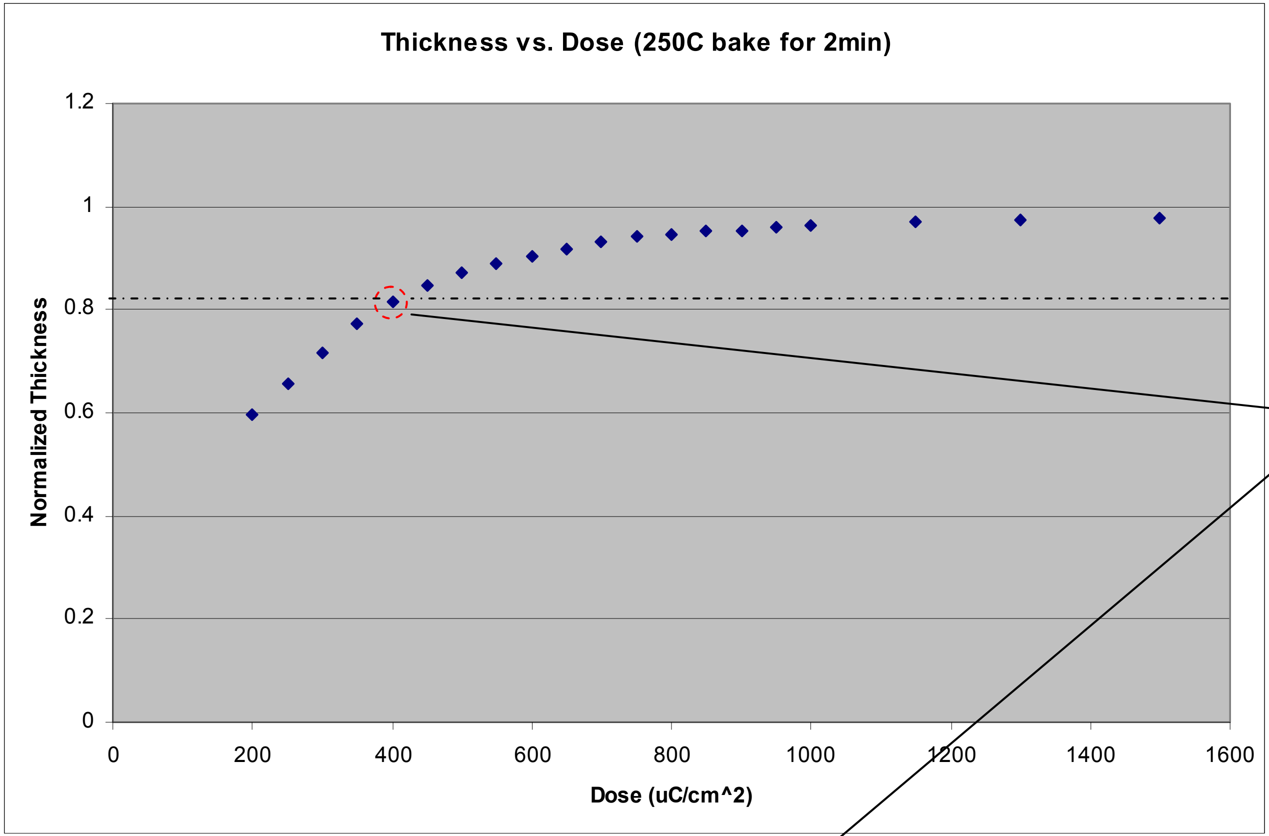
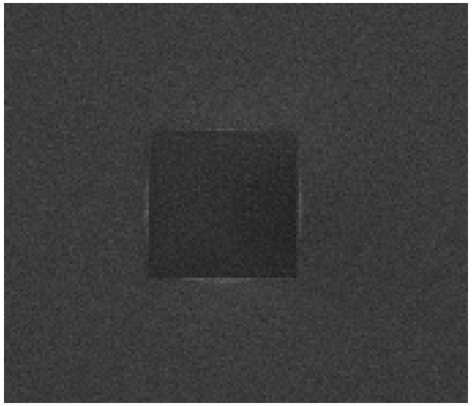
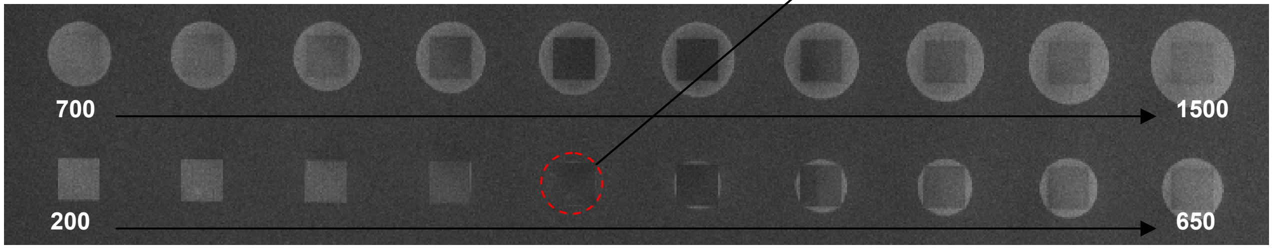


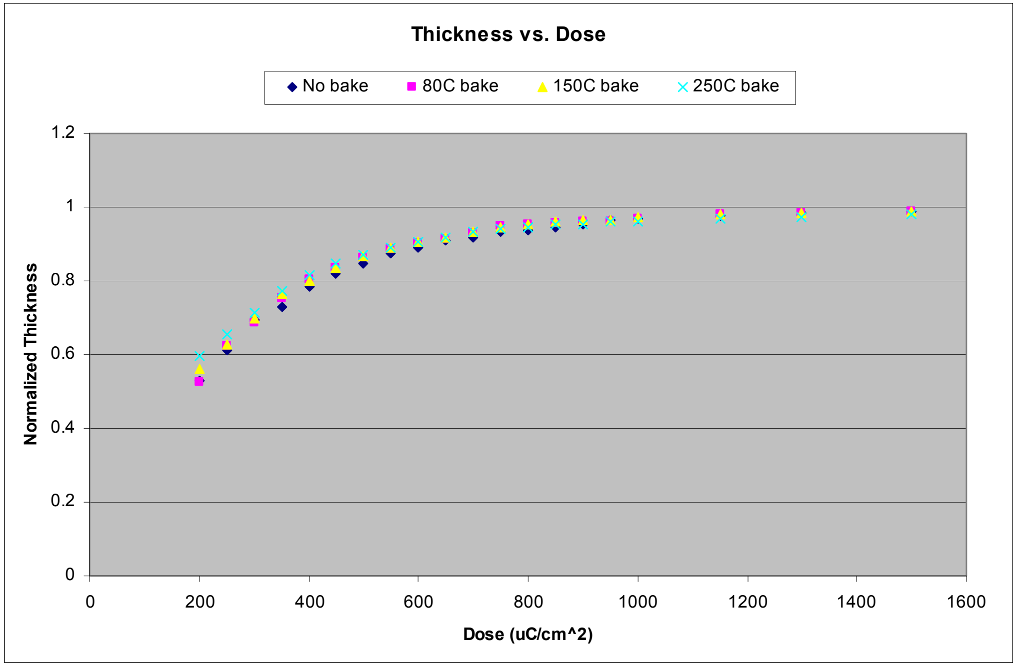


Residues around the square starts to appear at dose of 400uC/cm^2.



Squares of negative resist (HSQ) with different doses. Starting from the bottom left square to the bottom right square, doses are: 200,250,300,350,400,450,500,550,600,650 (uC/cm^2). Starting from the top left square to the top right square, doses are: 700,750,800,850,900,950,1000,1150,1300,1500 (uC/cm^2)

Summary of different bake conditions



bake	highest dose with no residue (uC/cm2)	thickness (nm)	pre-develop thickness (nm)
no bake	550	102	116
80 C 4 min	500	101	117
150 C 2 min	450	95	114
250 C 2 min	350	86	112

- some differences to experiment 1 but general trend is repeatable
- there is no significant difference in thickness vs. dose for the various bake conditions (left graph)
- BUT, there is a difference in residue around 50 x 50 um feature with different bake conditions (see right table)
- lower bake temperature can achieve a higher post develop resist thickness without residue by using higher dose (see right table)