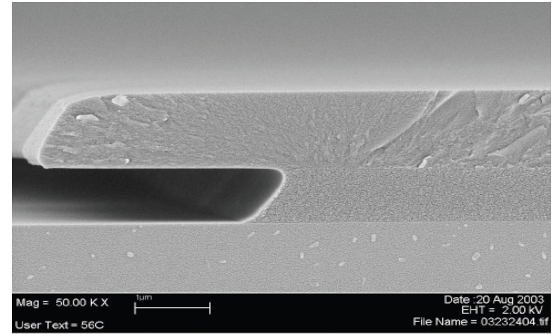
Jong Dae Baek
Microfluidics Lab
Dept. of Mechanical Eng.
Stanford university
March 4, 2006

Guide to SU-8 Processing



For MERL Clean Room

Introduction to SU-8

1. 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.
2. SU-8 is most commonly processed with conventional near UV (350~400nm) radiation, although it may be imaged with e-beam or x-ray.
3. For more information, go to http://www.microchem.com

SU-8	SU-8 2, SU-8 5; SU-8 10; SU-8 25	1.5 ~ 40㎛
	SU-8 50; SU-8 100	40 ~ 250㎛
SU-2000	SU-8 2002, SU-82005; SU-8 2007; SU-8 2010 SU-8 2015, SU-8 2025;	2 ~75㎛
	SU-8 2035, SU-8 2050; SU-8 2075, SU-8 2100	35 ~ 260㎛

Note: SU-8 procedures are notoriously empirical. So, these steps should be considered as guidelines instead of fixed rules

Schematics of the process

Pre-Cleaning and Substrate Preheating

To obtain maximum process reliability, substrates should be clean and dry prior to applying the SU-8 resist.

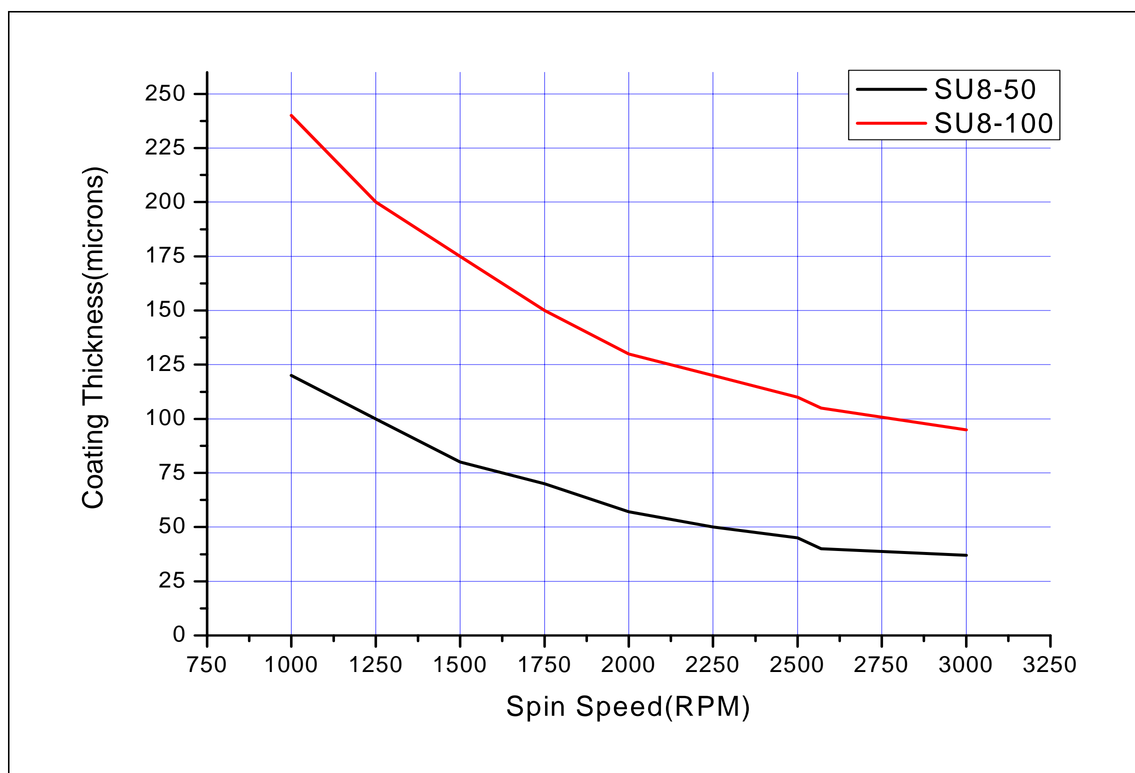
1. For simple clean, start with an acetone cleaning then isopropyl alcohol (IPA) vigorously.
2. For deep clean, Nanostrip, BOE, SC1 (NH_4OH: H_2O_2: H_2O=1:1:5) and SC2 (HCl: H_2O_2: H_2O=1:1:5) are available.
3. Dry the wafer with air or nitrogen.
4. Inspect the wafer to make sure it is clean. If not, you can rinse with acetone again.
5. To dehydrate the surface, bake at 125℃ for 5 minutes on a hotplate.

Jong Dae Baek
Microfluidics Lab
Dept. of Mechanical Eng.
Stanford university
March 4, 2006

Spin Coating

1. While the wafer is on the hotplate, pour SU-8 from the reagent bottle into a smaller amber bottle to easily control dispensing.
2. Remove the wafer from the hotplate and set the hotplate to 65℃.
3. Clean the spinner with acetone if dirty. Put carefully the wafer in the middle of the spinner chunk. The best way to check if the wafer is centered is to turn on the vacuum and manually spin the wafer a couple of times by hand.
4. Once the wafer is centered, pour SU-8 on the center of the wafer with a proper amount. To minimize trapping air bubble, pour SU-8 slowly.
5. Run the spinner. Before final spin, you should hold about 500rpm at 100rpm/sec for at least 10s to allow the resist to cover the entire surface. Final spin should be continued during 30s. Final spin speed depends on your desired thickness as shown below.
6. Remove the wafer from the spinner. If there is extraneous SU-8 around the edge of wafer, wipe carefully the edge of the wafer with a cleanroom wipe.

Note: you should consider a little lower spin speed than recommended Microchem® data sheet



Film thickness vs. Spin speed (from Microchem® data sheet)

Jong Dae Baek
Microfluidics Lab
Dept. of Mechanical Eng.
Stanford university
March 4, 2006

Soft Bake

After the resist has been applied to the substrate, it must be soft baked to evaporate the solvent and densify the film. Recommended soft bake parameters are

Name	Thickness(㎛)	Pre-Bake at 65℃(min)	Soft bake at 95℃(min)	Post-Bake at 65℃(min)
SU-8 50	40	5	15	5
	50	6	20	6
	100	10	30	10
SU-8 100	100	10	30	10
	150	20	50	20
	250	30	90	30

After post-bake, you can do a sticky test on the surface of coated wafer by using sharp-tip material.
Although Microchem® recommend two-steps soft bake process, it is much better to consider three-steps including post-bake to prevent unwanted cracks.

Exposure

SU-8 is optimized for near UV (350-400nm) exposure.
Start with this equation D=It

where, **D** = dose (mJ/cm^{-2})

I = intensity (mW/cm^{-2}) In MERL clean room, we use constant intensity, $22mW/cm^{-2}$.

t = exposure time(s).

i.e. 50um: 250 mJ/cm^{-2} → 250/22≈11sec

100um: 400 mJ/cm^{-2} → 400/22≈18sec

Recommended exposure doses are

Name	Thickness (μm)	Expose dose (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

Jong Dae Baek
Microfluidics Lab
Dept. of Mechanical Eng.
Stanford university
March 4, 2006

Post Expose Bake (PEB)

Following exposure, a post expose bake (PEB) must be performed to selectively cross-link the exposed portions of the film. Post expose bake is performed on hotplate operated in the same way as for the soft bake.

Recommended post expose bake parameters are as the following.

Name	Thickness (㎛)	PEB1 at 65℃ (min)	PEB2 at 95℃ (min)	PEB3 at 65℃ (min)
SU-8 50	40	1	4	1
	50	1	5	1
	100	1	10	1
SU-8 100	100	1	10	1
	150	1	12	1
	250	1	20	1

Develop

Note: In order to prevent excessive cracking, the coating is allowed to relax for about 10 minutes between PEB and develop.

SU-8 resists have been optimized for use with MicroChem®'s SU-8 developer. Other solvent based developers such as ethyl lactate and diacetone alcohol may also be used. Strong agitation is recommended for high aspect ratio and thick film structures.

1. Pour just enough developer into a large crystallization dish to cover the wafer.
2. Gently swirl until all uncured SU-8 has been removed.
3. Continue to develop for an additional 1~2min rather than recommended develop time.

Recommended develop times are as shown below.

Name	Thickness (㎛)	Develop time(min)
SU-8 50	40	6
	50	6
	100	10
SU-8 100	100	10
	150	15
	250	20

Jong Dae Baek
Microfluidics Lab
Dept. of Mechanical Eng.
Stanford university
March 4, 2006

Rinse and Dry

Following development, the substrate should be rinsed briefly with isopropyl alcohol (IPA), and then dried with natural air or nitrogen.

Note: if you see the white film on your wafer during rinse, this is an indication that the substrate has been under development. You can simply immerse or spray the substrate with SU-8 developer to remove film and complete the development process. Repeat the rinse step

NOTE