

SUEX (200) over SU-8 on Si wafers

1. PREPARE WAFERS. Use new wafers from a recently opened box.

- a. (OPTIONAL) Cleaning: clean wafer in Hamatech Hot Piranha.
- b. (REQUIRED) Dehydration: 90°C oven overnight or 160°C hot plate > 20 min.
- c. (OPTIONAL) Oxygen plasma in Oxford 81/82 for 30s for improved adhesion.

2. SPIN COAT SU-8 2050. On a wafer.

- a. Pour 4 ml of SU-8 in a symmetric, round puddle. Avoid bubbles.
- b. Spin

Velocity (rpm)	RMP (r/s)	Time (s)
500	100	10
3450	345	40

- c. Remove edge bead and clean backside of wafer with acetone-wetted wipe.

3. SOFT BAKE.

- a. 65°C for 1 min.
- b. Ramp to 95°C, at ramp rate of 4°C/min. Hold at 95°C for 7 min.
- c. Ramp to room temperature (Turn off hot plate, and wait 1 hr.)

4. EXPOSE SU-8 2050.

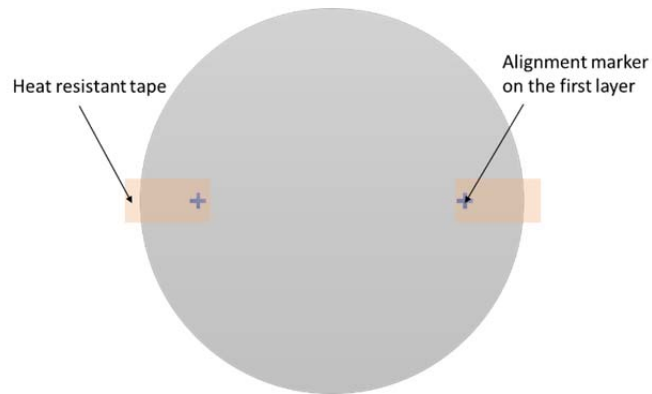
- a. Use 365LP filter. The dose on the ABM aligner is about 8 mJ/cm².
- b. DOSE = 160-180 mJ/cm² in 30-sec intervals with 15 to 30-sec rests.

5. POST-EXPOSURE BAKE OF SU8 2050.

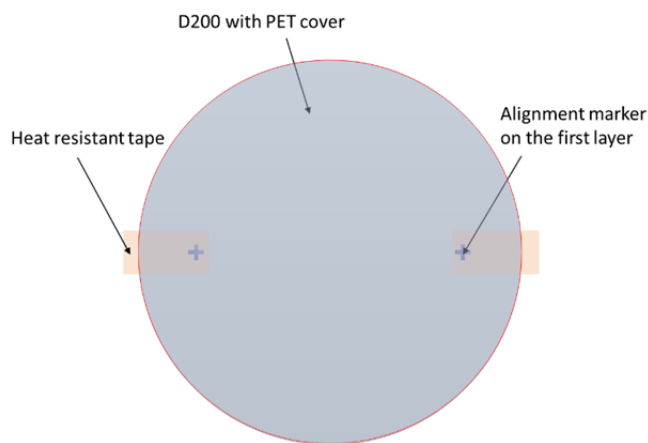
- a. 65°C for 1 min
- b. Ramp to 95°C, at ramp rate of 4°C/min. Hold at 95°C for 7 min.
- c. Ramp to room temperature (Turn off hot plate, and wait 1 hr.)
- d. DO NOT DEVELOP.

6. ALIGNMENT MARKS.

- a. Use heat resistant tape to cover the alignment marks on the first layer. 400 um will be too thick to see through. This aligning approach in this protocol will also work for even thicker layers.



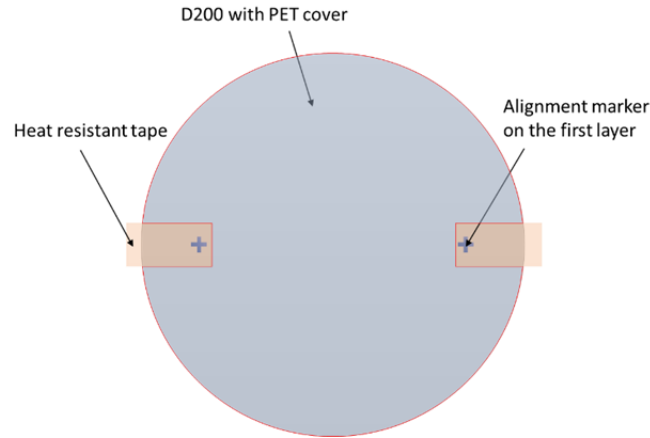
- 7. LAMINATE THE FIRST SUEX 200 SHEET.** Turn the laminator ON with rollers rolling at least 10 min beforehand. Wipe the rollers with an acetone-wetted ALPHA wipe; not a beta wipe.
- Place the wafer on the aluminum square and cover with a PET separator sheet. Use 1 set of spacers (500 micron-thick).
 - Remove the shiny PET covering from the SUEX. Place SUEX side-down on separator sheet.
 - Align SUEX chip and press gently at 12:00 on the wafer for 15 sec to adhere.
 - Laminate 65°C (actual temp) at 1 ft. /min roll rate.
 - Remove the hazy PET covering. **DO NOT BAKE.**



- 8. LAMINATE A SECOND SUEX 200 SHEET.**
- Repeat the previous step.

9. EXPOSE.

- Cut out the PET coversheet just above the tapes, and expose the alignment marks first by peeling off the heat resistant tapes and the SUEX on top of the tapes.
- Remove the rest of the hazy PET cover to expose the combined SU-8/SUEX layers.
- Use 365LP filter. The dose on the ABM aligner is about 8 mJ/cm^2 .
- DOSE = $1800 - 2000 \text{ mJ/cm}^2$ in 30-sec intervals with 15 to 30-sec rests.
(Yes, this is over 220 seconds!)



10. POST-EXPOSURE BAKE. Immediately following exposure on hot plates.

- 65°C for 5 min.
- Ramp to 95°C at a ramp rate of $3^\circ\text{C}/\text{min}$. Hold 10-30 min. (longer for smaller features). *Reflow may be seen in unexposed regions, but this doesn't seem to affect the features.*
- Ramp down to room temperature. (Turn off hot plate and wait 1 hr.).

11. DEVELOP. Face down in PGMEA (EBR-10A). Slow stirring may detach features.

- Immerse for 1 hr. Refresh the developer once near the end.
- Rinse in isopropanol for 5 min and dry thoroughly.

12. HARD-BAKE. (OPTIONAL) To remove residual developer and improve adhesion. SUEX will discolor at $110-120^\circ\text{C}$; it will turn to dark red at 180°C .

- Hot plate option: 95°C for 15 min; then ramp to room temperature.
- Oven option: $90-110^\circ\text{C}$ for 2-4 hr. Any regular oven will do.

The SU-8 layer was measured to be 49.3 to 50.5 μm ; and SU-8+SUEX layer was 411.1 to 429 μm .

The test batch of SUEX 200 from the manufacturer was actually 190 microns thick.

TROUBLESHOOTING

Poor adhesion.

- wafer not dehydrated – remove native oxide layer and bake dry thoroughly
- SUEX not laminated well – use recommended values
- underexposed – increase the dose. Be sure you're using the correct listed output. The ABM with the 365 LP filter is the value for 405 and 365 mirrors with the filter (bottom right value on the sticky note.)
- Too much agitation of small features during development – don't stir unless necessary.

Thickness is short of the expected height. **Expect SUEX to be at least 4% shorter than stated.**

- Lamination conditions are too harsh. You may notice that the SUEX is oozing from the hazy PET covering and sticking to the cover sheet on the aluminum square.
 - Use the settings for temperature that are listed on the laminator. They are much lower than the actual temperature.
 - Let the laminator equilibrate with rollers turning for 10 minutes.
 - Use 500-micron spacers for every 500 microns of substrate + SUEX thickness
- Batch variation straight from the manufacturer.
 - Lots of 200 SUEX have ranged as low as 180 um straight from the manufacturer.
 - Lots of 500 SUEX are typically at 480 um following this protocol.

Discoloration.

- The photoinitiator that is in the SUEX begins to turn yellow around 110 °C and turns dark red at 180 - 200°C.
 - Hard-bake for several hours at 100 °C or lower; preferably in an oven.

Surfaces of features are rough or 'pebbly'.

- It's a characteristic of the material. -SUEX is a hybrid is SU-8 and a proprietary polymer.