Photoresist Processing:

Notes:

- Photoresist shelf life may be extended to 6months or more by keeping it refrigerated at 30-70 oF.
- In general, the hard bake temperature should be at least as high as the expected wafer temperature during later processing, especially for plasma, ion, and wet chemical etch resistance.
- Higher hard bake temperatures can also improve film adhesion.
- Exceeding the recommended hard bake temperature of 150 oC can result in deformation of the resist profile.
- The process parameters given below can change based on room temperature, humidity, and condition of the process chemicals. The given conditions are meant as a guide. If you find that the recommended values do not result in acceptable results, alert the lab manager.
- If you choose to work with P/R thicknesses other than the standard 1.4um and 4.6um processes, be aware that you will need to modify the exposure dose, soft bake time, and develop time for your particular process.

Process Description:

- **Process Overview:**

```
- Dehydrate wafers in convection oven at 120C - 150C for 30min minimum
- Prme wafers with HMDS for adhesion (not required)
- Spin photoresist (AZ 5214 or AZ 9245)
- Softbake
- Expose
- Post-exposure bake (not required - can be used for image reversal in
- Develop (AZ 400K developer)
- Hard bake
- Strip after final processing (AZ 400T stripper)
```

- **Standard Processes:**

	Recipe 1 2.5um thick	Recipe 2 4.6um thick
Photoresist:	AZ 5214	AZ 9245
Min resolution:	< 1 um	1.4 um
Spin speed:	4000rpm (recipe 1)	4000rpm (recipe 1)
Softbake (oven):	80-100 oC	80-100 oC
Softbake (hotplate):	90-110 oC	90-110 oC
Exposure dose:	50-100 mJ/cm^2	550-1100 mJ/cm^2
Exposure time @ 6mW/cm^2 (channel CI1):	9sec - 17sec	1min 33sec - 3min 6sec
Exposure time @ 3mW/cm^2 (channel CI2):	17sec - 34sec	3min 5sec - 6min 11sec
Develop time:	~ 1 min	~ 5 min
Hard bake:	120C - 150C for 30min	120C - 150C for 30min

- **Spin Charts: Note:** The spin charts below are from the AZ product literature. The actual

results may differ significantly, and these charts are to be used only as a general guide. The settings listed above will be updated based on lab user feedback, and represent the best estimate of actual processing conditions.

- **AZ 5214:**

spin speed (rpm)	thickness
3000	1.63um
4000	1.41um
5000	1.26um
6000	1.15um
7000	1.01um

- **AZ 9245:**

spin speed (rpm)	thickness
1000	10.0um
2000	6.5um
3000	5.2um
3500	4.6um
4000	4.2um
5000	4.0um

AZ5214 PHOTORESIST

WHEN is AZ5214 USED?

- For image reversal. Please note this is a labor intensive process, and should be used only when re-design of mask is economically unfeasible or a quick fix is needed.

AZ5214 PROCESS INFORMATION

- **Singe** - 30 minutes at 150C (unless your wafers came out of a furnace or deposition system and are coated with resist within one hour).
- **Prime** - SVGCOAT prime program#1 in manual
- **Coat** - SVGCOAT coat program #3 or Headway spinner at 5000rpm for 30seconds.
- **Prebake** - SVGCOAT bake program#2 90C for 2 minute.
- **Expose** - 120mj/cm2
- **Post Exposure Bake** - 115C for 3 minutes
- **Flood UV Expose** - The original protocol was for exposure on the Canon501 for 35 seconds. This tool is no longer available. The exposure times on current tools is not yet characterized.
- **Develop** MF-322 for 60 seconds.

SVGCoat Program 3 should be setup as follows:

Spin	5 sec	5000 rpm	40 accel
spin (dispense)	10 sec	0.100 rpm	20 accel
spin	5 sec	0.25 rpm	40 accel
spin	30	5.00 rpm	40 accel

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Stanford Nanofabrication Facility
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Last Modified 9/14/00

Image reversal.

Expose 120 mJ/cm^2

RECOMMENDED LITHOGRAPHY PROCEDURE FOR AZ5214 RESIST

POSITIVE TONE RESIST:

Note: There is no magic process that works for all cases. A firm understanding of what you are trying to accomplish will determine the actual process which will work. This recipe should be seen as a starting point for many commonly useful processes.

1 Clean wafers:

A Remove photoresist if wafers are being reworked using acetone or AZ stripper (see step 11).

B (Depending on previous steps) RCA or sulfuric peroxide cleans are preferred but as a MINIMUM : 5 ' ultrasonic acetone, 5' ultrasonic isoproponol, 5' DI water rinse, Nitrogen blow dry (Do NOT let water evaporate from wafer, rewet if necessary).

2 Dehydration Bake:

A Hot Plate: 5' @ 150°C minimum (more is better)

OR

B Oven bake: 20'@250°C minimum (higher temp is better).

3 HMDS Vapor Prime:

CAUTION: HMDS IS HIGHLY FLAMMABLE AND POISONOUS. USE ONLY AT FUME HOOD, DO NOT BREATHE VAPORS AND KEEP AWAY FROM METHANOL. READ MSDS SHEETS

A Use beaker labeled HMDS at developer fume hood.

B About 1/2 inch of liquid should be in bottom of beaker (add more if necessary, HMDS is stored in base cabinet).

C Uncover beaker, remove wafer holder and place wafers or pieces in holder. (Make sure wafers are **not** still hot when lowering them into HMDS.)

D Lower holder and wafers into beaker. Wafer should NOT sit in the liquid but should be about 1/2-1 inch above liquid level. Wafers should not get wet.

E Recover beaker with lid and let wafers sit for at least 10 minutes in HMDS.

F Remove wafers from HMDS, put holder back in beaker and put cover back on beaker.

4 Spin Coat Wafers:

Spin speed depends on desired thickness. 4000 RPM for 30 seconds gives a coating after bake of a little more than 1 micron as shown below. For more exact thickeness data use Nanospec AFTER baking PR. Make sure resist has warmed up to room temperature before applying.

Approximate thickness (per manufacturer) vs spin speed after softbake:

3000 RPM	1.6 µM
4000	1.4
5000	1.25
6000	1.15
7000	1.0

RECOMMENDED LITHOGRAPHY PROCEDURE FOR AZ5214 RESIST

5 Soft Bake:

A Hot Plate: 1 minute @105°C

OR

B Oven: 20 minutes @ 95°C

6 Exposure:

Exposure depends on resist thickness, lamp intensity and many other variables, but for 4000 rpm with exposure intensity at 13mW/cm2, (280W, lamp power), 4-6 seconds is a good starting point on the Nanolab Quintel.

7 Develop:

Develop in beaker with 5:1 water: AZ400K developer with constant gentle agitation. (You should try to keep this step constant and adjust your exposure in step 6 to get desired results. Also softbaking affects this step greatly. Underbaked resist will develop very fast with little control. Overbaked resist will develop slowly and may not clear at all.) Rinse in flowing DI water immediately for at least 2 minutes and blow dry with nitrogen. (Do not allow water to evaporate).

8 Postbake:

Hotplate: 2 minutes @150°C

OR

Oven: 30 minutes @120°C minimum

Note: This step depends heavily on etch or ion implant step. Higher temperatures help image stability, adhesion and plasma/chemical resistance but above 120°C, stripping PR requires O2 plasma, acid strip or AZ300T. Postbake up to 150°C may be done without resist flow.

9 Descum:

It is strongly recommended that an oxygen plasma descum step be used especially for small geometries such as contacts and vias and especially if a dry etch step is being used. The RIE should be used with O2 at a power of maybe 100-150W to remove about 500Å of PR. Use the Nanospec to verify proper PR removal. If wet etching without this step appears to be taking longer than calculated then a PR scum layer may be interfering with the etch and the addition of this step may be required.

10 Wet Etch:

For Oxide etching it is recommended to use BOE etchant rather than HF-water mixtures. Undercut and resist lifting are much worse for HF-water than for BOE. For very long etches (~hrs) even in BOE, lifting may occur. For these cases, intermittent hard baking, resist hardening (UV or PRIST) or the use of a hard mask may be necessary.

11 PR Stripping:

For photoresist NOT exposed to ion beams, plasmas or temperatures in excess of 120°C, AZ 1500 Thinner or acetone may be used. Otherwise AZ300T stripper, O2 plasma or an acid strip (Pirhana, Caros acid etc.) may be used (depending on the underlying layer). Wafers must be free from old photoresist and organics before recoating them.

AZ 5200-E

NEGATIVE TONE PROCESSING

STEPS

DEHYDRATION BAKE

HMDS PRIME
AZ ADHESION PROMOTER

SPIN COAT
0.6 - 2.6UM

- AZ 5206-E yields 0.6
  AZ 5210-E yields 1.0
  AZ 5214-E yields 1.4
  2.6
  ram

SOFT BAKE

HOT PLATE	90 - 100C/45-60 sec.
CONVENTION	90 degrees/30 min.

EXPOSE

436nm	G-LINE STEPPER	400mj+
390-450nm	ULTRATECH STEPPER	
365-436nm	I-LINE STEPPER	
365-436nm	PE ALIGNER	50mj+
313nm	PE UV3, KARLSUSS	
248nm	EXIMER LASER	

- Perform expos
  ginning with li
  increasing in 1
  ments until ta
  profile achieve
- Under exposur
  lift-off profile
- Over exposure
  lication will pr
  profiles and 5(
  latitude for .l

POST EXPOSURE BAKE

HOT PLATE	110 - 120 C/45 sec.
CONVECTION	105 C/30 min.

- Any broad band acti
  using 365-436nm ca
  flood exposure incre
  ubility of the unexp
  greatly improves dev
  and resolution.

FLOOD EXPOSURE BAKE
365 - 405mn 1-2J/cm²

DEVELOP

	HIGH SPEED	HIGH CONTRAST/RESOLUTION
METAL BASED	AZ 400K 1:4/60sec AZ 351 1:3.54/60sec	AZ 400K 1:6/90-120sec AZ 351 1:6/90-120sec
METAL ION FREE	AZ 312 1:1.2/60sec AZ 227/100sec	AZ 422/90 sec.

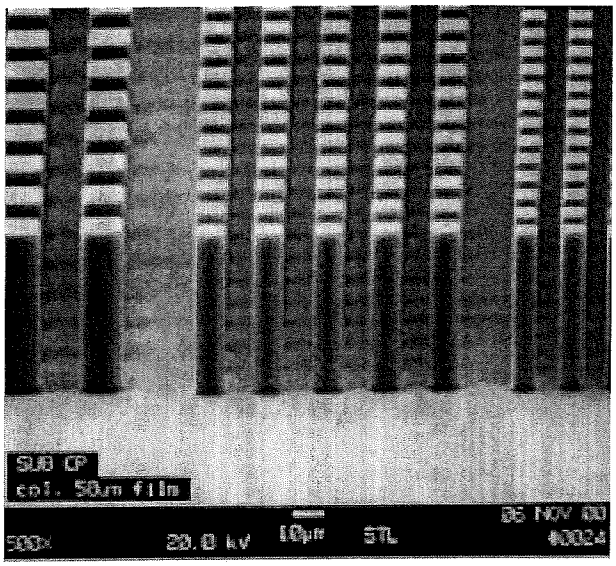
Non-flood exposure process
130 degrees PEB recommended

- Optimi
  line-w
  more
  longe

MICRO CHEM

NANO™ SU-8
Negative Tone Photoresists Formulations 2 - 25

- **High aspect ratio imaging with near vertical side walls**
- **Near UV (350-400nm) processing**
- **Film thicknesses from 1 to >200µm with single spin coat processes**
- **Superb chemical and temperature resistance**



5µm, 10µm and 20µm post arrays in a 50µm thick film.

SU-8 is a high contrast, epoxy based photoresist designed for micromachining and other microelectronic applications, where a thick chemically and thermally stable image is desired. The exposed and subsequently cross-linked portions of the film are rendered insoluble to liquid developers. SU-8 has very high optical transparency above 360nm, which makes it ideally suited for imaging near vertical sidewalls in very thick films. SU-8 is best suited for permanent applications where it is imaged, cured and left in place.

Process Guidelines

SU-8 is most commonly processed with conventional near UV (350-400nm) radiation, although it may be imaged with e-beam or x-ray. i-line (365nm) is recommended. Upon exposure, cross-linking proceeds in-two-steps (1) formation of a strong acid during the exposure process, followed by (2) acid-initiated, thermally driven epoxy cross-linking during the post exposure bake (PEB) step.

A normal process is: spin coat, soft bake, expose, post expose bake (PEB) and develop. A controlled hard bake is recommended to further cross-link the imaged SU-8 structures when they it will remain as part of the device. The entire process should be optimized for the specific application. A baseline process is given here to be used as a starting point.

Substrate Pretreat

↓

Coat

↓

Soft Bake

↓

Expose

↓

Post Expose Bake (PEB)

↓

Develop

↓

Rinse & Dry

↓

Hard Bake *(optional)*

↓

Imaged Material

↓

Remove *(optional)*

Substrate Pretreatment

To obtain maximum process reliability, substrates should be clean and dry prior to applying the SU-8 resist. Start with a solvent cleaning, or a rinse with dilute acid, followed by a DI water rinse. Where applicable, substrates should be subjected to a piranha etch / clean (H_2SO_4 & H_2O_2). To dehydrate the surface, bake at 200°C for 5 minutes on a contact hot plate or 30 minutes in a convection oven. Adhesion promoters are typically not required.

Coat

SU-8 resists are designed to produce low defect coatings over a very broad range of film thickness. The film thickness versus spin speed data displayed in Table 1. and Figure 1. provide the information required to select the appropriate SU-8 resist and spin conditions, to achieve the desired film thickness.

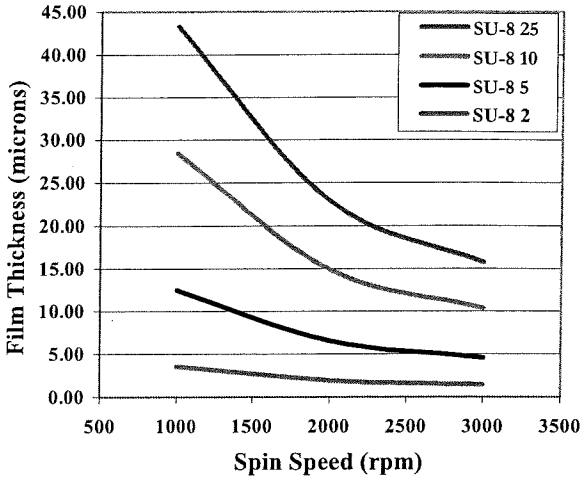


Figure 1. Spin speed vs. thickness curves for selected SU-8 resists.

The recommended coating conditions are:

(1) STATIC Dispense: Approximately 1ml of SU-8 per inch of substrate diameter.

(2) Spread Cycle: Ramp to 500 rpm at 100 rpm/second acceleration. This will take 5 seconds.

(3) Spin Cycle: Ramp to final spin speed at an acceleration of 300 rpm/second and hold for a total of 30 seconds.

Product	Viscosity **	Thickness	Spin Speed
	cst @ 25°C	µm	rpm
SU-8 2	43	1.5	3000
		2	2000
		5	1000
SU-8 5	293	5	3000
		7	2000
		15	1000
SU-8 10	1050	10	3000
		15	2000
		30	1000
SU-8 25	2525	15	3000
		25	2000
		40	1000
SU-8 50*			
SU-8 100*			

Table 1. Thickness vs. spin speed data for selected SU-8 resists.

*** Approximate*

** Please refer to data sheet, SU-8 formulations 50 & 100, for details on these resist products.*

Soft Bake

After the resist has been applied to the substrate, it must be soft baked to evaporate the solvent and densify the film. SU-8 is normally baked on a level hot plate, although convection ovens may be used. The following bake times are based on contact hot plate processes. Bake times should be optimized for proximity and convection oven bake processes since solvent evaporation rate is influenced by the rate of heat transfer and ventilation.

For best results, ramping or stepping the soft bake temperature is recommended. Lower initial bake temperatures allow the solvent to evaporate out of the film at a more controlled rate, which results in better coating fidelity, reduced edge bead and better resist -to-substrate adhesion. Refer to Table 2. for TWO STEP contact hot plate process recommendations.

Product	Thickness	Soft Bake Time (secs)	
	µm	STEP 1 65°C	STEP 2 95°C
SU-8 2	1.5	60	60
	2	60	180
	5	60	180
SU-8 5	5	60	180
	7	120	300
	15	120	300
SU-8 10	10	120	300
	15	120	300
	30	180	420
SU-8 25	15	120	300
	25	180	420
	40	300	900

Table 2. Recommended soft bake parameters

Expose

SU-8 is optimized for near UV (350-400nm) exposure. i-line exposure tools are recommended. SU-8 is virtually transparent and insensitive above 400nm but has high actinic absorption below 350nm. This can be seen in Figure 2. Excessive dose below 350nm may, therefore, result in over exposure of the top portion of the resist film, resulting in exaggerated negative sidewall profiles or T-topping. The optimal exposure dose will depend on film thickness (thicker films require higher dosage) and process parameters. The exposure dose recommendations in Table 3. are based on source intensity measurements taken with an i-line (365nm) radiometer and probe.

Expose tip: When using a broad spectral output source, for best imaging results, i.e. straightest sidewalls, filter out excessive energy below 350nm.

Catastrophic adhesion failure, severely negative sidewalls and excessive cracking often indicate an under cross-linking condition. To correct the problem, increase the exposure dose and/or increase the post exposure bake (PEB) time.

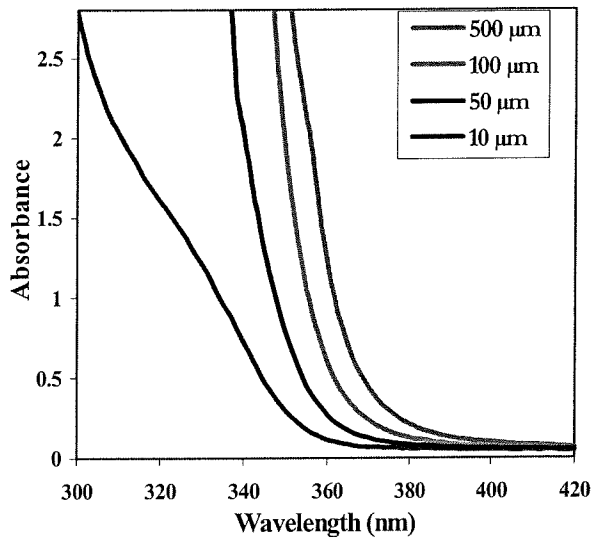


Figure 2. SU-8 absorbance vs. film thickness

Product	Film Thickness	Exposure Dose
	µm	mJ/cm^2
SU-8 2	1.5	85-100
	2	95-115
	5	120-130
SU-8 5	5	120-130
	7	150-185
	15	190-210
SU-8 10	10	185-200
	15	190-210
	30	230-250
SU-8 25	15	190-210
	25	220-230
	40	250-300

Table 3. Recommended exposure dose processes

Post Exposure Bake

Following exposure, a post expose bake (PEB) must be performed to selectively cross-link the exposed portions of the film. This bake can be performed either on a hot plate or in a convection oven. Optimum cross-link density is obtained through careful adjustments of the exposure and PEB process conditions. The bake recommendations below are based on results obtained with a contact hot plate.

PEB tip: SU-8 is readily cross-linked and can result in a highly stressed film. To minimize stress, wafer bowing and resist cracking, a slow ramp or TWO STEP contact hot plate process, as shown in Table 4., is recommended. Rapid cooling after PEB should be avoided.

Product	Film Thickness	P E B Time (sec)	
	µm	65°C	95°C
SU-8 2	1.5	60	60
	2	60	60
	5	60	60
SU–8 5	5	60	60
	7	60	60
	15	60	120
SU-8 10	10	60	120
	15	60	120
	30	60	180
SU–8 25	15	60	120
	25	60	180
	40	120	240

Table 4. Recommended post exposure bake parameters

Develop

SU-8 resists have been optimized for use with MicroChem's SU-8 Developer. Immersion, spray or spray- puddle processes can be used. Other solvent based developers such as ethyl lactate and diacetone alcohol may also be used. Strong agitation is recommended for high aspect ratio and/or thick film structures. Recommended develop times are given in Table 5. for immersion processes. These proposed develop times are approximate, since actual dissolution rates can vary widely as a function of agitation rate, temperature and resist processing parameters.

Product	Thickness	Develop Time
	µm	seconds
SU-8 2	1.5	60
	2	60
	5	60
SU-8 5	5	60
	7	60
	15	180
SU-8 10	10	120
	15	180
	30	300
SU-8 25	15	180
	25	240
	40	360

Table 5. Recommended develop processes

Rinse and Dry

Following development, the substrate should be rinsed briefly with isopropyl alcohol (IPA), then dried with a gentle stream of air or nitrogen.

Rinse tip: If a white film is produced during rinse, this is an indication that the substrate has been under developed. Simply immerse or spray the substrate with SU-8 developer to remove the film and complete the development process. Repeat the rinse step

Hard Bake (cure)

SU-8 has good mechanical properties, therefore hard bakes are normally not required. For applications where the imaged resist is to be left as part of the final device, the resist may be ramp/step hard baked between 150-200°C on a hot plate or in a convection oven to further cross link the material. Bake times vary based on type of bake process and film thickness.

Remove

SU-8, after expose and PEB, is a highly cross-linked epoxy, which makes it extremely difficult to remove with conventional solvent based resist strippers. MicroChem's Remover PG will swell and lift off minimally cross-linked SU-8. It will not remove fully cured or hard baked SU-8. Alternate removal processes include immersion in oxidizing acid solutions such as piranha etch / clean, RIE, laser ablation and pyrolosis.

To remove minimally cross-linked SU-8 with Remover PG, heat the bath to 50-80°C and immerse the substrates for 30-90 minutes. Actual strip time will depend on resist thickness and cross-link density.

Storage

Store SU-8 resists upright in tightly closed containers in a cool, dry environment away from direct sunlight at a temperature of 40-70°F(4-21°C). Store away from light, acids, heat and sources of ignition. Shelf life is twelve months from date of manufacture.

Disposal

SU-8 resists may be included with other waste containing similar organic solvents to be discarded for destruction or reclaim in accordance with local state and federal regulations. It is the responsibility of the customer to ensure the disposal of SU-8 resists and residues made in observance all federal, state, and local environmental regulations.

Environmental, Health and Safety

Consult product Material Safety Data Sheet before working with SU-8 resists. Handle with care. Wear chemical goggles, chemical gloves and suitable protective clothing when handling SU-8 resists. Do not get into eyes, or onto skin or clothing. Use with adequate ventilation to avoid breathing vapors or mist. In case of contact with skin, wash affected area with soap and water. In case of contact with eyes, rinse immediately with water and flush for 15 minutes lifting eyelids frequently. Get emergency medical assistance.

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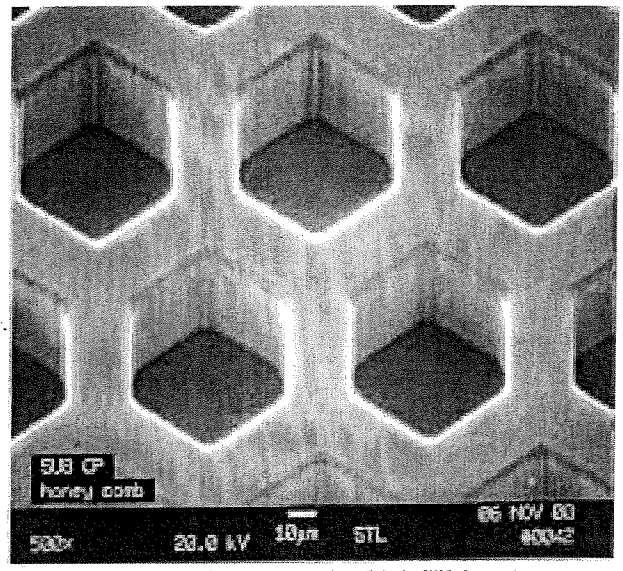
MICRO CHEM

NANO™ SU-8
Negative Tone Photoresists Formulations 50 & 100

- **Highaspect ratio imaging with near vertical side walls**
- **Near UV (350-400nm) processing**
- **Film thicknesses from 1 to >200µm with single spin coat processes**
- **Superb chemical and temperature resistance**



Honey comb structure in thick SU-8 resist

SU-8 is a chemically amplified, high contrast, epoxy based photoresist designed for micromachining and other microelectronic applications. SU-8 is a negative tone photoresist. The exposed and subsequently cross-linked portions of the film are rendered insoluble to liquid developers. SU-8 has very high optical transparency, which makes it ideally suited for imaging near vertical sidewalls in very thick films. SU-8 is best suited for permanent applications where it is imaged, cured and left in place.

Process Guidelines

SU-8 is most commonly processed with conventional near UV (300-400nm) radiation, although it may be imaged with e-beam or x-ray. i-line(365nm) is recommended. Upon exposure, cross-linking proceeds in two-steps (1) formation of a strong acid during the exposure process, followed by (2) acid-initiated, thermally driven epoxy cross-linking during the post exposure bake (PEB) step.

A normal process is: spin coat, soft bake, expose, post expose bake (PEB) and develop. A controlled hard bake is recommended to further cross-link the imaged SU-8 structures when they it will remain as part of the device. The entire process should be optimized for the specific application. A baseline process is given here to be used as a starting point.

Substrate Pretreat

↓

Coat

↓

Soft Bake

↓

Expose

↓

Post Expose Bake (PEB)

↓

Develop

↓

Rinse & Dry

↓

Hard Bake *(optional)*

↓

Imaged Material

↓

Remove *(optional)*

Substrate Pretreatment

To obtain maximum process reliability, substrates should be clean and dry prior to applying the SU-8 resist. Start with a solvent cleaning, or a rinse with dilute acid, followed by a DI water rinse. Piranha Etch of the substrates is highly recommended. To dehydrate the surface, bake at 200 °C for 5 minutes on a contact hot plate or 30 minutes in a convection oven. Adhesion promoters are typically not required.

Coat

SU-8 resists are designed to produce low defect coatings over a very broad range of film thickness using a variety of spin coat conditions. The film thickness versus spin speed data and plots displayed in Table 1. and Figure 1. provide the information required to select the appropriate SU-8 resist and spin conditions, based upon the desired film thickness.

Recommended spin coat conditions:

(1) Dispense approximately 1ml of resist per inch of substrate diameter.
(2) Spread Cycle: Ramp to 500 rpm at 100rpm/second acceleration and hold for a total of 10 seconds. That is, 5 seconds getting to 500 rpm plus another 5 seconds at 500 rpm. This is necessary since the viscosity of the material is so high.
(3) Spin Cycle: Ramp to final spin speed, based on film thickness desired, at an acceleration of 300 rpm/sec and hold for a total of 30 seconds.

Product	Viscosity**	Thickness	Spin Speed
	cst @ 25°C	µm	rpm
SU-8 50	12250	40	3000
		50	2000
		100	1000
SU-8 100	51500	100	3000
		150	2000
		250	1000

Table 1. Thickness vs. spin speed data for selected SU-8 resists

** *Approximate*

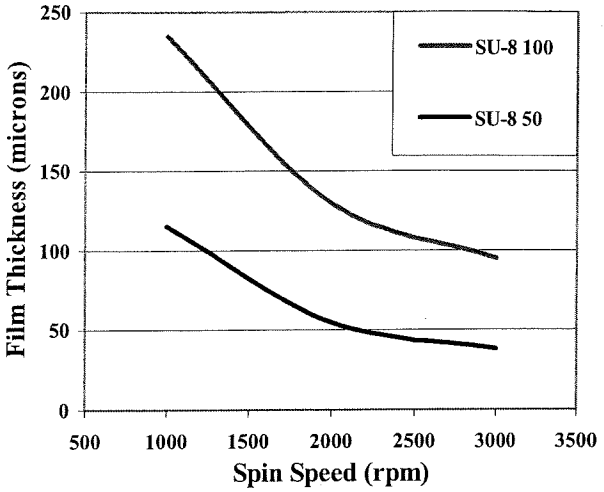


Figure 1. Film thickness vs. spin speed.

Soft Bake

After the resist has been applied to the substrate, it must be soft baked to evaporate the solvent and densify the film. SU-8 is normally baked on a hot plate, although convection ovens may be used. The following bake times are based on contact hot plate processes. Bake times should be optimized for proximity and convection oven bake processes since solvent evaporation rate is influenced by rate of heat transfer and ventilation.

For best results, ramping or stepping the soft bake temperature is recommended. Lower initial bake temperatures allow the solvent to evaporate out of the film at a more controlled rate, which results in better coating fidelity, reduced edge beads and better resist to substrate adhesion. Refer to Table 2. for recommendations for TWO STEP contact hot plate processes

Product	Thickness	Soft Bake Time (minutes)	
	µm	STEP 1 65°C	STEP 2 95°C
SU-8 50	40	5	15
	50	6	20
	100	10	30
SU-8 100	100	10	30
	150	20	50
	250	30	90

Table 2. Recommended soft bake processes.

Expose

SU-8 is optimized for near UV (350-400nm) exposure. It is virtually transparent and insensitive above 400nm and is highly absorbent and reactive to energy below 350nm. This can be seen in Figure 2. Excessive dose below 350nm may result in over exposure of the top portion of the resist film, resulting in exaggerated negative sidewall profiles or T-topping. The optimal exposure dose will depend on film thickness (thicker films require higher dosage) and process parameters. The exposure dose range recommendations in Table 3. are based on exposure source intensity measurements taken with an i-line (365nm) radiometer and probe.

Expose tip: When using a broad spectral output source, for best imaging results, i.e. straightest sidewalls, filter out excessive energy below 350nm.

Catastrophic adhesion failure, severely negative sidewalls and excessive cracking are often indications of an under cross-linking condition. To correct the problem, increase your exposure dose and or increase your post exposure bake (PEB) time.

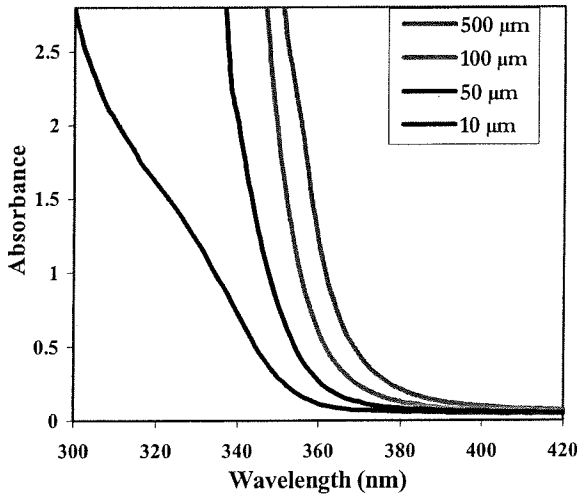


Figure 2. SU-8 absorbance vs. film thickness

Product	Thickness	Expose Dose
	µm	mJ/cm^2
SU-8 50	40	250-300
	50	400-500
	100	500-650
SU-8 100	100	500-650
	150	600-675
	250	625-700

Table 3. Recommended expose dose processes.

Post Expose Bake

Following exposure, a post exposure bake (PEB) must be performed to selectively cross-link the exposed portions of the film. SU-8 can be post exposure baked (PEB) either on a hot plate or in a convection oven. Optimum cross-link density is realized through careful adjustments of the exposure and PEB process conditions. The bake recommendations below are based on results obtained on a contact hot plate.

PEB Tip: SU-8 is readily cross-linked and can result in a highly stressed film. To minimize stress, wafer bowing and resist cracking, a slow ramp or TWO STEP contact hot plate process, as shown in Table 4., is recommended. Avoid rapid cooling after PEB.

Product	Thickness	P E B Time (minutes)	
	µm	STEP 1 65°C	STEP 2 95°C
SU-8 50	40	2	4
	50	2	5
	100	3	10
SU-8 100	100	3	10
	150	12	15
	250	15	25

Table 4. Recommended PEB processes.

Develop

SU-8 resists have been optimized for use with MicroChem's SU-8 Developer. Immersion, spray or spray- puddle processes can be used. Other solvent developers such as ethyl lactate and diacetone alcohol may also be used. Strong agitation is recommended for high aspect ratio and/or thick film structures. Recommended develop times are given in Table 5. for immersion processes. These proposed develop times are approximate, since actual dissolution rates can vary widely as a function of agitation rate, temperature and resist processing parameters.

Product	Thickness	Development
	µm	minutes
SU-8 50	40	6
	50	6
	100	10
SU-8 100	100	10
	150	15
	250	25

Table 5. Recommenended develop processes.

Rinse and Dry

Following development, the substrate should be rinsed briefly with isopropyl alcohol (IPA), then dried with a gentle stream of air or nitrogen.

Rinse tip: If a white film is produced during rinse, this is an indication that the substrate has been under developed. Simply immerse or spray the substrate with SU-8 developer to remove the film and complete the development process. Repeat the rinse step.

Hard Bake (cure)

SU-8 has good mechanical properties, therefore hard bakes are normally not required. For applications where the imaged resist is to be left as part of the final device, the resist may be ramp/step hard baked between 150-200°C on a hot plate or in a convection oven to further cross link the material. Bake times vary based on type of bake process and film thickness.

Remove

SU-8, after expose and PEB, is a highly cross-linked epoxy, which makes it extremely difficult to remove with conventional solvent based resist strippers. MicroChem's Remover PG will swell and lift off minimally cross-linked SU-8. It will not remove fully cured or hard baked SU-8. Alternate removal processes include immersion in oxidizing acids such as piranha etch/clean, RIE, laser ablation and pyrolosis.

To remove minimally cross-linked SU-8 with Remover PG, heat the bath to 50-80° C and immerse the substrates for 30-90 minutes. Actual strip time will depend on resist thickness and cross-link density

Storage

Store SU-8 resists upright in tightly closed containers in a cool dry environment away from direct sunlight at a temperature of 40-70°F (4-21°C). Store away from light, acids, heat and sources of ignition. Shelf life is twelve months from date of manufacture.

Disposal

SU-8 resist may be included with other waste containing similar organic solvents to be discarded for destruction or reclaim in accordance with local state and federal regulations. It is the responsibility of the customer to ensure the disposal of SU-8 resists and residues made in observance all federal, state, and local environmental regulations.

Environmental, Health and Safety

Consult product Material Safety Data Sheet before working with SU-8 resists. Handle with care. Wear chemical goggles, chemical gloves and suitable protective clothing when handling SU-8 resist. Do not get into eyes, or onto skin or clothing. Use with adequate ventilation to avoid breathing vapors or mist. In case of contact with skin, wash affected area with soap and water. In case of contact with eyes, rinse immediately with water and flush for 15 minutes lifting eyelids frequently. Get emergency medical assistance.

The information is based on our experience and is, we believe to be reliable, but may not be complete. We make no guarantee or warranty, expressed or implied, regarding the information, use, handling, storage, or possession of these products, or the application of any process described herein or the results desired, since the conditions of use and handling of these products are beyond our control.

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