

SU-8 Processing Suggestions

Cornell Nanoscale Facility

Substrate Pretreat

Clean the wafer RCA clean or Piranha
Dehydrate hotplate: 150-200°C; 15 minutes
 oven: 90-120°C; ≥3 hours
(Optional) Apply Omnicoat as release layer

TIPS:

*-A new (uncleaned) silicon wafer may be acceptable for simple PDMS mold devices.
-SU-8 adheres less well to fused silica and some metals. It does not adhere to gold.*

Spin Coat

Apply about 1ml of SU-8 per inch of substrate (dia.), symmetrically
MicroChem recommends: 500 rpm at 100 rpm/second 15 sec
 final rpm at 300 rpm/second 30 sec
Clean the backside of wafer and edge bead by wiping with an acetone-wetted wipe.

TIPS:

*-Pour small stock bottles of SU-8 2050 or thicker at least 24 hours prior to spinning to give time for bubbles to dissipate.
-SU-8 will re-flow until it is exposed and baked. Keep wafers very level.
-For layers ≥ 150 μm, allow the wafer to rest on the spinner so hanging resist can retract onto the wafer before cleaning the edge bead. If the outer 2-5 mm of resist is removed, it will reflow into the void during baking.*

Softbake (Always level the hotplates)

≤ 10 microns

Put the wafer on a 65° C hotplate, if recommended.
Transfer to 95° C hotplate, and bake for more time.

TIPS:

*-If the wafer is under-baked, too much solvent remains. The wafer will stick to the mask, and features may melt off the wafer during development. Touch the edge of the wafer to check for stickiness.
-If the wafer is over-baked, there can be cracking and brittleness after development.
-Avoid thermal stress with gradual heating and cooling for SU-8 ≥ 50 μm. Silicon wafers cool more rapidly than SU-8.
-Thin SU-8 layers (≤ 10 μm) are susceptible to variations in heating. If the vacuum rings cause a pattern on the wafer, place the wafer on a quartz disk on the hotplate.*

10 – 50 microns

Put the wafer on a 65° C hotplate

Ramp (10 degrees/min) to 95° C, and bake for more time.

Bring to room temperature on a level, wipe-insulated cooling surface

50 - 200 microns

Put the wafer on a hotplate at room temperature.

Ramp to 65° C (5-10 degrees/min). Bake for a given time when the temperature is reached.

Ramp to 95° C (5-10 degrees/min). Bake for a given time when the temperature is reached.

Cool down to 65° C on the hotplate then to room temperature on a level, wipe-insulated cooling surface.

TIPS:

-Consider increasing the bake times by a factor of 2- 3. Increase the exposure doses slightly, too.

-Cover the wafer for the first 15-20 minutes on the hotplate with a crystallization dish tilted to let solvent escape. This will prevent formation of a skin on thick SU-8.

≥ 200 microns or multiple, thick layers of SU-8

Put the wafer on a hotplate at room temperature.

Ramp to 65° C (5-10 degrees/min). Bake for a given time when the temperature is reached.

Ramp to 95° C (5-10 degrees/min). Bake for a given time when the temperature is reached.

Cool down to 40° C on the hotplate (about an hour).

TIPS:

-Increase the bake time by a factor of 3-5. Increase exposure doses slightly, too.

-Cover the wafer for the first 15-20 minutes on the hotplate with a crystallization dish tilted to let solvent escape. This will prevent formation of a skin on thick SU-8.

-Increase the bake time for a second layer of SU-8 to account for the insulating action of the first layer. Consider a lower temperature than 95° C, like 75° C.

-Baked wafers can be rested for several hours or stored for several days. Keep them level.

Exposure

Expose the wafer to UV light on an aligner or i-line stepper.

Wait 10 minutes before baking for optimal Lewis acid formation.

TIPS:

-For thicknesses ≥ 15 microns, energy below 360 nm should be filtered out using a 360 LP filter. Add approximately 40% more energy when using the filter.

-Underexposed features will melt off during development. Overexposure will increase the width and brittleness.

Post Exposure Bake (PEB)

≤ 10 microns

Put the wafer on a 65° C hotplate, if recommended.

Transfer to 95° C hotplate, and bake for more time.
Bring to room temperature on a level, wipe-insulated surface

10 – 50 microns

Put the wafer on a 65° C hotplate
Ramp (3-5 degrees/min) to 95° C, and bake for more time.
Bring to room temperature on a level, wipe-insulated surface.

50 - 200 microns

Consider increasing the bake times by a factor of 2-4.
Put the wafer on a hotplate at room temperature.
Ramp to 65° C (3-5 degrees/min). Bake for a given time when the temperature is reached.
Ramp to 95° C (3-5 degrees/min). Bake for a given time when the temperature is reached.
Cool back down room temperature on the hotplate.

≥ 200 microns (or multiple, thick layers of SU-8)

Put the wafer on a hotplate at room temperature.
Ramp to 65° C (3-5 degrees/min). Bake for a given time when the temperature is reached.
Ramp to 95° C (3-5 degrees/min). Bake for a given time when the temperature is reached.
Cool back down room temperature on the hotplate.

TIPS:

-Do not rapidly cool the wafer after the PEB. Thick layers are susceptible to thermal stress. Heating too quickly results in cracking. Cooling too quickly results in cracking or detachment.
-For layers thicker than 200 microns, heating only at 65 °C for many hours (or longer if there are multiple layers) may be better.

Development

Place the wafer in a dish of SU-8 developer, and gently agitate until the exposed features remain. Develop 1 minute more.
Rinse the wafer with IPA and dip into a dish of IPA. If a white film is visible while rinsing, more development is needed.
Dip in IPA for 30 seconds.
Rinse with water, then chase the water away with IPA. Then dry with nitrogen.

Pour the SU-8 developer into the flammable solvents waste container, and rinse the dish with acetone and then IPA into the same waste container.
Rinse the dish vigorously with water into the sink. If the dish still smells strongly of developer, repeat the acetone-IPA-water rinses before taking it to the dish rack.

TIPS:

-Development rates vary widely with agitation, sonication, temperature, and features.
-Stirring and developing the wafer upside down is recommended for large structures with a high aspect ratio, large thicknesses, or closely-pitched features.

- Small (≤ 5 microns) features don't require agitation. They can detach.
- Underdeveloped features will have "dirty" edges.

Hard Bake/Cure (optional)

Typical hard bake temperatures are in the range of 150 °C to 250 °C for 5-60 minutes.

The YES Polyimide Bake Oven recipe 1: 200° C for 1 hour suffices. Run takes 5-6 hours. Place wafers in a quartz dish in center of the oven.

TIPS:

- A hard bake is recommended if the SU-8 is to be left on as part of the final device or if there will be further thermal processing. A hard bake may also help to anneal any surface cracks after development
- Ramp from room temperature to the bake temperature and then back down.
- Devices with large areas run the risk of detaching due to thermal stress of cooling at the end of the cure.

Inspection

Height can be measured on a profilometer only after the SU-8 is developed. No heights ≥ 500 microns should be measured in the CNF profilometers. And the stylus should always start at the TOP of the feature and travel down in height. *The NBTC has a profilometer that measures heights up to 1000 microns.*

Optical inspections can be made on any light microscope.

For electron microscopy, prepare the SU-8 by sputtering 5 nm of gold.

Helpful Web pages

Discussion and tips page	http://memscyclopedia.org/su8.html
MicroChem SU-8 Product lines	http://www.microchem.com/Prod-SU8_KMPR.htm
BYU's SU-8 resources	http://www.cleanroom.byu.edu/su8.phtml