Positive Photoresist Photolithography Process

Lithography consists of six basic steps: Wafer Preparation, Photoresist coat, Softbake, Exposure, Development, and Post-Exposure Bake.

Note: Carry the wafers being processed in a quartz wafer carrier during the lithography process.

1. Prepare Wafer

I. Cleaning
  i. Cleaning - Use Simple Clean with Acetone and IPA

II. Dehydration Bake
  i. Set the Clean Oven to 120°C.
  ii. Transfer wafers to a metal wafer carrier.
  iii. Bake the wafers for 10 minutes in the oven.
  iv. Remove the wafer carrier from the oven using the metal carrier handle.
  v. Transfer wafers back to quartz carrier

2. Apply Photoresist

I. Adhesion Promotion
  i. Adhesion Promotion is not a necessary step but can be used to get better adhesion of photoresist to substrate. Adhesion promotion is especially useful when dealing with very small features < 1 micron.
  ii. HMDS

II. Photoresist Coating
  i. Mount the wafer on the Headway Spinner (Wafer should already be mounted if HMDS was used).
  ii. Apply a quarter sized (in diameter) puddle of resist to wafer.
  iii. Determine the required spin speed from the spin curves or PR Tables.
  iv. Set the spinner to spin at that speed with an acceleration equal to the speed/second (no ramping). This might need to be modified (resist dependent).
  v. Spin
  vi. Clean the spinner when done.

3. Softbake

I. Determine the softbake temperature from the PR Tables.
II. Heat the hotplate next to the Spinner to the required temperature.
III. Place the wafer on the hotplate, start timing.
IV. When the time is up, remove the wafer.

4. Expose

I. Clean Mask
  i. Place the mask in the mask cleaning holder.
  ii. Apply Acetone to the chrome surface. Do not allow the mask to dry with Acetone on it.
  iii. Scrub the chrome surface with a swab.
  iv. Rinse the mask with IPA.

II. Expose
  i. Determine the exposure dose from the swing curve for the photoresist (or from the Process Parameters Tables).
  ii. Measure the light intensity of the Karl Suss aligner (e.g., ~10mW/second).
  iii. Calculate the exposure time (Exposure dose / Measured Intensity)
  iv. Expose the wafer.
  v. If soft or hard contact was used, clean the mask.
  vi. Create an entry in the Karl Suss aligner log book when done.

5. Develop

I. Place the wafer on a dry wafer holder.

II. Determine the required development time from the PR Tables and the set the wet bench timer.
III. Start the timer. Place the wafer in the developer bath (using the wafer holder).
IV. Quickly remove the wafer from the developer bath and rinse it in the water bath for 30 seconds (using the wafer holder).
V. Place the wafer in a spin-dryer to dry it. Or put it on a clean room wipe, blow dry with N2 gun.
VI. Dry the wafer holder.

6. Post Exposure Bake

I. Determine the bake temperature from the PR Tables.
II. Set a hotplate to the required temperature.
III. Place the wafer on the hotplate, start timing.
IV. When the time is up, remove the wafer.

PR Table

Positive Photoresist	Spin Speed/Time	Thickness	Softbake Temp/Time	Exposure Time (assuming 10mW/cm^2)	Developer	Develop Time	Post-Exposure Bake Temp/Time	Minimum Feature Size
AZ 3312	4000rpm /60s	1um	90° C/60s	4-5s	AZ300 MIF	30-40s	90° C/60s	0.5um
AZ 3330	6000rpm /60s	2um	90° C/60s	8-10s	AZ300 MIF	30-40s	90° C/60s	1um
Shipley 1.2L	4000rpm /70s	1um	90° C/60s	5-6s	Shipley MF-26A	30-40s	115° C/60s	0.5um
Shipley 1.8M	4000rpm /90s	2um	90° C/60s	10-11s	Shipley MF-26A	30-40s	115° C/60s	1um

Negative Photoresist	Spin Speed/Time	Thickness	Softbake Temp/Time	Exposure Time (assuming 10mW/cm^2)	Post-Exposure Bake Temp/Time	Developer	Develop Time	Minimum Feature Size
nLOF 2020	2750rpm /60s	2um	110° C/60s	7-8s	110° C/60s	AZ300 MIF	60s	1um

Polymide / Spin-On-Glass	Spin Speed	Thickness	Softbake Temp /Time	Exposure Time (assuming 10mW /cm^2)	Post-Exposure Bake Temp /Time	Developer	Develop Time	Curing Temp /Time	Type	Minimum Feature Size
Note: After developing the SU-8, rinse the wafer off with isopropyl alcohol, NOT water!										
SU-8 5	Variable 1000 - 6000	6um - 2um	50° C/5min, 65° C/5min, 95° C/5min	20-25s	65° C/5min, 95° C/5min	SU-8 Developer, gently agitate	50s Very sensitive to concentration of developer	-	negative	-
SU-8	Vari	30u	50°	1min -	65°	SU-8	4-2	-	neg	-

[25](#)	able 1000 - 6000	m - 5um	C/5min, 65° C/5min, 95° C/5min	45s	C/5min, 95° C/5min	Developer, gently agitate	mins Very sensitive to concentration of developer		ative	
Honeywell 1513 EL	4000 rpm	1.5um	-	-	-	-	-	200C	-	-

Adhesion Promoter	Process
HMDS	Spin@2000rpm 3-5s or until spread; apply before photoresist
Omni-Coat	Apply, then spin wafer @ 3000 RPM for 20sec; apply before SU-8

Spin Speed and Thickness

Tables of various photoresists used in the Cleanroom. These tables are rough estimates of photoresist thicknesses obtained at different spin speeds.
NOTE: When changing the thickness of the photoresist layer the appropriate exposure time and developing time will change as well.

AZ 3312

Spin Speed (rpm)	Thickness (nm)
1000	2200
2000	1550
3000	1250
4000	1100
5000	950
6000	900

AZ 3330

Spin Speed (rpm)	Thickness (nm)
1000	5250
2000	3700
3000	3000
4000	2500
5000	2300
6000	2100

Shipley 1.2L

Spin Speed (rpm)	Thickness (nm)
2000	1900
3000	1590
4000	1400
5000	1300
6000	1200
7000	1020

Shipley 1.8L

Spin Speed (rpm)	Thickness (nm)
2000	2800
3000	2300
4000	2000
5000	1800
6000	1620
7000	1550

SU-8 5

Spin Speed (rpm)	Thickness (nm)
1000	7000
2000	4000
3000	3250
4000	2700
5000	2400
6000	2200

SU-8 10

Spin Speed (rpm)	Thickness (nm)
1000	-
2000	-
3000	-
4000	-
5000	-
6000	-

SU-8 25

Spin Speed (rpm)	Thickness (nm)
1000	32000
2000	13000
3000	9500
4000	7500
5000	7000
6000	6600

nLOF 2020

Spin Speed (rpm)	Thickness (nm)
1000	3400
2000	2350
3000	1900
4000	1700